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Estimating The Annual Cost of Smoking-Related Diseases in Indonesia

Bambang Sutrisna [1], Lujna Surtidewi [2], Anwar Jusuf, Ahmad Hudoyo [3],
Dede Kusmana, Budhi Setianto [4], Endang Purwaningsih [5]

ABSTRACT

Background: *Smoking plays a role in the development of chronic diseases and causes substantial negative economic consequences. This study was carried out to estimate the annual cost of smoking-related cardio-cerebrovascular and pulmonary diseases in the population by taking into account the direct costs associated with such co-morbid conditions in Indonesia.*

Methods: *Meta-analysis using the Mix-Programme Software of the data of patients from university medical centers who were active smokers for more than a year and more than 20-pack years or passive smokers for more than a year and diagnosed with Coronary Heart Disease, Myocardial Infarction, Stroke, COPD, Chronic bronchitis, or Lung Cancer had been conducted. Annual direct cost was taken into account using the Decision Analysis Tree Age Pro (=DATA) software; cost data related to health care expenditure were derived from secondary data sources in Jakarta. In addition, Population Attributable Risk (PAR) for each co-morbid conditions was calculated based on published epidemiological data from local and international journals.*

Results: *One-hundred and eighty-seven patients (96% male) satisfying the inclusion criteria, were analyzed, of whom confirmed diagnosis of Stroke was amongst 29% of the patients, CHD 16%, Myocardial Infarction 16%, Lung Cancer 15%, COPD 17%, and Chronic Bronchitis 7%. Mean direct annual cost was highest for Lung Cancer (Rp 51.6 million) followed by Myocardial infarction (Rp 38.5 million) and CHD (Rp 37.8 million); PAR for various co-morbid conditions (based on variations in relative risk and smoking prevalence estimates) were: Stroke ~16%-26%, CHD ~17%-27%, MCI ~ 22%-33%, Lung Cancer ~ 17%-26%, COPD ~ 13%-21%, Chronic Bronchitis ~ 42%-59%.*

Conclusions: *Annual cost of smoking-related diseases in Indonesia has been estimated. The highest cost is for Lung Cancer. The highest PAR is for Chronic Bronchitis.*

Keywords: *Smoking-related diseases, Annual cost, Indonesia.*

ABSTRAK

Estimasi pembiayaan per tahun penyakit terkait merokok di Indonesia

Latar belakang*: Merokok berkaitan dengan kejadian berbagai penyakit kronis dengan konsekuensi ekonomi berupa biaya yang sangat banyak. Penelitian ini bertujuan untuk mengestimasi biaya dampak merokok pada berbagai kondisi ko-morbid terkait penyakit jantung, otak dan paru di masyarakat Indonesia.*

Metode*: Meta-analisis dengan Mix-Programme software pada data sekunder penderita penyakit jantung iskemik, infark miokard, stroke, COPD, bronkitis kronis atau kanker paru dari Rumah Sakit Pendidikan Jakarta dengan kriteria : perokok aktif lebih 1 tahun dan merokok lebih 20 pak/tahun atau perokok pasif lebih 1 tahun. Cost-analysis dengan Tree Age Pro (=DATA) software dilakukan untuk membandingkan pengeluaran/biaya pengobatan per tahun menurut berbagai ko-morbid. Population Attributable Risk (PAR) untuk kondisi ko-morbid merujuk perhitungan yang ada pada jurnal epidemiologi lokal maupun internasional.*

Hasil*: Seratus delapan puluh tujuh=187 pasien (96% laki-laki) memenuhi kriteria inklusi; diantaranya 29% pasien menderita stroke, 16% penyakit jantung iskemik, 16% infark miokard, 15% kanker paru, 17% COPD, dan bronkitis kronis 7%. Rerata pengeluaran biaya per tahun tertinggi adalah kanker paru (Rp 51,6 juta), diikuti penyakit jantung iskemik (Rp 37,8 juta); dan infark*

[1] *Epidemiology Department, School of Public Health, Unviersity of Indonesia, Indonesia University Campus, Depok Indonesia*

[2] *Neurology Department, School of Medicine, University of Indonesia, Indonesia University Campus, Salemba street, Jakarta, Indonesia*

[3] *Pulmonology Department, School of Medicine, University of Indonesia, Indonesia University Campus, Salemba street, Jakarta, Indonesia*

[4] *Cardiology Department, School of Medicine, Indonesia University, Jakarta, Indonesia*

[5] *Nutrition Department, School of Medicine, Diponegoro University, Dr. Sutomo st. no 18, Semarang, Indonesia*

miokard (Rp 38,5 juta). PAR untuk masing-masing kondisi komorbid sebagai berikut: stroke 16-26%, penyakit jantung iskemik 17-27%, infark miokard 22-33%, kanker paru 17-26%, COPD 13-21%, dan bronkitis kronis 42-59%.

Simpulan*: Pengeluaran biaya per tahun tertinggi untuk penyakit terkait dampak merokok adalah kanker paru-paru dan bila PAR terbesar pada bronkitis kronis.*

INTRODUCTION

The number of smokers will increase mainly due to expansion of the world's population. By 2030 there will be at least another 2 billion people in the world.[1] Increasing number of smokers have markedly increasing risks of multiple cancer, particularly lung cancer, and are at far greater risk of coronary heart disease, strokes, emphysema, and many other fatal or non-fatal diseases.[1] In Indonesia, number of smokers increase due to increasing of population. In 2005, proportion of adult smokers is 31.5% (i.e. 62.2% are man and 1.3% woman).[2] Related to this proportion and results of Indonesian Household Health Survey, there are markedly increasing risks of smoking related diseases.[2] World Health Organization states that 6%-12% of yearly health care costs in Western Europe can be attributed to smoking.[3] Most of the studies of the direct medical costs of smoking in the United States conclude that these costs make up 6%-8% of overall annual cost of health care.[4,5,6] Estimates of the cost burden is similar in Canada (4%), Australia (6%) and Japan (4%).[6,7]

The human costs of smoking are substantial. Even with its life-threatening and well known consequences, tobacco smoking continues to be the single greatest cause of premature death, killing half of all people who continue to smoke for most of their lives.[8] Smoking has been shown to increase morbidity and mortality and to decrease quality of life. Serious complication that smokers are at increased risk of developing include: most cancer type, including lung, laryngeal, esophageal, bladder, pancreatic, gastric, cervical and endometrial; respiratory disorders like chronic obstructive pulmonary disease and pneumonia.[9,10] Cardiovascular diseases such as atherosclerosis and coronary heart disease,[9,12] and reproductive effects such as stillbirth and low birth weight.[9]

Although the exact percentage of costs related to tobacco use may vary by country, it seems clear that smoking causes substantial negative economic conesquences throughout the world. The World Health Organization projects that global annual economic costs of tobacco use in United States alone will be $500 billion a year by 2010.[1]

Burden of smoking-related diseases is never calculated in Indonesia. This economic costs of tobacco is crucial[11] to make a substantial health program. The objective of this study is to estimate the annual economic cost of smoking-related diseases as a reference for effective smoking cessation program.

The objectives of this study is to estimate the annual economic cost of smoking-related diseases - focused on: a. Cardiocerebrovascular diseases (Myocard infarction, stroke), b. Pulmonary diseases (Chronic bronchitis, COPD), c. Lung cancer; Taking into account the direct costs associated with smoking-related diseases as above in the population in Indonesia; Calculation of PAR (population attributable risk) for each targeted disease will be performed.

METHODS

Using the cost-of-illness framework, calculation of direct costs associated with smoking related diseases during 2006. Study conducted in one year time horizon.

Male or female age 30–80 years, active smoking more than one year and twenty pack-years or passive smoking more than one year, diagnosed as cardiocerebrovascular diseases (coronary heart diseases or myocard infarction) or pulmonary diseases (Chronic Bronchitis, COPD) or lung cancer.

Confirm diagnosed as cardiocerebrovascular or pulmonary diseases related to others causative i.e. congenital anomaly, work/environment pollution (asbestosis, pneumoconiosis), etc.

Cost data related to health care expenditure are based on direct costs of patient i.e. diagnostic costs, drugs costs, physician fee, inpatient-stay costs and outpatient visit costs. Direct cost accounted is average cost and within interval of 95% CI.

Calculation of cost is simply by accounted from population attributable risk (PAR) of each diseases times direct cost.

Population attributable risk (PAR) of each diseases will be calculated by formula $(p(RR-1))/(p(RR-1)+1)$, which p is proportion of smoking population in Indonesia and relative risk or odds ratio (RR) of each diseases is estimated by meta analysis of published local and international journals.[13-27]

RESULTS

One hundred eighty seven patients recruited satisfying the inclusion criteria. Ninety percentage of the patients are man. Confirmed diagnosis of stroke was amongst 29% of the patients and chronis bronchitis was the smallest percentage (7%). Table 1 provides detail of patient distribution.

Mean total annual direct cost of smoking-related diseases was Rp 27.6 million (range Rp 20.9 – 34.2 million), lowest total annual direct cost was Rp 0.43 million and the highest was Rp 379 million.

The highest mean total annual direct cost was for Lung cancer: Rp 51.6 million (range Rp 28.1–75.2 million) and the lowest mean total annual direct cost was for chronic bronchitis: Rp 7.682 million (range Rp 5.315–

10 million). Table 2 provides detail of direct cost for each disease.

Calculation of Relative Risk from metaanalysis presented in table 3. Highest RR was myocardial infarction: 3.50 (2.09;5.87), lowest RR was lung cancer: 1.53 (1.44;1.62). Highest PAR value also was on myocardial infarction: 44.06% (25.56%;60.54%), it means if smoking habit reduce will decrease burden of myorcardial infarction in Indonesia population by 44.06%. The lowest PAR value was lung cancer: 14.24% (12.25%;16.23%).

Table 1. Proportion distribution of smoking-related diseases

Disease	Total (N=187)	
	n	%
Stroke	54	28.88
Lung Cancer	28	14.97
Myocard infaction	30	16.04
Coronary Heart Disease	30	16.04
Chronic Bronchitis	14	7.49
COPD	31	16.58

Table 2. Mean total annual direct cost for each disease

Disease	Cost (Rupiah)			
	Mean	95% CI	Minimum	Maximum
Stroke	7.954.219	(5.224.813;10.700.000)	472.900	54.500.000
Lung Cancer	51.600.000	(28.100.000;75.200.000)	6.092.500	287.000.000
Infark Miokard	38.500.000	(24.700.000;52.200.000)	3.810.072	147.000.000
Coronary Heart Disease	37.800.000	(22.700.000;52.900.000)	4.868.457	180.000.000
Chronic Bronchitis	7.682.193	(5.315.018;10.000.000)	3.582.900	17.700.000
COPD	28.600.000	(2.488.615;54.800.000)	4.569.350	379.000.000
Total	27.600.000	(20.900.000;34.200.000)	472.900	379.000.000

Table 3. Relative risk dan population attributable risk of smoking-related diseases

Disease	RR[†]	95% CI	PAR[‡]	95% CI RR
Stroke	1.54	(1.47;1.61)	14.54	(12.94;16.14)
Lung Cancer	1.53	(1.44;1.62)	14.24	(12.25;16.23)
Myocardial infarction	3.50	(2.09;5.87)	44.06	(25.56;60.54)
Coronary Heart Disease	1.63	(1.57;1.69)	16.52	(15.27;17.77)
Chronic Bronchitis	3.34	(2.46;4.52)	42.38	(31.49;52.60)
COPD	2.77	(1.86;4.12)	35.76	(21.26;49.58)

[†] RR Relative risk (meta-analysis)
[‡] PAR : Population attributable risk

Having the mean total direct cost of smoking-related disease and PAR value, we can calculate estimated saving cost by smoking cessation. Table 4 provides

detail of the estimated cost. Event avoided of myocardial infarction was the highest estimated saving cost: Rp 1,696 million (Rp 984 million; Rp 2,330

million) and chronic bronchitis was the lowest: Rp 115 million (Rp 102 million; Rp 128 million).

The tables 5, 6, 7, and 8 provide detail of mean direct cost based on cost type and mean direct cost based on type of cost and type of disease. From the figure 1 we

can see that the highest PAR is in MI (44.06%) and its estimated saving cost is Rp 1.69 billion. The second highest PAR is chronic bronchitis (42.38%) with its estimated saving cost as Rp. 326 million.

Table 4. Estimated saving cost by 100 cases for each smoking-related disease

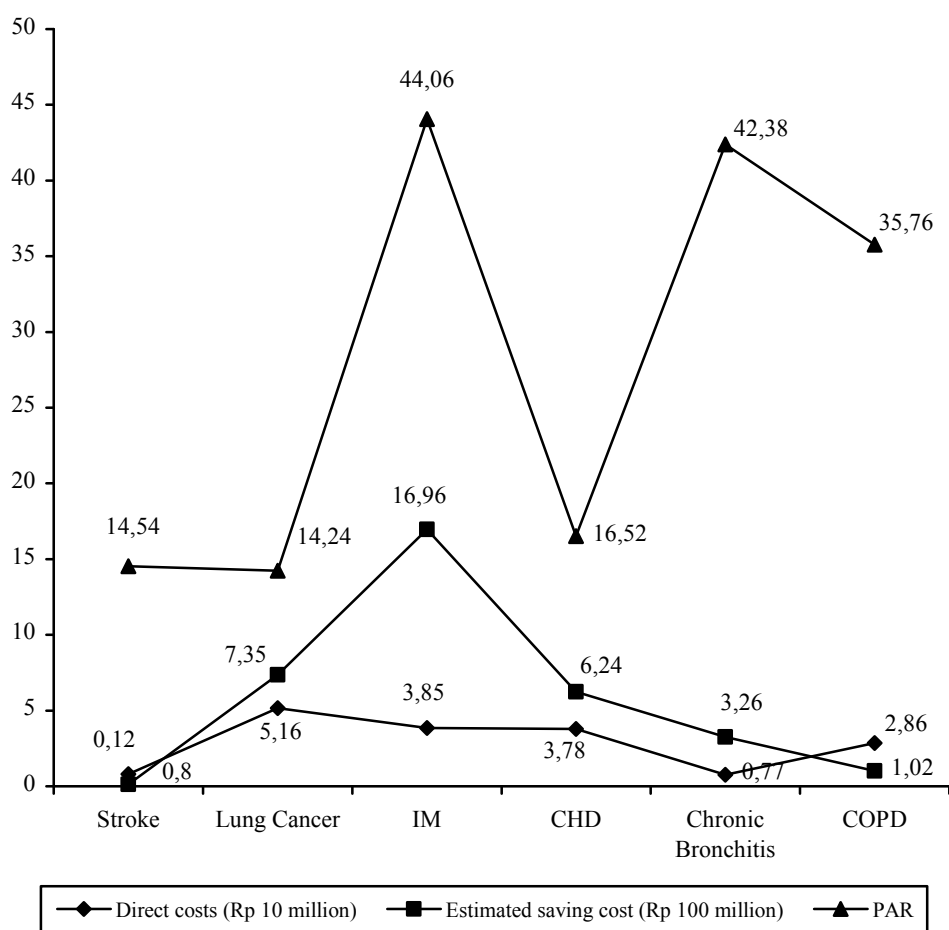| Disease	Estimated saving cost by 100 cases (Rupiah)	
Stroke	115.632.224	(102,955,852;128,381,861)
Lung Cancer	734.633.042	(631,876,933;837,396,385)
Myocardial infarction	1.696.153.846	(984,030,595;2,330,692,962)
Coronary Heart Disease	624.267.085	(577,098,748;671,677,425)
Chronic Bronchitis	325.575.547	(241,892,091;404,090,318)
COPD	1.022.668.114	(607,951,699;1,418,053,473)

Figure 1. Comparison between direct costs, PAR and estimated saving costs

Table 5. Mean direct cost based on cost type

Type of cost	ALL Diseases (in Rupiah)		ALL (COST in rupiah)	
	Mean	95% CI Mean	Minimum	Maximum
Diagnostic	**3.167.936**	(2.435.483;3.900.390)	**65.000**	**41.800.000**
Laboratorium	1.775.934	(1.191.370;2.360.498)	30.000	39.200.000
Radiology	1.473.495	(1.154.775;1.792.214)	45.000	13.000.000
Treatment	**16.000.000**	(11.900.000;20.000.000)	**92.745**	**220.000.000**
Hospitalization	**5.429.643**	(3.968.817;6.890.469)	**25.000**	**59.600.000**
Investigation	2.023.035	(1.442.536;2.603.534)	65.000	38.000.000
Inpatient	17.900.000	(11.600.000;24.100.000)	83.574	371.000.000
Outpatient	9.968.618	(6.190.136;13.700.000)	160.000	182.000.000
Total (ALL)	**27.600.000**	(20.900.000;34.200.000)	**472.900**	**379.000.000**

Treatment was the second highest mean direct cost based on cost type. Inpatient hospitalization was the highest one.

Table 6. Mean direct cost based on type of cost and type of disease

Type of cost	STROKE (in rupiah)				LUNG CANCER (in rupiah)			
	Mean	(95% CI mean)	Minimum	Maximum	Mean	(95% CI mean)	Minimum	Maximum
Diagnostic	**1.927.198**	(1.333.535;2.520.861)	**240.000**	**10.900.000**	**8.592.971**	(5.903.861;11.300.000)	**1.011.500**	**33.800.000**
Laboratorium	1.405.740	(807.632;2.003.847)	117.000	10.300.000	3.393.293	(1.546.114;5.240.471)	478.500	20.800.000
Radiology	693.320	(503.483;883.157)	45.000	3.800.000	5.199.679	(3.893.019;6.506.338)	219.000	13.000.000
Treatment	**3.355.869**	(1.894.524;4.817.214)	**92.745**	**29.600.000**	**27.900.000**	(11.200.000;44.600.000)	**2.391.000**	**220.000.000**
Hospitalization	**3.469.410**	(2.169.145;4.769.675)	**25.000**	**17.300.000**	**15.200.000**	(8.446.021;21.900.000)	**310.000**	**59.600.000**
Early Investigation	945.374	(805.990;1.084.757)	280.500	2.613.050	4.654.898	(3.256.351;6.053.445)	424.000	10.800.000
Inpatient	7.482.057	(4.676.859;10.300.000)	152.900	54.500.000	41.300.000	(25.200.000;57.400.000)	4.321.000	165.000.000
Outpatient					182.000.000			182.000.000
Total (ALL)	**7.954.219**	(5.224.813;10.700.000)	**472.900**	**54.500.000**	**51.600.000**	(28.100.000;75.200.000)	**6.092.500**	**287.000.000**

Table 7. Mean direct cost based on type of cost and type of disease

Type of cost	MYOCARDIAL INFARCTION (in rupiah)				CHD (in rupiah)			
	Mean	(95% CI mean)	Minimum	Maximum	Mean	(95% CI mean)	Minimum	Maximum
Diagnostic	**3.495.367**	(696.449;6.294.285)	**100.000**	**41.800.000**	**2.491.967**	(1.016.878;3.967.056)	**65.000**	**21.400.000**
Laboratorium	2.639.633	(6.315;5.272.951)	30.000	39.200.000	1.676.034	(278.631;3.073.438)	173.000	19.600.000
Radiology	855.733	(424.652;1.286.814)	70.000	4.380.000	871.800	(546.542;1.197.058)	60.000	3.405.000
Treatment	**30.400.000**	(17.700.000;43.000.000)	**61.852**	**68.000.000**	**28.600.000**	(17.000.000;40.300.000)	**298.699**	**27.100.000**
Hospitalization	**4.592.502**	(2.362.576;6.822.427)	**225.000**	**29.100.000**	**6.675.059**	(2.584.309;10.800.000)	**340.000**	**43.600.000**
Early investigation	2.016.744	(622.963;4.656.451)	65.000	38.000.000	658.937	(489.541;828.334)	71.663	1.368.874
Inpatient	9.480.056	(4.273.832;14.700.000)	332.160	59.800.000	9.306.074	(3.493.925;15.100.000)	83.574	66.600.000
Outpatient	11.000.000	(8.509.826;13.500.000)	160.000	24.600.000	8.313.758	(5.968.493;10.700.000)	176.427	27.000.000
Total (ALL)	**38.500.000**	(24.700.000;52.200.000)	**3.810.072**	**147.000.000**	**37.800.000**	(22.700.000;52.900.000)	**4.868.457**	**180.000.000**

Table 8. Mean direct cost based on type of cost and type of disease

Type of cost	CHRONIC BRONCHITIS (in rupiah)				COPD (in rupiah)			
	Mean	(95% CI mean)	Minimum	Maximum	Mean	(95% CI mean)	Minimum	Maximum
Diagnostic	**1.981.571**	(1.629.254;2.333.888)	**1.277.500**	**3.748.500**	**1.198.717**	(1.022.310;1.375.123)	**460.000**	**2.300.000**
Laboratorium	860.214	(719.320;1.001.109)	516.500	1.209.500	518.917	(443.466;594.368)	159.500	1.123.000
Radiology	1.121.357	(833.514;1.409.200)	619.000	2.770.000	679.800	(524.573;835.027)	145.000	1.885.000
Treatment	**4.400.979**	(2.481.263;6.320.695)	**1.425.400**	**13.000.000**	**4.096.245**	(3.322.307;4.870.183)	**213.938**	**10.800.000**
Hospitalization	**1.299.643**	(930.756;1.668.530)	**700.000**	**2.995.000**	**873.143**	(489.225;1.257.061)	**170.000**	**4.200.000**
Early investigation	2.050.371	(1.546.194;2.554.549)	913.000	4.103.400	2.294.398	(1.404.854;3.183.943)	612.300	9.794.000
Inpatient					63.000.000	(28.800.000;155.000.000)	3.591.403	371.000.000
Outpatient	5.631.821	(3.565.595;7.698.048)	2.082.900	15.300.000	5.533.867	(4.687.376;6.380.357)	3.622.600	12.000.000
Total (All)	**7.682.193**	(5.315.018;10.000.000)	**3.582.900**	**17.700.000**	**28.600.000**	(2.488.615;54.800.000)	**4.569.350**	**379.000.000**

Table 6, 7, and 8 showed that the highest animal cost of smoking-related diseases in Indonesia was lung cancer.

DISCUSSION

Estimated annual cost of smoking-related diseases have been calculated. The highest cost was for myocardial infarction. Table 5 provides total annual economic burden by govenment for one patient suffer from smoking-related disease; Rp 27.6 million. If there are 100 patients the cost will be Rp 2.7 billion. As a big population country, health care cost attributed to smoking will be huge. Detail of cost burden for each disease presented on table 6, 7, 8 and 9. This information can be used as a basis for cost effectiveness analysis of smoking cessation program to reduce smoking-related diseases.

CONCLUSIONS

Estimating annual cost of smoking-related diseases have been calculated for cardiocerebrovascular diseases (MI, CHD, Stroke) and pulmonary diseases (Chronic bronchitis, COPD, Lung cancer). Mean estimated annual cost of MI: Rp 38.5 million (24.7 million; 52.2 million). Mean estimated annual cost of CHD: Rp 37.8 million (22.7 million; 52.9 million). Mean estimated annual cost of Stroke: Rp 7.954 million (5.224 milllion; 10.7 million). Mean estimated annual cost of Lung cancer: Rp 51.6 million (28.2 million; 75.2 million). Mean estimated annual cost of Chronic bronchitis: Rp 7.682 million (5.315 million; 10 million). Mean estimated annual cost of COPD: Rp 28.6 million (2.488 million; 54.8 million). Total economic burden for smoking-related disease was Rp 27.6 million (20.9 million; 34.2 million). PAR value for MI 44.06%; CHD 14.54%; Stroke 14.54%; Lung cancer 14.24%; Chronic bronchitis 42.38%; COPD 35.76%.

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