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Original Article / Özgün Makale

Effects of smoking ban in Turkey on patients with chronic obstructive pulmonary disease: A retrospective analysis

Türkiye'de sigara yasağının kronik obstrüktif akciğer hastalığı olan hastalar üzerindeki etkileri: Retrospektif bir analiz

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ABSTRACT

Background: This study aims to investigate whether smoking ban is effective in preventing chronic obstructive pulmonary disease.

Methods: This study, which was conducted between July 2008 and July 2013 at Istanbul Haydarpaşa Numune Training and Research Hospital, included 795 patients (454 males, 341 females; mean age 72.2±11.4 years; range 26 to 99 years) who were diagnosed with chronic obstructive pulmonary disease and had acute respiratory failure before and after the smoking ban of 16 July 2009. Patients' age, gender, socioeconomic status, smoking/cessation status, number of exacerbations, chest X-ray findings, arterial blood gas analyses, duration of hospital stay, and leukocyte count were recorded.

Results: There was a statistically significant difference in smoking status of patients before and after the smoking ban ($p=0.002$; $p<0.01$). The rate of smokers declined year by year, while there was an increase in the rate of ex-smokers. The number of exacerbations in one year before the smoking ban was higher compared to the number of exacerbations in one year after the smoking ban, although the difference was close to statistical significance ($p=0.061$; $p>0.05$).

Conclusion: Our study demonstrated that smoking ban reduced the number of patients with chronic obstructive pulmonary disease and number of exacerbations. Therefore, we suggest that prohibiting the use of tobacco products is an important part of the strategy toward the prevention of this disease.

Keywords: Chronic obstructive pulmonary disease; smoking ban; Turkey.

ÖZ

Amaç: Bu çalışmada sigara yasağının kronik obstrüktif akciğer hastalığını önlemede etkili olup olmadığı araştırıldı.

Çalışma planı: Temmuz 2008 - Temmuz 2013 tarihleri arasında İstanbul Haydarpaşa Numune Eğitim ve Araştırma Hastanesinde yapılan bu çalışmaya 16 Temmuz 2009 tarihindeki sigara yasağından önce ve sonra kronik obstrüktif akciğer hastalığı tanısı konmuş ve akut solunum yetersizliği olan 795 hasta (454 erkek, 341 kadın; ort. yaş 72.2±11.4 yıl; dağılım 26-99 yıl) dahil edildi. Hastaların yaşı, cinsiyeti, sosyoekonomik düzeyi, sigara içme/bırakma durumu, atak sayısı, akciğer grafisi bulguları, arteriyel kan gazı analizi, hastanede kalış süresi ve lökosit sayısı kaydedildi.

Bulgular: Sigara yasağı öncesi ve sonrasında hastaların sigara içme durumunda istatistiksel olarak anlamlı farklılık vardı ($p=0.002$; $p<0.01$). Sigara içenlerin oranı yıldan yıla azalırken sigarayı bırakanların oranında artış vardı. Sigara yasağı öncesinde bir yılda geçirilen atak sayısı sigara yasağı sonrası bir yılda geçirilen atak sayısından yüksek olmakla beraber farklılık istatistiksel olarak anlamlılığa yakın idi ($p=0.061$; $p>0.05$).

Sonuç: Çalışmamız sigara yasağının kronik obstrüktif akciğer hastalığı olan hastaların sayısını ve atak sayısını azalttığını gösterdi. Bu nedenle, tütün ürünlerinin kullanımının yasaklanmasının bu hastalığın önlenmesine yönelik stratejinin önemli bir parçası olduğunu önermekteyiz.

Anahtar sözcükler: Kronik obstrüktif akciğer hastalığı; sigara yasağı; Türkiye.

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Chronic obstructive pulmonary disease (COPD) is a common and preventable disease characterized by progressive and permanent obstruction of the airways and lungs due to exposure to noxious gases and particles.[1] It is a chronic inflammatory disease characterized by increased neutrophil, macrophage, and T-lymphocyte count (particularly cytotoxic T lymphocytes; $CD8^+$) in the lungs with the effects of inflammatory mediators, mainly cytokines, chemokines, and oxidants.[1] The disease has been defined as a preventable and treatable disease by the Global Initiative for Chronic Obstructive Lung Disease and notable extrapulmonary effects are determinant factors for disease severity.[2] Acute respiratory failure, changes in mental status and hemodynamic fluctuations occurring during acute exacerbations of COPD often require careful treatment in the intensive care unit.[3] Projections to 2020 suggest that COPD will be ranked third among all causes of death and fifth among all causes of disabilities worldwide, if smoking is not prevented. Smoking cessation has been shown to decrease the risk of developing COPD and this step is the main treatment of this inflammatory disease.[4] Smoking cessation also decreases the prevalence of respiratory symptoms, number of hospitalizations, forced expiratory volume in 1 second and number of exacerbations, and all-cause mortality.[4] Of patients with COPD, 38 to 77% are smokers.[4]

Since the treatment of COPD is also expensive, cessation of smoking appears as the most effective way to prevent COPD. The smoking ban in indoor areas and public places came into effect in Turkey for the first time in 2008, and these bans were later extended to include cafes, restaurant, bars, and night clubs on 16 July 2009.[5] After the enactment of the smoking ban on 16 July 2009, we investigated how patients with COPD were affected by these bans, as smoking is closely related with the etiology of COPD. Therefore, in this study, we aimed to investigate whether smoking ban is effective in preventing COPD.

PATIENTS AND METHODS

The study included a total of 795 patients (454 males, 341 females; mean age 72.2±11.4 years; range 26 to 99 years) who were diagnosed with COPD at University of Health Sciences, Haydarpaşa Numune Training and Research Hospital of the University of Health Sciences between July 2008 and July 2013 or who presented with this clinical picture and had acute respiratory failure and were admitted to the hospital. Patients who were admitted to the hospital in this period due to chest tightness, worsening in the shortness of breath, wheezing, and expectoration, and who did not sufficiently respond to bronchodilators comprised the study population. During a retrospective review of the medical charts, the number of patients by years, socioeconomic statuses, smoking/cessation statuses, number of episodes, chest X-ray findings, arterial blood gas analyses, and leukocyte counts before and after the smoking ban were recorded.

A written informed consent was obtained from each patient. The study protocol was approved by the University of Health Sciences, Haydarpaşa Numune Training and Research Hospital Ethics Committee. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical analysis

Statistical analysis was performed using the NCSS (Number Cruncher Statistical System) version 2007 (Kaysville, Utah, USA) software. Descriptive data were expressed in the mean, standard deviation, median, frequency, rate, minimum, and maximum. One-way analysis of variance was used to compare the quantitative data between three or more groups showing normal distribution, and Tukey's honest significant difference test and Games-Howell test were used to determine the source of the difference. Kruskal-Wallis test was used to compare three or more groups with abnormal distribution, while Mann-Whitney U test was used to determine the source of difference. The Pearson's chi-square and Fisher-Freeman-Halton test was used to compare the qualitative data. P values of <0.01 and <0.05 were considered statistically significant.

RESULTS

Of the patients, 22.3% (n=177) were admitted to the hospital before the smoking ban, while 77.7% (n=618) were admitted after the ban. The rate of smokers was 19% (n=151), the rate of non-smokers was 51.1% (n=406), and the rate of ex-smokers was 20.1% (n=160). Chest X-rays revealed abnormal findings in 96.4% (n=766) of the patients and normal findings in 2.4% of the patients. However, chest X-rays were not available in 1.3% (n=10). Oxygen saturation ranged from 35.2 to 90.8% with a mean oxygen saturation value of 87.2±13.0%. The mean partial pressure of carbon dioxide was 47.5±15.9 (range 4.3 to 99.6). The mean length of hospital stay was 10.6±9.4 days (range 0 to 75 days) (Table 1).

There was a statistically significant difference in smoking status according to the smoking ban ($p=0.002$; $p<0.01$). The rate of smokers declined every

Table 1. Descriptive statistics

	n	%	Mean±SD	Median	Min-Max
Age (year)			72.2±11.4	74.50	26-99
Gender					
Female	341	42.9			
Male	454	57.1			
Result of chest X-ray					
Unknown	10	1.3			
Negative	19	2.4			
Positive	766	96.4			
Smoking bans					
Before bans	177	22.3			
After bans	618	77.7			
Smoking status					
Smoker	151	19.0			
Non-smoker	406	51.1			
Ex-smoker	78	9.8			
Unknown	160	20.1			
Length of hospital stay			10.6±9.4	8.0	0-75
O_2 saturation			87.2±13.0	92.00	35.20-99.80
pCO_2			47.5±15.9	44.50	4.25-99.60
pH			7.4±0.1	7.38	6.87-7.77

SD: Standard deviation; Min: Minimum; Max: Maximum; O_2: Oxygen; pCO_2: Partial pressure of carbon dioxide.

year. The comparison of patient characteristics before and after the smoking ban was presented in Table 2a. The comparison of the length of hospital stay before and after the ban was presented in Table 2b.

There was a significant change in the number of patients admitted to the hospital due to COPD and acute respiratory failure in relation to the smoking ban (p=0.001; p<0.01) (Table 3). The number of patients before the smoking ban was significantly higher than the number of patients at three and four years after the enactment of the smoking ban (p=0.001 and p=0.004; p<0.01). The number of patients at one year after the smoking ban was significantly higher than the number of patients before the ban and at three and four years after the ban (p=0.011; p=0.001; p=0.001; p<0.05). The number of patients at one year after the smoking ban was remarkably higher than the number of patients at two years after the ban, although the difference was not statistically significant (p=0.082; p>0.05). The number of patients at two years after the smoking ban was significantly higher than the number of patients at three and four years after the ban (p=0.001; p=0.001; p<0.01) (Table 3). There was no significant difference in the place of residence, number of episodes, and smoking status before and after the smoking ban (p>0.005) (Table 4). The number of episodes per year before the smoking ban was not significantly higher than the number of episodes per year after the ban; however, the difference was close to the statistical significance (p=0.061; p>0.05) (Table 5). There was no significant relationship between the smoking status and the number of episodes (p>0.005) (Table 6).

DISCUSSION

Smoking is the leading risk factor for COPD and smoking cessation is considered the first step in preventing COPD. Therefore, the Smoke-Free Partnership and European Heart Network established by the European Respiratory Society, French National Cancer Institute, and United Kingdom (UK) Cancer Research Institutions have recently published a report titled: "Lifting the smokescreen: 10 reasons for a Smoke-Free Europe" to control smoking. The report, presented in the Parliament of Europe in Brussels, is aimed at European politicians and those in other countries to support and implement anti-smoking legislations.[6] The report by general surgeons to reduce the use of tobacco products in 2000 was also taken into consideration.[7] On 16 November 2004, a proposal was submitted in the UK to put up anti-smoking notices almost at all public places, and this ban was later extended gradually until 2008.[8] Humair et al.[9] reported a remarkable decrease in the number of hospital admissions related to acute exacerbations of COPD after the enactment of the smoking ban in

Table 2. (a) Comparison of certain characteristics before and after smoking bans

	Smoking status						
	Smoker		Non-smoker		Ex-smoker		
	n	%	n	%	n	%	*p**
[1]Before smoking bans	33	26.8	67	54.5	23	18.7	0.002**
[2]1 year after smoking bans	34	19.1	126	70.8	18	10.1	
[3]2 years after smoking bans	39	32.5	66	55.0	15	12.5	
[4]3 years after smoking bans	24	28.9	55	66.3	4	4.8	
[5]4 years after smoking bans	21	16.0	92	70.2	18	13.7	

* Pearson's Chi-square test; ** p<0.01.

Table 2. (b) Evaluation of length of hospital stay before and after smoking bans

	Length of hospital (Day)				
	Mean±SD	Median	Min-Max	*p	Paired comparisons
[1]Before smoking bans (n=177)	10.5±8.4	9.0	0-55	0.280	1-2=0.864
[2]1 year after smoking bans (n=208)	11.3±10.1	9.0	1-66		1-3=0.062
[3]2 years after smoking bans (n=175)	9.8±10.0	7.0	0-75		1-4=0.745
[4]3 years after smoking bans (n=97)	10.7±9.5	8.0	0-55		1-5=0.692
[5]4 years after smoking bans (n=138)	10.6±8.8	9.0	1-53		2-3=0.051
					2-4=0.685
					2-5=0.627
					3-4=0.186
					3-5=0.148
					4-5=0.985

SD: Standard deviation; Min: Minimum; Max: Maximum; * Kruskal-Wallis test.

Geneva. This report clearly indicated that smoking ban could be particularly beneficial to patients with COPD. Tran et al.[10] also suggested that smoking cessation could reduce the risk of developing chronic diseases such as congestive heart failure, diabetes, and COPD in the Australian male and female population aged above 45 years, and even in the elderly. Hence, the use of tobacco products in indoor areas and public places has been prohibited, advertisements have been banned, and other protective measures have been implemented to control the hazards of tobacco products with the amendments dated 16 July 2009,

Table 3. Distribution of hospital admission before and after smoking bans

	COPD					
	With illness		Without illness			
	n	%	n	%	*p‡*	Paired comparisons
[1]Before smoking bans	177	0.5	34607	99.5	0.001**	1-2=0.011*
[2]1 year after smoking bans	208	0.7	31339	99.3		1-3=0.442
[3]2 year after smoking bans	175	0.6	31520	99.4		1-4=0.001**
[4]3 year after smoking bans	97	0.3	33451	99.7		1-5=0.004**
[5]4 year after smoking bans	138	0.4	37538	99.6		2-3=0.082
						2-4=0.001**
						2-5=0.001**
						3-4=0.001**
						3-5=0.001**
						4-5=0.073

COPD: Chronic obstructive pulmonary disease; ‡ Pearson's chi-square; * p<0.05; ** p<0.01.

Table 4. Comparison of distribution of certain characteristics before and after smoking bans

	Smoking bans				
	Before (n=49)		After (n=171)		
	n	%	n	%	*p*
Place of residence					0.581*
Unknown	1	2.0	9	5.3	
Low	11	22.4	46	26.9	
Moderate	37	75.5	112	65.5	
High	0	0.0	4	2.3	
Number of episodes					0.184*
No episodes	5	10.2	32	18.7	
1 episode	38	77.6	129	75.4	
2 episodes	6	12.2	9	5.3	
3 episodes	0	0.0	1	0.6	
Smoking status					0.993**
Smoker	15	30.6	54	31.6	
Non-smoker	14	28.6	51	29.8	
Ex-smoker	10	20.4	34	19.9	
Unknown	10	20.4	32	18.7	

* Fisher-Freeman-Halton Test; ** Pearson's chi-square test.

in the "The Law on Prevention and Control of Hazards of Tobacco Products," Law No: 4207, dated 19 January 2008.[11]

Since COPD has significant social and economic burden, cost-efficacy analyses are necessary. In Turkey, Hacievliyagil et al.[12] calculated the hospitalization costs of 314 patients at the Department of Pulmonary at Inönü University Faculty of Medicine between 1 January and 30 April 2005. The highest costs associated with medication and radiological investigations were observed in patients with lung cancer, while the highest hospital bed costs were noted for patients with pulmonary embolism and pneumonia. According to this study, when the total costs of all patients were calculated, COPD patients had the highest costs.

Smoking cessation is a more challenging process in patients with COPD, compared to other people. The reasons for this may include lower educational status, cumulative cigarette consumption, and depressive mood. Thus, more aggressive smoking cessation methods should be used in smoker patients with COPD, and behavioral therapy and drug therapy (i.e. nicotine replacement therapy, varenicline, bupropion) should be combined with strong motivation. A study conducted by Tashkin and Murray[13] in the Netherlands reported a 42% smoking cessation rate in one year among smoking patients with COPD; however, this rate was reported to be 68% in patients without COPD. In another study conducted by the same author, smoking cessation rate was lower in females with COPD due to fear of weight gain, compared to male patients.[14] The study by Solak et al.[15] reported a higher smoking cessation rate with the participation of smokers in smoking cessation programs, regular follow-up, and motivational support; however, they concluded that the presence of smoking-related diseases in any of the family members of an individual had no effect on the success of smoking cessation. Solak et al.[16] also reported that professional support increased the success of smoking cessation attempts in cases

Table 5. Comparison of number of episodes before and after smoking bans

	Smoking bans						
	Before (n=49)			After (n=171)			
	Mean±SD	Median	Min-Max	Mean±SD	Median	Min-Max	*p*
Number of episodes	1.0±0.5	1	0-2	0.9±0.5	1	0-3	0.061

SD: Standard deviation; Min: Minimum; Max: Maximum; Mann-Whitney U test.

Table 6. Comparison of number of episodes according to smoking status

	Smoking status																				
	Smoker (n=69)					Non-smoker (n=65)					Ex-smoker (n=44)					Unknown (n=42)					
	n	%	Mean±SD	Median	Min-Max	n	%	Mean±SD	Median	Min-Max	n	%	Mean±SD	Median	Min-Max	n	%	Mean±SD	Median	Min-Max	*p*
Number of episodes			0.9±0.4	1	0-2			0.9±0.6	1	0-2			0.9±0.4	1	0-2			10.0±0.6	1	0-3	0.916*
No episode	10	14.5				13	20.0				7	15.9				7	16.7				
1 episode	57	82.6				45	69.2				35	79.5				30	71.4				0.426**
2 episodes	2	2.9				7	10.8				2	4.5				4	9.5				
3 episodes	0	0.0				0	0.0				0	0.0				1	2.4				

SD: Standard deviation; Min: Minimum; Max: Maximum; * Kruskal-Wallis test; ** Fisher-Freeman-Halton test.

with COPD; however, they concluded that the rate of smoking cessation was lower despite intensive support and regular follow-up, compared to healthy smokers (49% versus 29%). On the other hand, the present study evaluated how the smoking ban affected patients with COPD and found a statistically significant relationship between the rate of COPD among the hospitalized patients and the smoking ban (p=0.001; p<0.01). In this study we found that there was a statistically significant difference in regard to number of COPD patients admitted to the Hospital between two periods before and after the smoking ban in Turkey. There was statistically significant decline in the number of COPD cases in the third and fourth years when compared to period before the smoking ban. Also there was significant decline in COPD cases in the third and fourth years when compared to the second year following the ban. Another important finding is that the number of episodes per year before the smoking ban was higher (close to the statistical significance) than the number of episodes per year after the ban, when episodes of COPD were evaluated in 220 randomly-selected cases. These findings are consistent with the findings of Humair et al.[9] published in 2014.

In another study, Abu Hassan et al.[17] evaluated the effects of smoking cessation on the quality of life of patients with COPD using the Clinical COPD Questionnaire. We also suggest that decreased number of episodes after the smoking ban favorably influenced the quality of life of the patients. On the other hand, we consider that the smoking ban may have favorably influenced the treatment-related costs based on our data and the findings of the study by Hacıevliyagil et al.[12] However, further large-scale, prospective surveys and studies for the quality of life and cost analysis are required to establish a conclusion.

Cigarette smoke contains more than 4,000 chemical compounds including strong respiratory tract irritants, and exposure to cigarette smoke results in serious illnesses and decreases survival. Significant health benefits are achieved even within a month in a smoke-free workplace. Considering these findings, it appears reasonable to enact the smoking ban in the workplace.[18] Smoke-free workplace legislation proved effective in reducing exposure to second-hand smoke.[18] Second-hand smoke at the workplace is associated with a more severe exposure compared to exposure at home and it is a stronger predictor of respiratory morbidity.[18] This difference originates from both more intense and sustained exposure to cigarette smoke. The exposure to cigarette smoke at

the workplace can be regarded as an "occupational disease," similar to hazards caused by exposure to hazardous dusts and gases.[19]

Comprehensive legislation has been prepared within the scope of the Framework Convention on Tobacco Control prepared by the World Health Organization to protect individuals against the hazardous effects of second hand smoking.[20-22] In 2015, Navas-Acien et al.[23] conducted a cross-sectional study on the ban on smoking in governmental buildings in Turkey and recommended that indoor areas, places near entrances, as well as patios and gardens, should be included in the scope of the smoking ban to prevent second-hand smoking.

This study has some limitations about the present study which number of cases before smoking ban is less than the number of cases after the ban.

In conclusion, smoking is the major cause of chronic obstructive pulmonary disease, which requires a long-term, difficult, and expensive treatment. The present study found that smoking ban resulted in reduced number of patients with chronic obstructive pulmonary disease and disease episodes. Therefore, the prevention of the use of tobacco products is an important part of the strategy toward disease prevention.

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