

ORIGINAL ARTICLE

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The costs of asthma disease on the healthcare system

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Abstract

Asthma is a lung disease characterized by coughing, episodic wheezing and shortness of breath resulting from airway inflammation and hypersensitivity. It is thought that both the incidence and prevalence of asthma increase depending on the increase in lifestyle and environmental risk factors. In this study, we aimed to analyze the cost of patients with asthma in our country and to consider the reasons that increase the cost of asthma. The data of 100 patients (fifty female and fifty male) followed up with a diagnosis of asthma were analyzed in this study. The mean total cost of antibiotics was 1278.157±3645.403. The mean hospital costs of the patients were 2623.022±7519.284 and the mean intensive care unit (ICU) cost of the asthmatic patients in the ICU was 9557.877±114371.217. Statistically significant relations were detected between length of stay in hospital and total hospital cost (THC) ($P=0.000$), length of stay in the ICU and THC ($p=0.000$), length of stay in the service and THC ($p=0.011$), antibiotic use and THC ($p=0.018$) and total cost of ICU stay and THC. Asthma affects people at various levels and causes significant costs on governments. Effective management of the disease can be achieved by eliminating and preventing both internal and external factors causing the disease and improving asthma education.

Keywords: Asthma, burden of asthma, hospital cost

Introduction

Asthma is a one of the most common chronic lung diseases defined with cough, episodic wheeze and breathlessness caused from airway inflammation and hyperresponsiveness [1]. The geographic distribution of asthma varies from by state (4.9% to 12.7%), sex (6.2% in males and 10.4% in females), and those below the poverty line (11.8%). Despite the wide variety of treatment options, nearly half of adults with asthma had one or more attacks in the previous year, emphasizing the importance of symptom management and disease control [2]. It was reported that more than 9% of children under 18 years old suffer from asthma, especially its' ratio among some racial groups is higher in the United States [3]. It was thought that both asthma incidence and prevalence have increased depending on the rising of lifestyle and environmental risk factors. In particular, the increasing number of emergency department

applications from children with poorly controlled asthma puts pressure on the health system due to increased costs [4]. It was estimated that the mean cost of patient with asthma (with intermittent, mild, moderate or severe persistent asthma) between 2008-2013 was \$3 billion in losses caused by missed work and school days, \$29 billion caused by asthma-related mortality and \$50.3 billion in medical costs. In the United States, the total cost of asthma was \$81.9 billion \$ in 2013 [5]. High-risk patients can be identified and cost-effective home visiting programs can be offered to improve quality of life and social benefits from a chronic illness such as asthma, reduce costs for insurance providers, and enable patients and their families to benefit from many services [6].

Making the necessary programs to reduce the prevalence of asthma, in addition to reducing costs, is of great importance not only in terms of reducing the morbidity caused by asthma but also obtaining many quality of life and social benefits for patients. Studies on the determination of the main factors affecting the cost in asthma treatments may help reduce the costs and loss of workforce caused by asthma, as well as lead to the fair and effective use of scarce health resources by assisting future clinical and economic studies. Therefore in this study, we aim to analyze

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the cost of patients with asthma and to be taken into consideration of the reasons that increase the cost of asthma in our country.

Materials and Methods

The current study was performed in the chest diseases clinic of hospitals affiliated to the ministry of health in Konya province, between 1 January 2018-31 December 2018. The data of 100 patients (fifty women and fifty men) who were followed up with asthma were included and analyzed in the current study. The current study was conducted with the permission and approval of Konya Provincial Health Directorate commission and provincial health director with the following date and numbered (Date:05/07/2018/ Number:16-03).

73 patients with moderate and severe asthma attacks, and 27 patients with life-threatening exacerbations who were followed-up-treated in the intensive care unit were included in the current study. Patients who did not have asthma and who were admitted to the hospital and/or hospitalized for reasons other than asthma were not included in this study.

Demographical features (such as age, length, weight and gender) of the patients, the number of outpatient apply, total number of hospitalizations in the last two years, length of hospitalization in intensive care, additional diseases in addition to asthma, types of antibiotics used, daily and total costs of antibiotics used, duration of antibiotics total hospitalization cost, total hospitalization cost of intensive care were recorded. Costs were stated in US dollars. Cost data of patients with more than one hospitalization were entered separately.

Statistical Analysis

The data were analyzed via "SPSS (Statistical Package for Social Sciences) for Windows 22.0 (SPSS Inc, Chicago, IL)". Descriptive statistics were performed. The suitability of variables to normal distribution was examined using visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov / Shapiro-Wilk Test). Pearson Chi-Square Test was used

to evaluate categorical variables. The Mann-Whitney U Test was used as a statistical method for statistical significance between two independent groups. Also polynomial regression test was performed. The $p < 0.05$ was accepted as statistically significant.

Results

A total of 100 patients with a diagnosis of asthma, 50 of whom were male and 50 of them were female were included in the current study. The mean age of the patients was 68.790 ± 12.552 . The mean length and weight of the patients were 166.507 ± 8.307 and 76.945 ± 14.025 , respectively.

The mean number of outpatient clinic apply of patients with asthma in the last two years was 11.290 ± 6.325 , while the mean number of hospitalizations in the last two years was 2.441 ± 1.363 days. The mean length of stay in the intensive care unit (ICU) was 9.240 ± 17.517 days. The mean length of service stay was 7.957 ± 5.925 .

The mean hospital costs of the patients was 2623.022 ± 7519.284 and the mean ICU cost of the patients with asthma who stayed in the ICU was 29557.877 ± 114371.217 . The mean duration of antibiotic use, antibiotic daily cost and antibiotic total cost were 8.089 ± 5.886 , 9.736 ± 0.936 and 1278.157 ± 3645.403 , respectively.

The 93% of patients diagnosed with asthma had at least one additional disease. In these diseases, hypertension was 42%, COPD was 15%, diabetes mellitus was 27%, heart failure was 21%, chronic renal failure was 4%, bronchitis was 8% and others (goiter, appendicitis, cholecystitis, gastric hernia, bladder tumor, rheumatoid arthritis, cerebrovascular disease) was 10%. In those diseases; hypertension took the first place with 42%, followed by diabetes mellitus with 27%, heart failure with 21% and COPD with 15%. The least common additional diseases were bronchitis (8%) and chronic renal failure (4%). The demographical features, antibiotic use, length and cost of stay at the healthcare institution level where COPD patients apply according to sex of patients with asthma were given in table 1.

Table 1. Demographical features, antibiotic use, length and cost of stay at the healthcare institution level where Asthma patients apply according to sex

Parameters	Sex		Z	p
	Male (n=50)	Female (n=50)		
Age (year)	68.22±13.012	69.36±12.179	-0.259	0.796
Length	171.313±4.736	157.280±5.311	-6.824	0.000*
Weight	76.229±6.563	78.32±22.422	-0.396	0.692
The outpatient clinic apply number in last 2 years	11.8±5.98	10.78±6.674	-0.767	0.443
The mean length of hospitalization (day)	8±5.115	11.480±13.371	-0.072	0.943
The mean length of stay in ICU	6.222±6.058	10.938±21.514	-0.733	0.464
The mean length of service stay	7.255±4.183	8.674±7.27	-0.258	0.796
Total hospitalization cost	1425.417±1198.22	3772.722±10382.413	-1.297	0.195
Total ICU stay cost	80056.334±207125.056	7464.803±17723.81	-0.200	0.841
Antibiotic Use Time (day)	7.445±2.766	8.571±7.441	-0.813	0.416
Antibiotic Using Cost (day)	9.656±1.400	9.793±0.351	-0.301	0.763
Total antibiotic cost	1745.446±4115.484	939.776±3297.775	-1.465	0.143

n: Number of patients; *Mann-Whitney U Test; ICU: Intensive Care Unit

The antibiotic treatment was applied to 50.0% of the patients examined within the scope of the study. The mean duration of antibiotic use was 68.089 ± 5.886 days, daily cost of antibiotics used was 9.736 ± 0.936 and the total cost of the antibiotic used was 1278.157 ± 3645.403 . Looking at the antibiotics used; while Cefaks (Sefuroksim Sodyum 750 mg) was applied to 9% of the patients, Desefin (Seftriakson 1000 mg) was applied to 13% of the patients, Eqiceft (Seftriakson 1000 mg) was applied 1% of the patients, Seffur (Sefuroksim Sodyum 750 mg) was applied in the 27% of patients.

Statistically significant relations between hospitalization length

and THC ($p=0.000$), the mean length of stay in ICU and THC ($p=0.000$), the length of service stay and THC ($p=0.011$), antibiotic use and THC ($p=0.018$) and total ICU stay cost and THC ($p=0.000$) were detected (Table 2).

The asthma causes and triggers (Smoking, Pollutions, Household Chemicals, Genetic Predisposition, Bacteria and Viruses, Fatty Foods, Dusts and Pets), statistically significant relations between hospitalization length and THC (a), the length of service stay and THC (b), the mean length of stay in ICU and THC (c), antibiotic use and THC (d), total ICU stay cost and THC (e) were given in figure 1.

Table 2. Model Summary and Parameter Estimates for total hospitalization cost, the mean length of hospitalization (day), the mean length of stay in ICU, the mean length of service stay, antibiotic use and total ICU stay cost

Model Summary						Parameter Estimates				
	Equation	R2	F	df1	df2	sig	Constant	b1	b2	b3
Hospitalization length and THC	Linear	.742	276.507	1	96	.000	-3468.404	637.777		
	Log	.198	23.704	1	96	.000	-5493.872	4175.734	-1.890	.099
	Cubic	.920	359.367	3	94	.000	37.705	215.295		
The mean length of stay in ICU and THC	Linear	.975	842.424	1	22	.000	-1007.975	802.115		
	Log	.491	21.242	1	22	.000	-4903.213	8348.018	27.235	-.220
	Cubic	.987	501.929	3	20	.000	1165.325	110.443		
The length of service stay and THC	Linear	.044	4.055	1	89	.047	1127.338	91.139		
	Log	.006	.517	1	89	.474	1369.707	262.842	47.895	-.840
	Cubic	.120	3.949	3	87	.011	3292.612	-587.483		
Antibiotic use and THC	Linear	.017	.784	1	46	.381	4889.246	-223.563		
	Log	.115	6.006	1	46	.018	12007.569	-4820.407	345.613	-6.515
	Cubic	.175	3.107	3	44	.036	20142.227	-4968.135		
Total ICU stay cost and THC	Linear	.014	.294	1	21	.593	5993.751	.015		
	Log	.274	7.910	1	21	.010	-22380.606	3810.878	.000	-3.312
	Cubic	.999	15051.853	2	20	.000	565.923	1.010		

ICU: Intensive Care Unit

THC: Total hospitalization cost

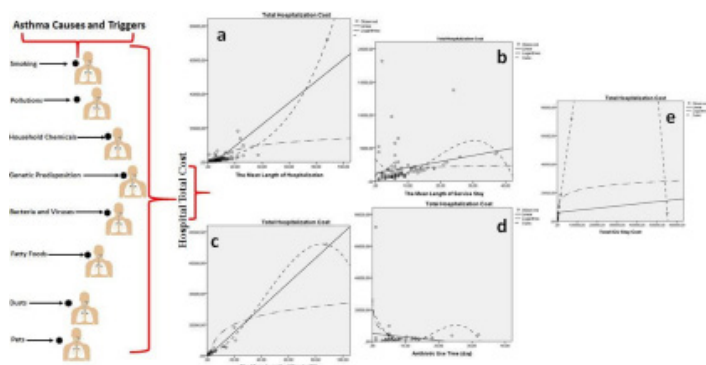


Figure 1. Asthma causes and triggers (Smoking, Pollutions, Household Chemicals, Genetic Predisposition, Bacteria and Viruses, Fatty Foods, Dusts and Pets), statistically significant relations between hospitalization length and THC (a), the length of service stay and THC (b), the mean length of stay in ICU and THC (c), antibiotic use and THC (d), total ICU stay cost and THC (e) were detected

Discussion

As a chronic disease, Asthma is defined with abnormal physiological function of the lungs. Severe asthmatics constitute 5-15% of all individuals with asthma worldwide, and these individuals are at high risk for exacerbations and poor quality of life [7]. The prevalence of treatable asthma is approximately 4.5% in adults and may vary geographically from 1% to 22% [8]. It is widely accepted that asthma and COPD can coexist as asthma COPD overlap. In addition to asthma and COPD, the complaining of respiratory symptoms (cough, sputum, dyspnea) or with airflow limitation can cause other diseases such as obstructive bronchiolitis, bronchiectasis, diffuse panbronchiolitis, congenital sinobronchial syndrome, congestive heart failure pulmonary tuberculosis, pneumoconiosis, pulmonary lymphangiomyomatosis, interstitial lung disease, and lung cancer [9]. According to our

results, the 93% of patients diagnosed with asthma had at least one additional disease such as hypertension, COPD, diabetes mellitus, heart failure, chronic renal failure, bronchitis and others (goiter, appendicitis, cholecystitis, gastric hernia, bladder tumor, rheumatoid arthritis, cerebrovascular disease) diseases. In those diseases; hypertension took the first place with 42%, followed by diabetes mellitus with 27%, heart Failure with 21% and COPD with 15%. The least common additional diseases were bronchitis (8%) and chronic renal failure (4%).

Most studies suggest that targeted biological therapies with a population-specific response can be achieved, or that the costs of the therapeutic approach should be reduced further. Although the quality of the studies performed was generally satisfactory, further improved evidence is needed to link health-related quality of life to public services and to further understand the impact of interventions on asthma-related mortality [10]. The majority of cases with asthma can be controlled via treatment steps in the Global Initiative for Asthma (GINA) guidelines. These steps involve short-acting beta-agonists, low-dose inhaled corticosteroids, low-dose ICS in combination with long-acting beta-agonists and low-dose inhaled corticosteroids / long-acting beta-agonists medium/high dose, respectively [11]. Allergen immunotherapy is cost-effective compared to standard drug treatment in the treatment of allergic rhinitis and asthma. The magnitude of the cost-effectiveness of allergen immunotherapy has probably been underestimated, as most studies have considered costs during treatment and not the long-term benefits or preventive/prophylactic effects of allergen immunotherapy [12]. It was reported that 8788 (44%) of 19811 cases hospitalized for an asthma exacerbation treated with corticosteroids received antibiotics [13]. According to our results, the antibiotic treatment was applied to 50.0% of the patients examined within the scope of the study. When the antibiotics used to be considered; while Cefaks (Sefuroksim Sodyum 750 mg) was applied to 9% of the patients, Desefin (Seftriakson 1000 mg) was applied to 13% of the patients, Egiceft (Seftriakson 1000 mg) was applied 1% of the patients, Seffur (Sefuroksim Sodyum 750 mg) was applied in the 27% of patients.

Epidemiological studies show that there is a significant increase in asthma prevalence all over the world and the economic burden of the disease. Access to health care, improving asthma education, removing ethnic disparities in asthma treatment and management can help prevent the increased costs associated with controlling, improving outcomes and effective management of this common disease [14]. The estimated annual cost of asthma in a Brazilian study population has been reported to have a significant impact on the family budget. This cost was higher in adult patients with more than 20 years of illness, obese or overweight individuals, and those with more severe or worse asthma. The cost units with the greatest potential impact on the total cost of the disease were asthma medications, long hospitalization, environmental control measures and rhinitis medications. Asthma medications, environmental control measures, and long-term health clearances had the greatest potential impact on overall cost variation [15]. It was estimated that the mean cost of patient with asthma (with intermittent, mild, moderate or severe persistent asthma) between 2008-2013 was \$3 billion in losses caused by missed work and school days, \$29 billion caused by asthma-related mortality and \$50.3 billion in medical costs. In the United States, the total cost of asthma was

\$81.9 billion \$ in 2013 [5]. According to our results, the median hospital costs of the patients examined within the scope of the study was 1029.91 and the median ICU cost of the patients with asthma who stayed in the ICU was 1497.150. The median duration of antibiotic use, antibiotic daily cost and antibiotic total cost were 7, 9.59 and 67.130, respectively. Also, there were statistically significant relations between hospitalization length and THC, the mean length of stay in ICU and THC, the length of service stay and THC, antibiotic use and THC and total ICU stay cost and THC. Among patients who hospitalized in ICU, total hospital cost was significantly higher than those who did not. Additionally, when the length of hospitalization of cases with asthma increased, the total cost of the hospital increased significantly, too. It can be said that when the number and duration of patients hospitalized increased, the total cost of the hospital increased, too.

The limitations of our study are that it was conducted in only one province of our country (Konya), limited long-term clinical follow-up data, small sample size compared to other drug trials, limited knowledge about the side effects.

Conclusion

Asthma affects individuals at various levels, cause important costs over the state from hospitals. The frequency of hospital admissions, the length of stay in the intensive care unit, the bad prognosis of the disease and the drugs used cause serious financial burdens, loss of healthcare personnel time and also loss of individuals' workforce who suffer from asthma. It can be said that targeted biological therapies with a population-specific response, the elimination and prevention of the both of internal and external factors that cause the disease, especially without the need for medication, improving asthma education, an effective management of the diseases are fundamental importance for the prevention and reduction of both financial and labor loss caused from the disease.

Conflict of interests

The authors declare that they have no competing interests.

Financial Disclosure

All authors declare no financial support.

Ethical approval

Konya Provincial Health Directorate Commission, 05/07/2018/ Number:16-03.

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