Original Article
http://mjiri.iums.ac.ir
Medical Journal of the Islamic Republic of Iran (MJIRI)

Med J Islam Repub Iran. 2017(23 Sep);31.63. https://doi.org/10.14196/mjiri.31.63

Does smoking status affect cost of hospitalization? Evidence from three main diseases associated with smoking in Iran

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Received: 22 Feb 2016 Published: 23 Sep 2017

Abstract

Background: Smoking is recognized as one of the main public health problems worldwide and is accounted for a high financial burden to healthcare systems and the society as a whole. This study was aimed at examining the effect of smoking status on cost of hospitalization among patients with lung cancer (LC), chronic obstructive pulmonary disease (COPD) and ischemic heart diseases (IHD) in Iran in 2014.

Methods: A total of 1,271 patients (consisting of 415 LC, 427 COPD and 429 IHD patients) were included in the study. Data on age, sex, and insurance status, length of hospital stay and cost of hospitalization were extracted from the medical records of the patients. The smoking status of the patients was obtained through a telephone survey. A generalized linear model (GLM) was used to compare the costs of hospitalization of current, former and never smokers. The analysis was done using Stata v.12.

Results: The mean±SD cost of hospitalization per patient was 45.6 ± 41.8 million IR for current smokers, 34.8±23 million IR for former smokers and 27.6±24.6 million IR for never smokers, respectively. The findings indicated that the cost of hospitalization for current and former smokers was 65% and 26% in the unadjusted model and 35% and 24% in the adjusted model higher than for never smokers.

Conclusion: The findings revealed that smoking drains a large hospital resource and imposes a high financial burden on the health system and the society. Therefore, efforts should focus on reducing the prevalence of smoking and the negative economic consequences of smoking.

Keywords: Smoking Status, Cost of Hospitalization, Generalized Linear Model, Iran

Cite this article as: Akbari Sari A, Rezaei S, Arab M, Karami Matin B, Majdzadeh R. Does smoking status affect cost of hospitalization? Evidence from three main diseases associated with smoking in Iran. *Med J Islam Repub Iran. 2017* (23 Sep);31:63. https://doi.org/10.14196/mjiri.31.63

Introduction

Smoking is the most important public health problem that requires attention globally (1, 2). Lung cancer, ischemic heart disease and respiratory illness, etc. among many other diseases are closely associated with and caused by smoking. Each year, more than five million adults die from conditions related to smoking. The annual death rate is expected to rise to about 8 million people by the year 2030. More than 80% of these deaths will be in low- and middle-income countries (3, 4). The financial consequences associated with smoking and related diseases to health systems as well as societies as a whole is considerably high (5-7). However, most evidence on the negative effect of smoking on utilization of health services, direct and indirect costs and work absenteeism has been from developed countries (7-16). Evidence from developing countries concerning the negative effects of smoking is less documented (2, 4).

Recent evidence from Iran shows that the prevalence of

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↑What is "already known" in this topic:
This is the first attempt about examine the association between smoking status and the cost of hospitalization with a large sample in Iran.

→What this article adds:
There is a statistically significant association between smoking and cost of hospitalization. The cost of hospitalization for current and former smokers was 35% and 24% higher than for never smokers.

[DOI: 10.14196/mjiri.31.63]

smoking is 12.5% (23.4% f or males and 1.4% for females) and that an individual on average smokes 13.7 sticks of cigarettes daily (17). A previous study reported that smoking was accounted for 4,623 cancer deaths, 80,808 years of potential life lost and US$ 83,019,583 cost of productivity lost (4). To our knowledge, little information is available on the impact of smoking on healthcare cost, length of hospital stay and healthcare utilization related to smoking associated conditions in Iran (4, 15). However, reliable evidence is required to effectively reduce the prevalence of smoking and successfully implement smoking cessation interventions in the country. This study aimed to address the information gap concerning the effect of smoking status on cost of hospitalization for patients with lung cancer (LC), chronic obstructive pulmonary disease (COPD) and ischemic heart diseases (IHD) in Iran in 2014.

Methods

Study Setting

Tehran is a province as well as the capital city of Iran. According to the census 2011 report, the total population of the city was around 9 million, and 16 million in the wider metropolitan area. Tehran is the largest city in Iran, the second largest city in Western Asia, and the third largest in the Middle East.

Sample Size and Data Collection

In the health system network of Iran, inpatient care is delivered through hospitals owned by different providers. Governmental hospitals are the main providers of inpatient services and account for 68% of total hospital beds. Private hospitals account for 12% of the total hospital beds. However, Social Security Organization (SSO) and Armed Forces hospital beds account for 9 and 4%, respectively. Oil Company and NGOs hospital beds account for the rest of the share (18). The provider's perspective was used to include the cost of hospitalization in the analysis.

All patients aged 35 years and older, who were discharged from the hospitals during 21 March 2014 to 22 March 2015 and were managed for LC, COPD or IHD related to smoking constituted the study population. The latent period between initial exposure to smoking and occurrence of cancer is believed to be about 20 years and more (19). Thus, the patients were identified using the International Classification for Diseases 10th Revision (ICD-10) codes for LC (C33-C34), COPD (J40-J44) and IHD (I20-I25).

The samples for the study were selected in two stages. First, 1,503 patients (501 patients with LC, 501 patients with IHD and 501 patients with COPD) who were admitted during the study period were selected based on the proportion of hospital beds of the different providers. That is, 73% of the patients were from governmental hospitals, 12% from the private hospitals, 9% from social security hospitals and 4% from the Armed Forces hospitals. Data on sex, age, insurances status, type of disease, residence, length of hospital stay and hospitalization costs were retrieved from the patients' medical records, using self-constructed checklist. In the next stage, information about smoking status of the selected patients was obtained through telephone survey. Based on the response of the interviewees, 1,271 patients (415 LC patients, 427 COPD patients and 429 IHD patients) were included in the analysis.

Patients were classified as current smokers if they were smoking at least one cigarette per day at the time of hospitalization, never smokers if they have never had smoked or smoked less than 100 piece of cigarettes in their lifetime, former smokers if they have had smoked regularly or occasionally in the past and before hospitalization.

Ethics

The ethics Committee of the Deputy of Research of Tehran University of Medical Sciences reviewed and approved the study protocol (Code: IR.TUMS.REC. 1394.659).

Statistical Analysis

To account for the non-normality of data on the cost (Shapiro Wilk test ($p<0.001$), Kruskal-Wallis test was used to explore the existence of any significant difference in hospitalization cost among different groups. To consider the skewed distribution of the costs, GLM with gamma and log-link were used. This model has been used as a good method for determining healthcare costs (11, 20, 21). The Modified Park Test confirmed gamma distribution at $p= 0.45$, and Pregibon Link-Test at $p= 0.24$ and Pearson Correlation Test at $p= 0.58$ confirmed the choice of the log link function.

The cost ratio (CR) was used to report the association between the dependent and independent variables. Thus, the CR equal to one showed no association between the dependent and independent variables. The CR higher than one indicated a positive relationship between the dependent and independent variables. The age of less than 35 years was used as an offset variable for the study population aged 35 years and above. For the cost data, the original Iranian Rials (IR) was used where during the study period 34,500 Rials were equal to US $1. The association was considered statistically significant at p-value of less than 0.05, and all analyses were done using Stata software version 12.

Results

A total of 1,271 patients with a mean±SD age of 62.5±10.8 years (age range of 35 to 93 years) were included in the study. Of whom, 415 (32.6 %) were diagnosed with LC, 427 (33.6 %) with COPD and 429 (33.8 %) with IHD. Men comprised of 67.6% (n= 860) of all the study patients. Besides, 70.8% of LC, 65% of IHD and 67.2% of COPD patients were among males. The mean±SD LoS was 9.4±8.4 days for current smokers, 7.3 ±5.3 days for former smokers, and 6.02±5.05 days for never smokers. The prevalence of current smoking patients was 33.9% while the prevalence of former and never smokers was 12 and 54.1%, respectively (Table 1).

The average cost of hospitalization was 34.5±32.4 million IR. However, the average cost of hospitalization was 45.6±41.8 million IR for current smokers, 34.9±23 million

[DOI: 10.14196/mjiri.31.63]

Table 1. Descriptive Characteristics of the Study Population

Variable		Total	Hospitalization Cost (%)			p*
		n (%)	Low	Middle	High	
Sex	Male	860 (67.6)	293 (34.07)	249 (28.95)	318 (36.98)	
	Female	411 (32.4)	131 (31.87)	175 (42.58)	105 (25.55)	0.059
Age (year)	35-64	719 (56.6)	228 (31.71)	232 (32.27)	259 (36.02)	
	>65	552 (43.4)	196 (35.51)	192 (34.78)	164 (29.71)	0.039
Hospital length of stay days	Less than 3	270 (21.2)	192 (71.11)	54 (20.00)	24 (8.89)	
	3-5	373 (29.4)	178 (47.72)	135 (36.19)	60 (16.09)	
	6-9	309 (24.3)	49 (15.86)	165 (53.40)	95 (30.74)	0.0001
	> 9	319 (25.1)	5 (1.57)	70 (21.94)	244 (76.49)	
Smoking Status	Never	688 (54.1)	280 (40.70)	254 (36.92)	154 (22.38)	
	Former	152 (12)	44 (28.95)	47 (30.92)	61 (40.13)	0.001
	Current	431(33.9)	100 (23.20)	123 (28.54)	208 (48.26)	
Type of diseases	COPD[a]	427 (33.6)	168 (39.34)	177 (41.45)	82 (19.20)	
	IHD[b]	429 (33.7)	133 (31.00)	128 (29.84)	168 (39.16)	0.001
	LC[c]	415 (32.7)	123 (29.64)	119 (28.67)	173 (41.69)	
Type of Hospital	Governmental	938 (73.8)	349 (37.21)	305 (32.52)	284 (30.28)	
	Armed Forces	56 (4.4)	29 (51.79)	19 (33.93)	8 (14.29)	
	Private	162 (12.7)	11 (6.79)	59 (36.42)	92 (56.79)	0.001
	Social Security	115 (9)	35 (30.43)	41 (35.65)	39 (33.91)	
Type of insurance	MSIO[1]	549 (43.2)	187 (34.06)	185 (33.70)	177 (32.24)	
	SSIO[2]	501 (39.4)	182 (36.33)	167 (33.33)	152 (30.34)	
	AMIO[3]	56(4.4)	22 (39.22)	21 (37.50)	13 (23.21)	
	Other	128 (10.1)	25 (19.53)	40 (31.25)	63 (49.22)	0.045
	Noninsurance	37 (2.9)	8 (21.62)	11 (29.73)	18 (48.65)	

[a] Chronic obstructive pulmonary disease; [b] Ischemic heart diseases; [c] Lung cancer; [1] Medical service insurance organization; [2] Social security insurance organization; [3] Armed Forces insurance organization

IR for former smokers and 27.6±24.6 million IR for never smokers, respectively. Furthermore, the average cost of hospitalization was 25.3±21 million IR for COPD, 39.1±37.2 million IR for IHD and 39.3 ± 34.7 million IR for LC patients, respectively. The results of GLM with gamma distribution and log link function of costs of hospitalization are presented in Table 2. The adjusted gamma regression model revealed that smoking status, LoS, type of disease and type of hospitals were associated with higher hospitalization cost.

Compared with never smokers, current and former smokers had 35 and 24% increased costs of hospitalization, respectively (p<0.001). LoS was associated with increased cost of hospitalization. The cost of hospitalization for patients with LoS between 3 and 5 days was 91% compared to those with LoS less than 3 days. In addition, the cost of hospitalization was statistically and significantly associated with type of hospitals (p<0.001). The average cost of hospitalization for private and social security hospitals was respectively 2.17 and 1.27 times higher than the cost of the patients admitted to the Armed Forces hospital.

Table 2. Results of GLM with Gamma Distribution and Log Link Function for Hospitalization Costs

Variable		Unadjusted IRR	Adjusted IRR
Sex	Female	1	1
	Male	1.21 (1.09 -1.35)	1.03 (0.95 – 1.12)
Age (year)	≥65	1	1
	35-64	1.12 (1.01 – 1.24)	1.06 (0.98-1.14)
Hospital length stay days	Less than 3	1	1
	3-5	1.42 (1.25-1.61)	1.91 (1.71-2.14)
	6-9	2.03 (1.77 – 2.32)	2.64 (2.35 – 2.97)
	> 9	3.98 (3.48 – 4.55)	5.22 (4.62 – 5.9)
Smoking Status	Never	1	1
	Former	1.26 (1.08 – 1.47)	1.24 (1.10 – 1.40)
	Current	1.65 (1.43 – 1.83)	1.35 (1.24 – 1.47)
Type of diseases	COPD[a]	1	1
	IHD[b]	1.54 (1.37 – 1.74)	1.4 (1.23 – 1.95)
	LC[c]	1.55 (1.37 – 1.75)	1.65 (1.55- 1.84)
Type of Hospital	Armed Forces	1	1
	Governmental	1.29 (1.03 – 1.66)	1.37 (1.05 – 1.80)
	Private	2.04 (1.54- 2.70)	2.17 (1.63 – 2.89)
	Social Security	1.38 (1.02 – 1.85)	1.27 (0.95- 1.70)
Type of insurance	AMIO[3]	1	1
	SSIO[2]	1.21 (0.93 – 1.57)	0.96 (0.73- 1.25)
	MSIO[1]	1.24 (0.96 – 1.61)	0.94 (0.72 – 1.23)
	Other	1.54 (1.14 – 2.07)	0.77 (0.57 – 1.04)
	Noninsurance	1.50 (1.01 – 2.22)	0.74 (0.52 – 1.05)

[a] Chronic obstructive pulmonary disease; [b] Ischemic heart diseases; [c] Lung cancer; [1] Medical service insurance organization; [2] social security insurance organization; [3] Armed Forces insurance organization

[DOI: 10.14196/mjiri.31.63]

Discussion

This study investigated the effect of smoking status on the cost of hospitalization from the provider's perspective in Iran. This study found that the total cost of hospitalization for the current and former smoker categories were respectively 65% and 26% higher in unadjusted model and 35% and 24% in the adjusted model higher than for the never smoker category of patients. These findings are in line with other studies that have reported increased costs in current and former smoker patients compared to never smokers (2, 11, 14, 15, 22). A study in Germany reported a positive association between history of smoking, and direct and indirect costs. The total annual costs were more than 20% and 35% higher for current and former smokers, respectively, compared with never smokers (11). Similarly, another study also found that costs for current and former smokers were significantly higher compared with never smokers. The monthly cost of hospitalization for current smokers was $400 higher than the costs for never smokers. However, the cost for former smokers was $273 higher than the costs for never smokers (14). In our study, the difference in cost of hospitalization between current and never smokers was 17.9 million IR, whereas the difference between former smokers and never smokers was 7.2 million IR.

Another factor affecting the cost of hospitalization was the LoS. Our findings revealed that the cost of hospitalization for patients with more than 9 days LoS was 5.2 times higher compared to those with LoS less than 3 days. The average LoS for current and former smokers was 9.4±8.4 days and 7.3±5.3 days, respectively, while for never smokers it was 6.02±5.05 days. This finding are consistent with the reports of previous studies in Japan (15) and USA (10) and Iran (22). Moreover, Izumi et al. found that the hospitalization rate of current plus former smokers was 26% (in males) and 22% (in females) higher than in never smokers (15). Overall, the hospitalization rate for current and former smokers was respectively 30% and 20% higher than in never smokers. A study in the United States on medical services utilization by smokers during 1999 to 2004 indicated that current smokers were more likely to be hospitalized than never smokers. Besides, outpatient visits for current smokers was four times higher than never smokers (9). Our study did not find any statistically significant relationship between age and sex and cost of hospitalization, which is consistent with findings of another study (23). However, there was a positive relationship between being male and age 35-64 years and cost of hospitalization. These findings can be explained by the fact that the prevalence of smoking for males is higher compared to the prevalence among females (42.8% vs. 15.3% or for more patients in the age category of 35-64 years compared to those over the age of 64 years (36.7% vs. 30.2%).

There are, however, some limitations to our study. This study was carried out in Tehran, so the generalizability of the findings is limited. Besides, the effect of severity of diseases on the cost of hospitalization was not adjusted because data for these factors were not available in the medical records of the patients. The self-reported smoking status of the patients through the telephone survey might have led to social desirability bias and under estimation of the prevalence of current and former smoking behavior of the patients. Furthermore, total costs of hospitalization might not reflect the actual hospital cost of smoking and did not include government subsidies to hospital services and all out of pocket payments by the patients. Indirect medical costs such as transportation and food costs and other indirect costs associated with loss of productivity due to disability and mortality were not included in the study as measuring these costs was beyond the scope of the study.

Conclusion

This study demonstrated that considerable costs of hospitalizations are attributable to smoking in Iran. The financial consequences of smoking on health system, especially on hospitals, and on the society as a whole are substantial. However, further studies are needed to investigate the impact of smoking status on healthcare utilization, physicians' visits, pharmaceutical costs and LoS. The current findings suggest the need for strong preventive measures for smoking and its negative economic consequences.

Acknowledgments

This article was part of a PhD thesis in Health Economics by Satar Rezaei, which was funded and supported by Tehran University of Medical Sciences, Tehran, Iran.

Conflict of Interests

The authors declare that they have no competing interests.

References

1. Beaglehole R, Bonita R, Horton R, Adams C, Alleyne G, Asaria P, et al. Priority actions for the non-communicable disease crisis. The Lancet. 2011;377(9775):1438-47.
2. Ross H, Trung DV, Phu VX. The costs of smoking in Vietnam: the case of inpatient care. Tob Control. 2007;16(6):405-9.
3. US Department of. Health and Human Services. The health consequences of smoking: a report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. 2004;62.
4. Rezaei S, Akbari Sari A, Arab M, Majdzadeh R, Mohammadpoorasl A. Estimating Economic Burden of Cancer Deaths Attributable to Smoking in Iran in 2012. J Res Health Sci. 2015;5(4):228-33.
5. Jia H, Lubetkin EI. Trends in quality-adjusted life-years lost contributed by smoking and obesity. Am J Prev Med. 2010;38(2):138-44.
6. Max W. The financial impact of smoking on health-related costs: a review of the literature. Am J Health Promot. 2001;15(5):321-31.
7. Rezaei S, Akbari Sari A, Arab M, Majdzadeh R, Poorasl AM. Economic burden of smoking: a systematic review of direct and indirect costs. Med J Islam Repub Iran. 2016; 30: 397.
8. Baliunas D, Patra J, Rehm J, Popova S, Taylor B. Smoking-attributable morbidity: acute care hospital diagnoses and days of treatment in Canada, 2002. BMC Public Health. 2007;7(1):1.
9. Kahende JW, Adhikari B, Maurice E, Rock V, Malarcher A. Disparities in health care utilization by smoking status–NHANES 1999-2004. Int J Environ Res Public Health. 2009;6(3):1095-106.
10. Robbins AS, Fonseca VP, Chao SY, Coil GA, Bell NS, Amoroso PJ. Short term effects of cigarette smoking on hospitalisation and associated lost workdays in a young healthy population. Tob Control. 2000;9(4):389-96.
11. Wacker M, Holle R, Heinrich J, Ladwig K-H, Peters A, Leidl R, et

[DOI: 10.14196/mjiri.31.63]

al. The association of smoking status with healthcare utilisation, productivity loss and resulting costs: results from the population-based KORA F4 study. BMC Health Serv Res. 2013;13(1):1.
12. Wagner EH, Curry SJ, Grothaus L, Saunders KW, McBride CM. The impact of smoking and quitting on health care use. Arch Intern Med. 1995;155(16):1789-95.
13. Weng SF, Ali S, Leonardi-Bee J. Smoking and absence from work: Systematic review and meta-analysis of occupational studies. Addiction. 2013;108(2):307-19.
14. Warner DO, Borah BJ, Moriarty J, Schroeder DR, Shi Y, Shah ND. Smoking status and health care costs in the perioperative period: a population-based study. JAMA Surg. 2014;149(3):259-66.
15. Izumi Y, Tsuji I, Ohkubo T, Kuwahara A, Nishino Y, Hisamichi S. Impact of smoking habit on medical care use and its costs: a prospective observation of National Health Insurance beneficiaries in Japan. Int J Epidemiol. 2001;30(3):616-21.
16. Akbari Sari A, Rezaei S, Arab M, Majdzadeh R, Matin B, Zandian H. Effects of Smoking on Cost of Hospitalization and Length of Stay among Patients with Lung Cancer in Iran: a Hospital-Based Study. Asian Pacific journal of cancer prevention: APJCP. 2016; 17(9):4421.
17. Meysamie A, Ghaletaki R, Haghazali M, Asgari F, Rashidi A, Khalilzadeh O, et al. Pattern of tobacco use among the Iranian adult population: results of the national Survey of Risk Factors of Non-Communicable Diseases (SuRFNCD-2007). Tob Control. 2010;19(2):125-8.
18. Hajizadeh M, Nghiem HS. Hospital care in Iran: an examination of national health system performance. Int J Healthc Manag. 2013;6(3):201-10.
19. Kang HY, Kim H, Park TK, Jee SH, Nam CM, Park HW. Economic burden of smoking in Korea. Tob Control. 2003; 12(1):37-44.
20.Diehr P, Yanez D, Ash A, Hornbrook M, Lin D. Methods for analyzing health care utilization and costs. Annu Rev Public Health. 1999; 20(1):125-44.
21. Barber J, Thompson S. Multiple regression of cost data: use of generalised linear models. J Health Serv Res Policy. 2004; 9(4):197-204.
22. Rezaei S, Akbari Sari A, Arab M, Majdzadeh R, Shaahmadi F, Mohammadpoorasl A. The Association between Smoking Status and Hospital Length of Stay: Evidence from a Hospital-Based Cohort. Hosp Pract. 2016;44(3):129-32.
23. Chow WL, Tin AS, Meyyappan A. Factors influencing costs of inpatient ischaemic stroke care in Singapore. PoSH. 2010;19(4):283-91.

[DOI: 10.14196/mjiri.31.63]