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ECONOMIC EVALUATION OF SMOKING INDUCED LUNG DISEASES TREATMENT AND THEIR SOCIAL IMPACT

[1*]Angelova Sofiya, [2]Naseva Emilia, [3]Avramov Toma, [4]Valev Dinko, [4]Tafradgiiska Maya, [5]Manolova Antoaneta, [3]Valcheva Silvia, [3]Shirov Todor and [6]Petkov Rosen

[1]Ambulatory for individual practice and specialized medical caredomestic and lung diseases Slatina District, bl. [4]7-E, Sofia, 1574, Bulgaria
[2]Medical University - Sofia, Faculty of Public Health. 8, Bjalo More str, Sofia, 1508, Bulgaria
[3]ENT Clinic, University Hospital "Tzaritsa Yoanna", 8, Bjalo More str, Sofia, 1508, Bulgaria
[4]Specialized Hospital for Active Treatment of Pulmonary Diseases «St. Sofia» Ltd, Bronchological Department, 19, Acad. Iv. Geshov Blvd. Sofia, 1431, Bulgaria
[5]National Center for Public Health and Analysis, 15, Acad. Iv. Geshov Blvd. Sofia, 1431, Bulgaria
[6]Thoracic Surgery Department, Saint Sophia University Hospital of Pulmonary Disease, Medical University, Sofia, 19 Acad. Iv. Geshov Str. Sofia 1431, Bulgaria

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ABSTRACT

Introduction: The aim of the study was to estimate and analyze the direct and indirect costs for treatment of three categories of patients with COPD and asthma - smokers, passive smokers and non-smokers after exacerbation and hospitalization in the clinic for pulmonary suppurative disease, pneumonia and bronchoscopy procedures and calculate price that society pays for one hospitalization and one patient exacerbation of each year.
Materials and Methods: We present data on 144 COPD and asthma patients with exacerbations and hospital observation of 326 hospitalized patients. The assessments of smoking, the costs are divided as to treatment (medical costs) and as non-medical costs.
Results: The results in all three groups showed significant differences as the highest average cost of therapy is in smokers, followed by passive smokers and the fewest resources are allocated to non-smokers ($p<0.05$). Three groups of patients differ significantly and number of days of absence from work - most smokers, followed by passive smokers and non-smokers ($p<0.05$).
Conclusion: The data from the analysis showed that the treatment of smokers (one exacerbation and one hospitalization per year) costs to the society only 451 BGN more than a passive smokers and 1326 BGN more than a non-smoking persons.

INTRODUCTION

Smoking is one of the most widespread drug addictions of modern times and its consequences are extremely hard in medical, social and economic context. There are 1.2 billion smokers currently in the world and 70% of them live in the developing countries. Tobacco pandemic is widespread in Central and Eastern Europe and the Western Pacific region (World Bank report, 2013). Bulgaria is one of the European countries with the most serious health problems caused by smoking. Smoking prevalence among men is typically high, but in the recent years it increases among women and young people. The percentage of smoking pupils 15-16 years of age, especially in girls, also increases (Crofton and Simpson, 2003). Although tobacco use is the leading preventable cause of illness and death, it's still widespread. Smoking causes cancer, heart disease, stroke, lung diseases (including emphysema, bronchitis, and chronic airway obstruction), and even diabetes. For every person who dies from a smoking-related disease, about 30 more people suffer with at least one serious illness from smoking (U.S. Department of Health and

Corresponding author: Angelova Sofiya
Ambulatory for individual practice and specialized medical caredomestic and lung diseases Slatina District, bl. [4]7-E, Sofia, 1574, Bulgaria

Human Services, 2014). Worldwide, tobacco use causes more than 5 million deaths per year, according to World Health organisation (WHO) data. Smoking endangers not only the health of smokers and reduces the duration of their lives, but also have consequences for the people around them. It causes more than 15% of deaths in men and 7% of women worldwide (World Health Organization, 2011). Smoking-related diseases including obstructive lung diseases such as asthma and COPD constitute a serious public health issue with significant financial and resource burdens on the healthcare system (U.S. Department of Health and Human Services, 2014, Andreevska *et al*., 2014). The aim of this study is to calculate and analyse the direct and indirect costs of treating three categories of patients with COPD and asthma: smokers, passive smokers and non-smokers in an outpatient setting for exacerbation and hospitalization for the same categories of patients hospitalised in a pulmonary clinic for three clinical pathways: purulent diseases, pneumonia and bronchoscopy procedure and to calculate the cost to society for one hospitalization and one exacerbation of each patient per year. According to the Bulgarian social insurance legislation, temporary absence from work (temporary disability days) for medical reasons (adequately documented by a physician) are paid for:

- The first 3 days by the employer, 70% of their total (gross) salary;
- The days after the third one by National Social Security Fund (NSSF), 80% of their social security income (NSSF, 2015).

All the costs for patients' medical treatment are covered by the National Health Insurance fund (NHIF) and/or the patients themselves.

MATERIALS AND METHODS

Outpatient follow-up of 144 patients who suffered from chronic obstructive pulmonary disease (COPD) and/or asthma with exacerbations has been done (Angelova, 2014). Inpatient follow-up of 326 patients who has been hospitalized on three clinical pathways – "Purulent disease", "Pneumonia" and "Bronchoscopic procedures" has been done (Angelova, 2014). Patients with chest traumas are excluded from the analysis (Dimitrova and Mihaylova, 2011). All the patients are treated according to the best medical practices (Hristov and Pesheva, 2013, Pesheva and Hristov, 2013). Smokers are defined as persons who smoke at least 1 cigarette per day, every day. Smoking of electronic cigarettes is excluded (Lebanova *et al*., 2011). Ex-smokers are excluded from the analyses because of their low number. All calculations are in Bulgarian Lev (1 BGN=1.95583 EUR) (Bulgarian National Bank, 2015). The calculations are based on the losses, caused by the absence from work and the treatment costs:

- For the NHIF for the hospital treatment;
- For the hospital that cover the overstay (the stay that is more than provisioned by the clinical pathways);
- For the society, because the employees who don't work, don't contribute for gross domestic product (GDP);
- For the employers, who pay for the first three days of their employees' absence;
- For NSSF who pays for the days 4 to the end of temporary incapability to work;
- For the employees for the additional (outpatient) treatment;
- For the employees because they don't receive their full salary.

The average insurance income, used for the calculations, is 618.06 BGN (NSSF, 2015). The average gross salary is 777 BGN (NSI, 2015). The additional bed day cost in pulmonary clinic in Sofia is 110.46 BGN. The drug costs are according to the prices, paid by NHIF. For the clinical pathways "Purulent disease", "Pneumonia" and "Bronchoscopy procedures" are provisioned respectively 8, 7 and 1 bed days and their cost, paid by NHIF, is respectively 663, 410 and 120 BGN (NHIF, 2015). All the costs and salaries are valid for 2011 year.

Statistical methods

Frequency and cross-tables, means and 95% CI, Kolmogorov-Smirnov Test for testing the distributions of quantitative variables, Kruskal-Wallis test, Chi-square test.

Economical method

A prevalence-based disease-specific cost of illness approach was utilised to calculate the costs caused by several smoking-related diseases and conditions: COPD, asthma, purulent disease, pneumonia and need of diagnostic bronchoscopy procedure (Kernick, 2002, Shtereva, 2010).

RESULTS AND DISCUSSION

Outpatient follow-up

The patients are been followed-up between 1 January and 31 December 2011. Smokers, passive smokers and non-smokers are similar by gender (Chi-square test, $p>0.05$). These three groups are different in their age, the average oldest group is non-smokers, the youngest – passive smokers (Kruskal-Wallis test, $p<0.05$). The patients have been prescribed with antibiotics, bronhodilatators, secretolitics and, if necessary, corticosteroids. The total average cost of their treatment and days absent from work is shown in Table 1.

The costs for society are related to the GDP that is not produced. They are the total salary of the employees for the days they not work, but receive compensations. The costs for the employers are calculated as they pay the compensations for the first three days of the illness. The costs for NSSF are the compensations for the days after the third. Employees' experience additional costs because they don't receive their full salary for the days they are temporary incapable to work, but 70% for the first 3 days and 80% for the next days. That decrease a little their income tax, but its effect is negligibly small. The sum of all costs is shown in the column Total costs. The costs are presented in Table 2.

The confidence intervals for smokers' and passive smokers' costs overlap, so the difference between these two groups' costs is not significant. The costs for non-smokers are significantly lower than the other two groups (Fig. 1).

Table 1. Average cost for medication treatment and average number of days absent from work by smoking status

	n	Total cost of medication treatment (BGN)			n	Number of days absent from work		
		mean	95% CI lower	95% CI upper		mean	95% CI lower	95%CI upper
smokers	63	52,33	49,22	55,44	42	12,40	11,82	12,99
passive smokers	47	45,73	42,44	49,03	35	11,94	11,26	12,63
non-smokers	34	42,88	40,19	45,58	14	10,14	9,50	10,79

Table 2. Costs related to outpatient treatment follow-up by smoking status

	Costs for society (BGN)			Costs for the employers (BGN)			Costs for NSSF (BGN)			Costs for the employees (BGN)			Total costs (BGN)		
	mean	95% CI lower	95% CI upper	mean	95% CI lower	95% CI upper	mean	95% CI lower	95% CI upper	mean	95% CI lower	95% CI upper	mean	95% CI lower	95% CI upper
smokers	321,28	306,20	336,37	54,39	54,39	54,39	155,01	145,40	164,61	62,06	59,66	64,46	645,07	614,87	675,27
passive smokers	309,32	291,55	327,09	54,39	54,39	54,39	147,39	136,08	158,70	60,16	57,33	62,99	617,00	581,78	652,21
non-smokers	262,70	245,99	279,41	54,39	54,39	54,39	117,73	107,09	128,36	52,74	50,08	55,40	530,44	497,75	563,13

Table 3. Average bed days, days overstay and total days absent from work by smoking status and clinical pathways

		n	Actual number of bed days			Number of days over the provisioned by the clinical pathways			n*	Number of days absent from work			Total number of days absent from work		
			mean	95% CI lower	95% CI upper	mean	95% CI lower	95% CI upper		mean	95% CI lower	95% CI upper	mean	95% CI lower	95% CI upper
Purulent disease	smokers	115	8,17	8,07	8,26	1,36	1,03	1,69	74	18,68	18,14	19,21	26,77	26,22	27,32
	passive smokers	30	8,10	7,96	8,24	1,50	0,52	2,48	17	18,47	17,32	19,62	26,53	25,38	27,68
	non-smokers	17	8,00	8,00	8,00	0	0,00	0,00	12	18,42	17,35	19,48	26,42	25,35	27,48
Pneumonia	smokers	54	7,19	7,03	7,34	1,67	1,01	2,32	47	18,62	17,98	19,26	25,83	25,13	26,53
	passive smokers	24	7,00	7,00	7,00	0	0,00	0,00	24	17,79	17,06	18,53	24,79	24,06	25,53
	non-smokers	14	7,00	7,00	7,00	0	0,00	0,00	12	18,42	17,22	19,61	25,42	24,22	26,61
Bronchoscopy procedures	smokers	30	2,77	2,61	2,92	1,77	1,61	1,92	20	24,90	20,52	29,28	27,65	23,32	31,98
	passive smokers	20	2,40	2,18	2,62	1,40	1,18	1,62	11	23,36	16,72	30,01	26,00	19,18	32,82
	non-smokers	22	2,36	2,16	2,57	1,36	1,16	1,57	13	11,08	9,53	12,62	13,54	11,94	15,13

* The number of patients is less from the total number of patients, because not every patient works and resp. needs a document for absence from work.

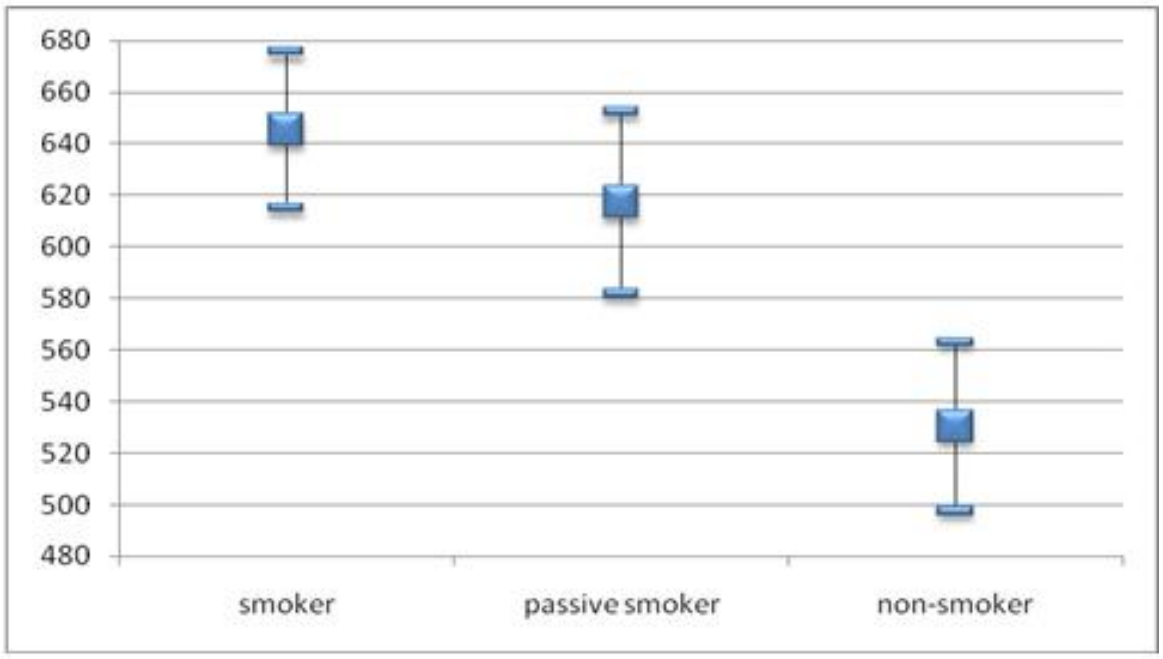

Figure 1. Total costs for outpatient treatment of pulmonary diseases by smoking status (mean and lower and upper bound of 95% CI, BGN)

Table 4. Clinical pathways costs of the patients by smoking status (BGN)

	n	mean	95% CI lower bound	95% CI upper bound
smokers	199	512,49	484,92	540,05
passive smokers	54	434,19	383,88	484,50
non-smokers	73	370,77	307,67	433,88

Table 5. Total costs for the hospital, society, employers, NSSF and employees by smoking status and clinical pathways (BGN)

		Costs for the hospital			Costs for society			Costs for the employers			Costs for NSSF			Costs for the employees		
		mean	95% CI lower	95% CI upper	mean	95% CI lower	95% CI upper	mean	95% CI lower	95% CI upper	mean	95% CI lower	95% CI upper	mean	95% CI lower	95% CI upper
Purulent disease	smokers	149,91	113,26	186,56	693,35	679,08	707,62	54,39	54,39	54,39	391,77	382,69	400,86	121,25	118,98	123,52
	passive smokers	165,69	57,44	273,94	687,11	657,23	716,99	54,39	54,39	54,39	387,80	368,79	406,82	120,26	115,51	125,01
	non-smokers	0,00	0,00	0,00	684,19	656,63	711,76	54,39	54,39	54,39	385,94	368,40	403,48	119,80	115,41	124,18
Pneumonia	smokers	184,10	111,93	256,27	668,99	650,90	687,08	54,39	54,39	54,39	376,27	364,76	387,78	117,38	114,50	120,26
	passive smokers	0,00	0,00	0,00	642,10	623,03	661,18	54,39	54,39	54,39	359,16	347,02	371,30	113,10	110,07	116,14
	non-smokers	0,00	0,00	0,00	658,29	627,39	689,19	54,39	54,39	54,39	369,46	349,80	389,13	115,68	110,76	120,59
Bronchoscopy procedures	smokers	195,15	178,14	212,15	716,14	604,05	828,22	54,39	54,39	54,39	406,27	334,95	477,60	124,88	107,05	142,71
	passive smokers	154,64	130,31	178,98	673,40	496,88	849,92	54,39	54,39	54,39	379,08	266,75	491,40	118,08	90,00	146,16
	non-smokers	150,63	127,90	173,35	350,65	309,35	391,94	54,39	54,39	54,39	173,69	147,41	199,97	66,73	60,16	73,30

Inpatient follow-up

The patients are been hospitalised between 1 January and 31 December 2011. Smokers, passive smokers and non-smokers are similar by age and gender (Kruskal-Wallis and Chi-square test, $p>0.05$). The average number bed days are calculated separately for smokers, passive smokers and non-smokers, divided by clinical pathways (Table 3). The costs for the NHIF (the clinical pathways costs) are calculated totally but not by clinical pathways because the three categories by smoking status are significantly different proportion in the pathways (chi-square test, $p<0.05$) so it's important to highlight that smokers prevailed in more expensive pathways (Table 4). Total costs for the hospital, society, employers, NSSF and employees by smoking status and clinical pathways is presented in Table 5.

Summing the total costs will result that the smokers' costs are the largest and significantly higher than the non-smokers (Table 6).

Table 6. Total costs for the inpatient treatment by smoking status (BGN)

	mean	95% CI lower	95% CI upper
smoker	4821,11	4408,38	5233,85
passive smoker	4397,79	3810,07	4985,51
non-smoker	3609,00	3344,06	3873,95

Non-smokers' costs are significantly less than smokers'. Passive smokers costs' confidence interval overlap both smokers' and non-smokers' ones (Fig. 2).

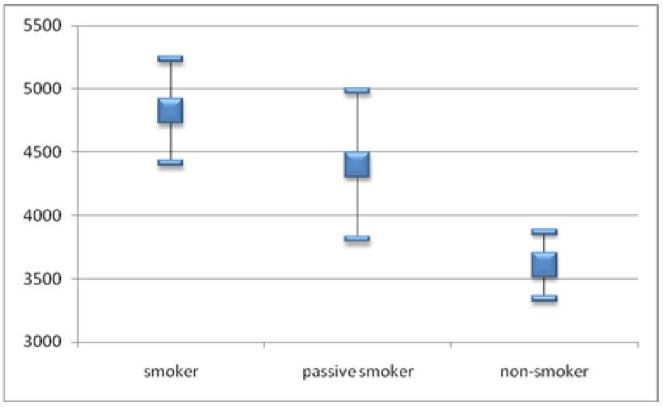

Figure 2. Total costs for inpatient treatment of pulmonary diseases by smoking status (mean and lower and upper bound of 95% CI, BGN)

The analysis of direct and indirect costs of outpatient and inpatient treatment of smoking-caused diseases shows that non-smokers are the group with the least cost of treatment. The difference between smokers and non-smokers are significant ($p<0.05$), but for some of the expenses smokers don't differ significantly from passive smokers ($p>0.05$). If we assume that a patient with pulmonary disease has only one exacerbation and only one hospitalisation per year, the total costs could be calculated as the sum of those from inpatient and outpatient treatment - Table 7, Fig. 3. The treatment of a smoker (per year, per person) costs to the society in average 451 BGN more than a passive smoker and nearly 1327 BGN more than non-smoker. The average difference in the expenses between people exposed to second hand smoke and non-smokers is 875 BGN per year, per person.

Table 7. Total costs for inpatient and outpatient treatment by smoking status (BGN)

	mean	95% CI lower	95% CI upper
smokers	5466,19	5023,25	5909,13
passive smokers	5014,79	4391,86	5637,71
non-smokers	4139,44	3841,80	4437,08

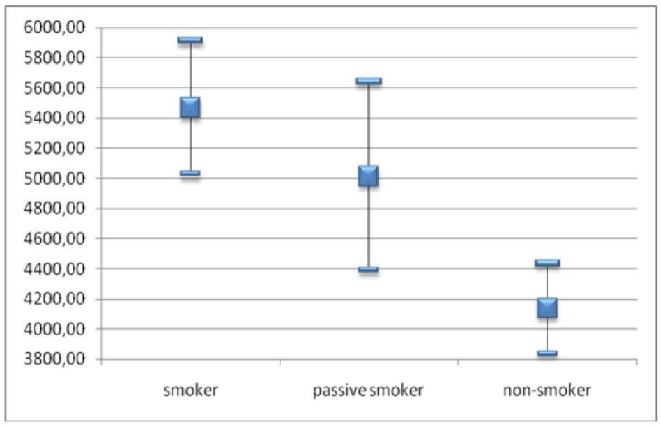

Figure 3. Total costs for inpatient and outpatient treatment of pulmonary diseases by smoking status (mean and lower and upper bound of 95% CI, BGN)

It's important to highlight that smokers' costs are significantly higher than those of non-smokers. Non-smokers' confidence limits are very wide and overlap those of passive smokers, so the difference between these two groups is not significant. The fact that there is no significant difference between smokers and passive smokers' costs, have to warn the society and increase public awareness to the problem. Passive smoking is at least as dangerous as active smoking and the society should know the truth (World Bank report, 2013). Although quitting smoking for COPD patients does little for improving COPD symptoms, it may slow the rate of lung decline that occurs with the disease. Smoking cessation also will save huge amount of money to the society (Andreevska, 2014, Sutherland and Cherniak, 2004).

Conclusion

The society could save a lot of money by preventing the start of smoking. The patients, the passive smokers, the young people should be aware and educated to keep themselves away from smoking. Efforts from the whole parts of healthcare and educational systems must be included. The money invested in health promotion will result in healthy and productive people. Preventing of smoking and smoking cessation not only saves money to the society, it also contributes to better health of its members and gives them the opportunity to contribute more for GDP (Petrova-Gotova *et al*., 2013, Zlatanova *et al*., 2012).

List alphabetical abbreviations

BGN	Bulgarian Lev
COPD	Chronic obstructive pulmonary disease
EUR	Euro
GDP	Gross domestic product
NHIF	National Health Insurance Fund
NSSF	National Social Security Fund
NSI	National Statistical Institute
WHO	World Health Organisation

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