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## **AN ANALYSIS OF CLINICAL, DEMOGRAPHIC CHARACTERISTICS AND COSTS OF ACUTE COPD EXACERBATION PATIENTS ADMITTED TO OUR EMERGENCY DEPARTMENT**

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**Aim:** Our study aimed to determine the demographic factors affecting the hospital costs of patients with COPD exacerbation.

**Methods:** The study was retrospectively conducted on patients, who presented to the Department of Emergency Medicine of Abant İzzet Baysal University with the complaints of COPD exacerbation between 01.06.2016 - 30.06.2017. The correlation between age, gender, occupations, places of residence, levels of education, history of smoking, methods of heating, comorbidities, times of application, symptoms, vital findings and findings of physical examination, blood gas results, frequency of admission to emergency department, frequency of hospitalization, emergency department outcomes of all patients and the cost was analyzed.

**Results:** The median age of the patients was 73 years, and 76.8% of them were male. The median cost of the patients was TRY 136.8. There was no correlation between the cost and gender, employment status, place of residence, level of education, duration of smoking, type of medicines used at home, and method of heating ( $p>0.05$ ). The costs of the patients who were admitted in the spring months were significantly lower compared to those who were admitted in other seasons ( $p>0.05$ ). It was found that the cost was not increased by the presence of comorbidities, HT, CHF, and DM ( $p>0.05$ ). It was found that the cost increased significantly as the general condition worsened ( $p>0.05$ ). It was determined that the cost was positively correlated with respiratory rate and negatively correlated with DKS ( $p>0.05$ ). The cost was found to be significantly higher in patients with extrapulmonary examination findings ( $p>0.05$ ).  $\text{HCO}_3^-$  and cost were found to be negatively correlated ( $p<0.05$ ). No correlation was found between the cost and the frequency of admission to emergency department and hospitalization of the patients ( $p>0.05$ ). The costs of the patients, who were admitted to intensive care or ward, were significantly higher ( $p>0.05$ ).

**Conclusion:** The cost is affected by a number of factors in patients admitted due to COPD exacerbation, the most important factor affecting the cost is patient's clinic. Poor patient clinic determines both the treatment to be provided in the emergency department and the status of hospitalization.

**Keywords:** COPD exacerbation, cost, emergency department.

Резюме

## **АНАЛИЗ КЛИНИЧЕСКИХ, ДЕМОГРАФИЧЕСКИХ ХАРАКТЕРИСТИК И ЭКОНОМИЧЕСКИХ ЗАТРАТ У БОЛЬНЫХ С ОБОСТРЕНИЕМ ХОБЛ, ГОСПИТАЛИЗИРОВАННЫХ В ОТДЕЛЕНИЕ НЕОТЛОЖНОЙ МЕДИЦИНЫ**

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**Целью** нашего исследования было определение демографических факторов, влияющих на больничные расходы на пациентов с обострением ХОБЛ.

**Материалы и методы:** ретроспективное исследование проведено на выборке из пациентов, обратившихся в отделение неотложной медицины Университета Абант Иззет Байсал с жалобами на обострение ХОБЛ в период с 01.06.2016 по 30.06.2017. Была проанализирована взаимосвязь между возрастом, полом, профессией, местом проживания, уровнем образования, анамнезом курения, способами отопления жилья, сопутствующими заболеваниями, временем и частотой обращения за помощью, симптомами, жизненно важными показателями и

результатами физикального обследования, результатами анализа газов крови, частотой госпитализаций, исходами лечения в отделении неотложной помощи и стоимостью расходов на лечение.

**Результаты:** средний возраст пациентов составлял 73 года, 76,8% из них были мужчинами. Средняя стоимость лечения пациентов составила 136,8 турецких лир. Не было найдено корреляции между расходами и полом, статусом занятости, местом жительства, уровнем образования, продолжительностью курения, видами лекарств, используемых дома, и способом отопления жилья ( $p > 0,05$ ). Затраты на пациентов, поступивших в весенние месяцы, были значительно ниже по сравнению с пациентами, поступившими в другие сезоны ( $p > 0,05$ ). Было установлено, что стоимость не увеличивалась из-за наличия сопутствующих заболеваний (АГ, ХСН и СД ( $p > 0,05$ )). Оказалось, что стоимость лечения значительно увеличивалась по мере ухудшения общего состояния ( $p > 0,05$ ). Было установлено, что стоимость положительно коррелировала с частотой дыхания и отрицательно коррелировала с DKS ( $p > 0,05$ ). Стоимость лечения была значительно выше у пациентов, нуждающихся в дополнительном обследовании ( $p > 0,05$ ). Было обнаружено, что  $\text{HCO}_3$  и стоимость лечения имеют отрицательную корреляцию ( $p < 0,05$ ). Корреляции между стоимостью и частотой поступления в отделение неотложной помощи и госпитализации пациентов не установлено ( $p > 0,05$ ). Затраты на пациентов, которые были помещены в отделение реанимации или переведены в отделение, были значительно выше ( $p > 0,05$ ).

**Заключение:** на стоимость лечения пациентов, госпитализированных в связи с обострением ХОБЛ, влияет ряд факторов, наиболее важным фактором, влияющим на стоимость, является симптоматика. Плохие показатели у пациентов определяют как лечение, которое оказывается в отделении неотложной помощи, так и статус госпитализации.

**Ключевые слова:** обострение ХОБЛ, стоимость, отделение неотложной помощи.

Түйіндеме

## КЛИНИКАЛЫҚ, ДЕМОГРАФИЯЛЫҚ СИПАТТАМАЛАРДЫ ТАЛДАУ ЖӘНЕ ШҰҒЫЛ МЕДИЦИНА БӨЛІМШЕСІНЕ ӨСОА АСҚЫНУЛАРЫМЕН ЖАТҚЫЗЫЛҒАН НАУҚАСТАРДАҒЫ ЭКОНОМИКАЛЫҚ ШЫҒЫНДАР

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Біздің зерттеуіміздің мақсаты - өркениетін созылмалы ӨСОА ауруымен ауыратын науқастардың аурухана шығындарына әсер ететін демографиялық факторларды анықтау.

**Материалдар мен әдістер:** Абант Иззет Байсал университетінің жедел жәрдем бөліміне ӨСОА-ның өршуіне шағыммен жүгінген науқастардың үлгісіне ретроспективті зерттеу жүргізілді, 06.06.2016 - 30.06.2017 ж. жасы, жынысы, кәсібі, тұрғылықты жері, білім деңгейі, темекі шегу тарихы, үйін жылыту әдістері, қатар жүретін аурулар, көмекке жүгінудің уақыты мен жиілігі, белгілері, өмірлік белгілері және физикалық тексеру нәтижелері, қанға жүргізілген талдау нәтижелері, ауруханаға жатқызу коэффициенттері арасындағы байланыс талданды. Жедел жәрдем бөліміндегі емдеу нәтижелері және емделуге кететін шығындар.

**Нәтижелер:** науқастардың орташа жасы 73 жасты құрады, олардың 76,8%-ы ер адамдар. Науқастарды емдеудің орташа құны 136,8 түрік лирасын құрады. Шығындар мен жыныс, жұмыс жағдайы, тұрғылықты жері, білім деңгейі, темекі шегудің ұзақтығы, үйде қолданылатын дәрі-дәрмектер түрлері және жылыту әдісі арасында өзара байланыс табылған жоқ ( $p > 0,05$ ). Көктемгі айларда қабылданған науқастардың шығындары басқа маусымдарға қарағанда айтарлықтай төмен болды ( $p > 0,05$ ). Ілеспе аурулардың болуына байланысты шығындар жоғарыламағаны анықталды (АН, СНФ және ДМ ( $p > 0,05$ )). Жалпы жағдайдың нашарлауына байланысты емделуге кететін шығындар айтарлықтай өсті ( $p > 0,05$ ). Құны тыныс алу жылдамдығымен оң және ДКС-мен теріс корреляцияланған ( $p > 0,05$ ) анықталды. Емдеу құны қосымша тексеруді қажет ететін науқастарда едәуір жоғары болды ( $p > 0,05$ ).  $\text{HCO}_3$  және емдеу құны теріс корреляцияға ие болды ( $p < 0,05$ ). Жедел жәрдем бөліміне жатқызу мен пациенттерді ауруханаға жатқызу бағасы мен жиілігі арасында өзара байланыс болған жоқ ( $p > 0,05$ ). Реанимация бөліміне түскен немесе бөлімге ауыстырылған науқастардың шығындары едәуір жоғары болды ( $p > 0,05$ ).

**Қорытынды:** COPD өршуінің салдарынан ауруханаға жатқызылған науқастарды емдеу шығындарына бірқатар факторлар әсер етеді, шығындарға әсер ететін маңызды фактор симптоматология болып табылады. Науқастардың нашар балдары жедел жәрдем бөлімінде пайда болатын емді де, ауруханаға жатқызу жағдайын да анықтайды.

**Түйінді сөздер:** ӨСОА өршу, шығындар, жедел жәрдем бөлімі.

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**Introduction**

Chronic Obstructive Pulmonary Disease (COPD) is an important health problem worldwide in terms of mortality and morbidity [1]. Although COPD is a progressive and irreversible disease with a slow course, it is of importance in that it is preventable, with the possibility to cease the progression [2]. COPD not only affects the individual in a systematic manner, it also has physical, social and emotional effects [3].

Chronic obstructive pulmonary disease leads to significant physiopathological disorders. Respiratory distress, which is the most common symptom, causes significant levels of exhaustion and sleep disorders in individuals, and accordingly disturbances in daily life activities and a poor quality of life are observed [4-6]. In the course of time, social isolation develops in individuals with COPD, along with a failure to meet their own needs and falls occur during self-care [6, 7]. Furthermore, mental disorders and agitation may occur due to the dyspnea and low quality of life that individuals suffer from [8]. These mental adversities can be observed not only in patients but also in individuals bearing the role of caregiver [7].

Exacerbations of chronic obstructive pulmonary disease are also a significant cause of COPD-related healthcare expenses. Healthcare expenses frequently tend to increase due to hospitalization. In a study conducted in the United States of America, the cost of COPD-related hospitalizations was predicted to be USD (\$) 11.9 billion in 2006, with a median cost of hospitalization estimated to be \$ 9,545 [9]. In a study carried out in China, however, exacerbations of COPD were also found to have high polyclinic costs (10). COPD leads to direct health expenditures of \$ 256 million in the Netherlands and of \$ 179 million in Sweden [11,12]. COPD-related hospitalizations cause an annual cost of \$ 6.1 billion in the USA [13].

Our study aimed to determine the demographic factors affecting the hospital costs of patients with COPD exacerbation.

**Materials and methods**

Following the acquisition of the consent of the Ethics Committee of Abant İzzet Baysal University, our study was retrospectively conducted on patients, who presented to the Department of Emergency Medicine of The Abant İzzet Baysal University with the complaints of COPD exacerbation between 01.06.2016 - 30.06.2017.

The correlation between age, gender, occupations, places of residence, levels of education, history of smoking, methods of heating, comorbidities, times of application, symptoms, vital findings and findings of physical

examination, blood gas results, frequency of admission to emergency department, frequency of hospitalization, emergency department outcomes of all patients and the cost was analyzed.

Patients who were not diagnosed with COPD despite admitting to emergency department with the complaints of dyspnea/respiratory distress, and patients whose file data were not accessible were excluded from the study.

The software "SPSS for Windows 22" was used for the analysis of the data. The Kolmogorov-Smirnov test was employed to test the range of distribution of continuous variables. Median and interquartile range (IQR) were used to present quantitative data, and number of cases (n) and percentile representation (%) were used to present qualitative variables. The Chi-square test was employed to analyze categorical data, whereas the continuous data were analyzed using the Mann-Whitney U and Kruskal-Wallis tests. The correlation between the cost and variables was evaluated using the Spearman's correlation test. The results were evaluated at a confidence interval of 95% and significance at the level of  $p < 0.05$ .

**Results**

The study included 401 patients diagnosed with COPD between the predetermined dates. The median cost of the patients was TRY 136.8 (IQR: TRY 93), with the lowest cost of TRY 21 and the highest cost of TRY 566. The median age of the patients was 73 (IQR: 14) years. No statistically significant correlation was found between age and cost ( $r = -0.018$ ,  $p = 0.33$ ). Of the patients, 308 were male (76.8%) and 93 were female (23.2%). The median cost of male patients was found as TRY 138.4 (IQR: TRY 90), and of female patients as TRY 124.6 (IQR: TRY 107). Even though male patients had a high cost, it was not statistically significant difference ( $p > 0.05$ ).

The median cost of 111 patients, who were actively working, was found as TRY 143.5 (IQR: TRY 100), the median cost of the unemployed/retirees was found to be TRY 126.4 (IQR: TRY 83), and the median cost of housewives was determined as TRY 128 (IQR: TRY 109). Even though active workers had a high cost, it was not statistically significant difference ( $p > 0.05$ ).

No statistically significant difference was found between the place of residence and cost ( $p > 0.05$ ).

The median cost of the illiterate individuals was TRY 108.6 (IQR: TRY 110) (Table 1). No statistically significant difference was found between the level of education and cost ( $p > 0.05$ ).

No statistically significant difference was found between the duration of smoking and cost ( $p > 0.05$ ) (Table1).

Table 1.

Characteristics of patients demographic.

Variable		n (%)	Cost [median (IQR)]	P value
Gender	Male	308 (76.8%)	138.4 (90)	p>0.05
	Female	93 (23.2%)	124.6 (107)	
Status of employment	Employed	140 (32.4)	143.5 (100)	p>0.05
	Retiree	196 (48.9)	126.4 (83)	
	Housewife	75 (18.7)	128 (109)	
Place of residence	City Center	124 (30.9%)	137.1 (94)	p>0.05
	District center	95 (23.7%)	138.7 (80)	
	Village	182 (45.2%)	131.7 (102)	
Educational background	Illiterate	34 (8.5)	108.6 (110)	p>0.05
	Literate	169 (42.1)	137.7 (93)	
	Primary school	68 (17.0)	133 (105)	
	Secondary school	139.5 (82)	139.5 (82)	
	High school	17 (4.2)	159 (53)	
Smoking (years)	Non-smoker	124 (30.9%)	144.5 (100.2)	p>0.05
	0-10 years	3 (0.7)	159.0 (91.2)	
	11-20 years	45 (11.2)	139.6 (67.0)	
	21-30 years	108 (26.9)	113.2 (75.9)	
	31-40 years	94 (23.4)	135.2 (105.0)	
	Over 41 years	27 (6.7)	156.6 (191.5)	
Method of heating	Natural gas/central heating	135 (33.7)	138.7 (95)	p>0.05
	Wood/coal	266 (66.3)	134.1 (92)	
Season	Spring	103 (25.7)	143.5 (90)	p<0.05
	Summer	75 (18.7)	154.6 (102)	
	Autumn	84 (20.9)	109.9 (84)	
	Winter	139 (34.7)	131.7 (96)	
EP examination finding	Yes	285	156.5 (107)	p<0.05
	No	126	126.3 (TRY 81.3)	
Patient outcome	Hospitalization	97 (24.2)	182.3 (168)	p<0.05
	Discharged	252 (62.8)	128.1 (82)	
	Intensive care	41 (10.2)	202.6 (165)	
	Exitus	3 (0.7)	14 (3.2)	
	Refusal of treatment	8 (2.0)	13 (7)	

Of the patients, 135 (33.7%) were found to be using natural gas or central heating, while 266 (66.3%) used wood or coal as a method of heating. The median cost of those using natural gas or central heating for heating purposes was found to be TRY 138.7 (IQR: TRY 95), while the median cost of those using wood or coal was found as TRY 134.1 (IQR: TRY 92). No statistically significant

difference was found between the method of heating and cost (p>0.05). Of the patients in our study, 334 (83.1%) were found to have at least one comorbidity, except for COPD (Table 2). While a higher cost was found in patients with HT, CHF and DM (p>0.05), no differences could be found in terms of cost in CAD, CKF, CVA and other comorbidities (p>0.05) (Table 2).

Table 2.

**Correlation between non-COPD comorbidity pathologies of patients and cost**

	Yes/No N (%)	Yes Median (IQR)	No Median (IQR)	p
Comorbidities	334/67	138.6 (97)	100 (87)	0.001
HT	279/121	138.5 (97)	125.4 (83)	0.022
CAD	143/258	137 (103)	133.9 (88)	0.689
CHF	129/272	167.6 (106)	122.5 (78)	<0.001
DM	105/296	144.5 (92)	130.5 (95)	0.023
CKF	14/387	143.5 (72)	135.1 (93)	0.084
CVA	8/394	172 (46)	135.1 (93)	0.185
OTHER	18/383	136.8 (93)	131.9 (105)	0.717

HT: Hypertension, CAD:Coronary artery disease, CHF: Congestive heart disease, DM:Diabetes mellitus, CKF:Cronic Kidney failure, CVA:Cerebrovascular disease

The median cost of patients admitted in the summer months was TRY 154.6 (IQR: TRY 102), and the median cost of patients admitted in the fall months was TRY 109.9 (IQR: TRY 84). The costs of patients admitted in the spring months were significantly lower, compared to those admitted in other seasons ( $p>0.05$ ) (Table 1).

Of the patients included in our study, 397 (99.0%) were admitted with dyspnea, 186 (46.4%) with cough/phlegm, 114 (28.4%) with fever, 83 (20.7%) with fatigue, 47 (11.7%) with chest pain, 22 (5.5%) with malnutrition, 20 (5%) with nausea/vomiting, 18 (4.5%) with headache, 9 (2.2%) with dizziness, 4 (1.0%) with blood in phlegm, and 3 (0.8%) with other complaints. No statistically significant difference was found between symptom type and cost ( $p>0.05$ ).

Of the patients, 126 (31.4%) were found to have extrapulmonary examination findings. The median cost was found as TRY 156.6 (IQR: TRY 107) in the patients who were determined to have additional examination findings, and as TRY 126.3 (IQR: TRY 81.3) in those who did not have any. The cost was found to be significantly higher in patients with examination findings ( $p>0.05$ ).

No correlation was found between the cost and the systolic blood pressure, diastolic blood pressure, pulse rate, saturation and fever of the patients ( $r=-0.032, 0.026, 0.057, -0.096, 0.091, p>0.05$ ), whereas it was determined that the cost was positively correlated with respiratory rate, and negatively correlated with GCS ( $r=0.242, -0.232, p<0.05$ ).

While no correlation was found between the levels of pH,  $PO_2$ ,  $PCO_2$  and lactate of the patients included in our study and the cost ( $r=-0.006, 0.025, -0.095, -0.020, p>0.05$ ),  $HCO_3$  was found to be negatively correlated with cost ( $r=-0.189, p>0.05$ ).

**Correlation of blood gas results of patients with cost.**

The frequency of admission of the patients was not found to be correlated with cost ( $p>0.05$ ). The frequency of hospitalization of the patients was not found to be correlated with cost ( $p>0.05$ ).

In our study, the median cost of discharged patients was found as TRY 128.1 (IQR: TRY 82), the median cost of patients admitted to ward as TRY 182.3 (IQR: TRY 168), the median cost of patients admitted to intensive care as

TRY 202.6 (IQR: TRY 165), the median cost of died patients in the emergency department as TRY 143.2, and the median cost of patients refused treatment was found as TRY 137 (IQR: TRY 90). The costs of the patients, who were admitted to intensive care or ward, were significantly higher ( $p>0.05$ ).

**Discussion**

Chronic obstructive pulmonary disease is a global health problem in the entire world with an ever-increasing importance, particularly in developing countries [15]. With high rates of mortality and morbidity, COPD may also cause long-term and frequent hospitalizations [15]. Pharmacological and non-pharmacological treatment methods, which vary particularly among developed countries, are the most important factors affecting the increasing cost of care [16]. Patient follow-ups and treatments, patients frequently admitting to hospitals due to exacerbation, long-term hospitalizations, and the use of multiple drugs to relieve symptoms lead to an increase in the costs of care of COPD patients [17,18].

In a study by Hacıevliyagil et al., the median COPD-related hospital cost was found to be TRY 1,336.23 in total [19]. Hilleman et al. found the costs of hospitalization for COPD patients in mild, moderate and acute stages as \$ 680, \$ 2.658 and \$ 6.770, respectively [20]. In their study, Varol et al. reported the cost of medication per exacerbation as TRY 526.55 [21]. In an article investigating the acute exacerbation of COPD and cost, Yıldırım et al. found the total median cost per patient as TRY 1.064 [22]. In a review conducted by Toy et al. including 11 studies, the cost of exacerbation of COPD was reported to be varying between \$ 88 and \$ 7.757 [23]. In our study, the median cost of patients hospitalized for COPD was found as TRY 136.8. We are of the opinion that the different costs reported in the studies are related to the total days of hospitalization of patient groups in relevant studies, whether they took antibiotics during the hospitalization period, and whether there were any additional examinations and treatments performed.

In their study, Yıldırım et al. reported that the mean age of patients was 70 years and that the age factor did not affect the increase in the total cost [22]. Ulubay reported

that patients were over the age of 45 and that no statistically significant correlation could be found upon the analysis of the correlation between the ages of patients and the total cost [24]. In their study, Inal et al. found the mean age of the patients as 68.2, detecting no statistically significant difference with regard to cost [25]. In our study, the median age of the patients was 73 years, and no correlations could be found between age and cost in line with the literature. As is seen in the relevant studies, our study might not have yielded any correlation between age and cost as nearly all of the patients were of advanced ages and had similar clinical characteristics.

In their study, Yildirim et al. emphasized that 77 out of the 99 patients participated in the study (77.8%) were male and that gender did not have an effect on cost [22]. In their study, Emre et al. reported that 91.3% of patients were male and that gender had no effect on cost [26]. In a study conducted in our country by Tanriverdi, no differences could be found in regard to gender in terms of inpatient treatment for acute exacerbation of COPD [27]. Ulubay reported that there were no differences between the hospitalization of male and female patient in respect of their effects on the cost [24]. In our study, similar to studies in the literature, it was found that the vast majority of the COPD patients were male and that the gender factor and cost were not correlated. Today, even though the male gender constitutes the vast majority of the group of COPD patients, we are of the opinion that female patients will catch up males in the upcoming years due to an increase in smoking in favor of women, along with the use of biomass, and the use of wood and coal. We believe that gender has no effect on cost as the risk factors such as infection and treatments given are similar for both genders.

Yildirim et al. analyzed the health insurances of patients as required by their jobs, and the effects of this on cost, and reported that the social securities of patients had no increasing effect on cost [22]. In our study, it was determined that the majority of patients hospitalized for exacerbation of COPD were in the retiree group, whereas those working actively were found to have high costs, though it was statistically insignificant. We believe that retired patients are admitted to emergency services more frequently due to the fact that COPD patients are of advanced age, face long-term environmental/occupational exposure, and are in contact with cigarette more. We are of the opinion that those working actively are not admitted until their general condition worsens and that they are hospitalized more frequently when they are admitted, leading to an increase in costs.

Studies in the literature found no correlation between the place of residence of patients and cost. In a study by Demirtas et al., the rate of COPD was reported to be higher in women living in rural areas compared to women living in urban areas. In this study, COPD and smoking were found to be correlated in women living in urban areas, while no correlation could be found between COPD and smoking in women living in rural areas [28]. Yakisan et al. reported that COPD patients had a higher rate of settlement in rural areas/villages [29]. In our study, it was found that the admitted patients mostly lived in villages, while no correlation was found between the place of residence and cost. Even though it is believed that the exacerbation of

COPD is increased by the use of biomass, exposure to dust, smoke and smell, living in moldy and humid settings, and exposure to herbicides, insecticides and agricultural pesticides, which is caused by living in villages, we are of the opinion that the groups living in urban areas experience exacerbations due to similar reasons, such as the use of wood-burning and coal-burning stoves, and the increase in air pollution due to exhaust gases. The groups admitted for similar predisposing factors might have caused the costs to be found similar.

Some studies have shown that individuals with low income and no education have even worse health outcomes [30, 31]. In their study, Yakisan et al. investigated the levels of education of female COPD patients and found a low literacy rate in the patient group [29]. Of the patients participated in the study by Okutan et al., 60.8% were reported to be secondary school graduates [32]. Kartaloglu et al. determined the level of education as 38% for secondary school and above in COPD patients [33]. In our study, it was determined that the patients were mostly primary school graduates and that there was no correlation between the level of education and cost. High levels of education, patients taking good care of themselves, taking medications regularly and attending to regular doctor follow-ups increase the awareness; nevertheless, we are of the opinion that admissions cannot be fully prevented even though climate conditions, socioeconomic levels, smoking or remaining in a place where others are smoking, and occupational exposures could reduce the frequency of admissions by patients for the exacerbation of COPD. Even though educated patients attempt to pull through the exacerbations at home after it occurs, we believe that the treatments provided are similar to costs in the hospital if the situation cannot be solved, and therefore, it does not change the patient cost per admission. This might not have changed the treatments at admission, even though it changed the annual cost.

In their study, Hacievliyagil et al. reported that smoker COPD patients, who were hospitalized for treatment, had higher costs compared to those who did not smoke [19]. The thesis written by Ulubay analyzed the correlation between the amount of cigarettes smoked by patients (in packs-year) and costs of hospitalization, and no statistically significant correlation could be found [24]. Furthermore, smoking was reported to be increasing costs through other comorbidities [34, 35]. In our study, it was determined that a higher rate of patients smoked (69.9%) and that the duration of smoking and costs were not correlated. Studies in the literature have found different results. The relationship between smoking and COPD is unclear. It is known that continuing smoking COPD patients further destroy the lungs that have already been ravaged, therefore increasing the susceptibility to infection. We believe that this could lead to an increase in costs as it may tend to increase the use of antibiotics, the frequency and duration of hospitalization, and the methods and numbers of treatment. Nevertheless, cost might have remained the same following the exacerbation as the treatment protocols were similar.

Although not a single article could be found in the literature studies that compared the correlation between the method of heating and cost. In our study, it was determined that the patients mainly used wood or coal (66.3%) for

heating and that there was no correlation between the method of heating and cost of COPD. Methods of heating can be associated more with individuals' places of residence. We are of the opinion that those living in cities also use wood and coal, but those living in villages are more exposed to the smoke of wood, coal and cow dung, which in turn increases the prevalence of COPD exacerbations, and that the cost per exacerbation remains the same even though the annual cost per capita changes as the severity of exacerbation and duration/method of treatment determine the cost, instead of factors that lead to COPD.

In a study conducted by Yildirim et al., comorbidity had no effect on total cost [22]. In their study, Emre et al. reported that the total costs of cases significantly increased in the presence of comorbidities. They also reported that the length of hospital stay and total costs of healthcare increased in line with the increase in the number of comorbidities [26]. In the thesis written by Ulubay, the effects of comorbidities on the cost were analyzed, and those with no comorbidities were compared with those who had only one comorbidity and with those with multiple comorbidities, and no statistically significant difference could be found [24]. In a study by Chen et al., a significant correlation was found between the hospital costs and cor pulmonale, respiratory failure, and hypertension. [10] Similar to the literature, our study found that 83.3% of the patients had comorbidities and the most common comorbidities were HT (69.6%) and CAD (35.7%). The presence of comorbidities, HT, CHF and DM was found to be increasing cost. We are of the opinion that the risk of comorbidities is increased by our population consisting of elderly, the presence of HT, CHF and DM causes the patients to be admitted to hospitals more while increasing the frequency of demands for consultation, the types and numbers of the drugs given, and that the drugs prescribed increase the adverse effect-drug interaction, the number and frequency of examinations and treatments, and the length of hospital stay, therefore increasing the cost.

No studies could be found in the literature that compared the period of admission with cost. On the other hand, exacerbations of COPD peak during the winter months, when the circulation of viruses is maximum in the society, therefore exacerbations cause a seasonal increase in the number of hospitalizations and outpatient treatments [36]. In their study, Karlikaya et al. reported that the frequency of admissions related to COPD exacerbations peaked in the autumn and winter months [37]. In our study, it was found that the patients were admitted to the emergency department mostly in the winter months (34.7%), while the cost was lowest during the autumn months. It can be speculated that the frequency of admissions tends to increase in the winter months due to reasons such as microbial factors and air pollution that increase in the winter months. The fundamental reason of the correlation between seasons and cost could be the fact that the pneumonia accompanying COPD in the winter months is viral, while the factor is mostly bacterial in patients who develop exacerbations in the summer and spring. Furthermore, the increasing air pollution in the winter months might have led the patients to remain hospitalized longer as they did not relieve in the emergency department.

Some studies have shown that the COPD symptoms increase the cost of care [38-40]. Patients use spirometers and bronchodilator drugs in order to relieve the symptoms of dyspnea, cough and phlegm, and the studies have shown that such practices increase the patient cost [38-40]. In our study, it was determined that the patients were admitted with the complaints of dyspnea (98.6%) and cough/phlegm (45%), although no correlation could be found between symptoms and cost. The frequency of symptoms was similar to the literature. The fundamental reason why symptoms were not correlated with cost could be caused by the fact that each patient had symptoms and patients had multiple symptoms, although the symptoms were different.

In chronic obstructive pulmonary disease, there is a weak correlation between the clinical findings of patients and airway obstruction, and that the physical examination and vital parameters can be normal in patients who have a clinically poor condition. In a study by Deveci et al., it was found that the baseline respiratory rates of COPD patients increased [41]. In their study, Yildirim et al. emphasized that the use of NIMV did not change the cost, [22] while Ulubay et al. reported that the cost of patients with poor general condition, who were admitted to intensive care units, was higher than those hospitalized in wards [24]. Chen et al. reported that the level of FEV<sub>1</sub> was negatively correlated with cost [10]. There are also other studies suggesting that the level of FEV<sub>1</sub> shows the clinic of the patient, but it is not correlated with cost [27,42]. In our study, it was determined that the vital parameters were generally within the normal range, the cost tended to increase as the general condition worsened, and the cost was positively correlated with the respiratory rate and negatively correlated with GCS. We are of the opinion that with these results in our study, good vital findings and general conditions of the majority of the patients shortened the duration of examination and treatment, decreased the frequency of consultation, the requirement for mechanical ventilators, the use of antibiotics, and as a result, led to low costs in the patients. Furthermore, elderly patients sometimes do not exhibit all of the expected symptoms, and the response to treatment may not be as expected. This may increase the number and type of antibiotics, along with the support given to the patients, and we think that this may lead to an increase in cost. We believe that a poor general condition and a low GCS could lead to poor condition for the patient, causing impairments in vital findings, increasing the length of hospital stay and the use of antibiotics, while causing the orders for consultation, examination, and the type and number of treatment to increase, therefore paving the way to an increase in the costs.

No studies could be found in the literature that analyzed the correlation between additional examination findings and costs. Of the patients included in our study, 31.4% were found to have extrapulmonary examination findings, and the costs of these patients were significantly high. We believe that extrapulmonary physical examination findings point out the presence of other pathologies accompanying COPD at advanced stages. We believe that costs increase due to the fact that additional examinations are ordered in order to evaluate the additional pathologies of these patients during their emergency department screening, more drugs and

materials are used to relieve the patients with COPD, and due to the presence of additional pathologies and longer hospitalization of patients with COPD.

No studies could be found in the literature that show the effects of the blood gas results on cost. In our study, the median values of pH, pO<sub>2</sub>, pCO<sub>2</sub> and lactate of the patients included in our study were within the normal range, and no correlation could be found between the pH, pO<sub>2</sub>, pCO<sub>2</sub> and lactate values and cost. The HCO<sub>3</sub> value was found to be negatively correlated with cost. The fact that the blood gas values were normal or nearly normal could be associated with the fact that the patients generally had a good condition. Nevertheless, even though COPD is expected to cause acidosis due to an increase in CO<sub>2</sub>, it should be kept in mind that pCO<sub>2</sub> could reduce in cases of tachypnea-related hyperventilation. Therefore, the pH, pO<sub>2</sub>, pCO<sub>2</sub> values might be not correlated with cost. The HCO<sub>3</sub> value can be correlated with renal compensation, and excessive HCO<sub>3</sub> with even higher acidosis of the lungs. Moreover, this could be interpreted as a predictor of comorbidity and/or metabolism. Thus, the HCO<sub>3</sub> value may be closely correlated with the cost in relation to the poor condition of the patients.

Patients use spirometers and bronchodilator drugs in order to relieve the symptoms of dyspnea, cough, and phlegm. The studies have shown that such practices increase the patient cost [39]. In their study, Ozkaya et al. reported that 53.5% of the inpatient treatment cost of COPD patients was associated with the drugs used. In the same study, they reported that that 53.5% of the inpatient treatment cost of COPD patients was associated with the drugs used [43]. In their study, Yildirim et al. reported that 82 (82.8%) of patients received antibiotics treatment in addition to exacerbation treatment, while 17 (17.2%) did not receive antibiotic treatment. The two groups were compared in terms of cost, and the use of antibiotics was found to be an independent factor that increased the total cost [22]. Varol et al. found that the cost per patient was higher in the group using antibiotics compared to the group that did not [21]. Holland et al. evaluated the cost and effectiveness of home-based pulmonary rehabilitation of COPD patients, gave home exercises to 166 patients for eight weeks, provided them with phone-based consultation, and as a result of the study, they found that the home-based pulmonary rehabilitation was cost-effective [44]. Haesum et al. analyzed the cost-effectiveness of the Telehomecare, Chronic Patients and the Integrated Healthcare System (TELEKAT) project in Denmark, which was created to monitor the home-based rehabilitative activities of acute and very acute COPD patients to protect them from the disease and to reduce the frequency of admission to hospitals, and they found that this program was more cost-effective for COPD patients [45]. Of the patients in our study, 94.8% were found to have received treatments for COPD and these treatments did not change the hospital costs. The literature studies calculate the patient cost and total cost. According to studies, home-based treatment and rehabilitative practices reduce the total cost of the patient. Since our study calculated the hospital cost, we are of the opinion that it did not change cost. We are of the opinion that the total cost is increased by the fact that COPD

patients use numerous drugs and take antibiotics at home and in the hospital during the exacerbation period.

In our study, no correlation could be found between the frequency of hospitalization and cost. Even though the increase in the frequency of admission and/or hospitalization led to an increase in costs, the fact that each admission was separately analyzed in our study and this process started all over again for each admission could have led to no correlation between the frequency of admission and/or hospitalization and cost.

Sullivan et al. found that the hospitalization and emergency admission costs of COPD patients constituted 72.8% of healthcare expenditures for COPD [46]. Toy et al. reported that the rates of hospitalization for the exacerbation of COPD varied between 38% and 93% and that these had the major share in terms of COPD-related costs [23]. As for the costs of hospitalization, however, the cost of hospitalization due to the exacerbation of COPD was found to be approximately 2.7 times more than the hospitalizations for any reason [47]. In a study by Ely et al., 44 COPD patients who were monitored in the ICU were compared with 256 patients who were hospitalized due to non-COPD reasons, and it was reported that the daily patient cost of the COPD group was significantly higher compared to the other group [48]. In our study, it was found that 62.8% of the patients were discharged, 34.4% were hospitalized, and 0.7% died in the emergency department. The costs of the patients hospitalized, particularly of those hospitalized in the intensive care unit, were found to be significantly high. We are of the opinion that the opportunities and sufficiency of the hospital are the most fundamental reasons why there are differences in the literature in regard to emergency department outcomes. We believe that the cost of inpatients is caused by factors such as high pricing for intensive care costs beyond examination and treatment, newer and more expensive materials used, longer duration of treatment, and medical personnel providing patients with service for longer period of time. We are of the opinion that hospitalization in ward increases both drug costs and other costs, despite being lower than those of intensive care.

## Conclusion

Although the cost is affected by a number of factors in patients who are admitted with the complaints of COPD exacerbation, the most important factor affecting the cost is the patient's clinic. Poor patient clinic determines both the treatment to be provided in the emergency department and the status of hospitalization.

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## Conflicts of interest:

The authors have no conflicts of interest to declare

## Contribution of the authors to the study:

Kale Y. – literature search, writing a review,

Kavalci C. - correspondence with the editorial office, writing a review.



*Celik K. – developing ideas and concepts, methodologically assessing the quality of the articles included, writing a review.*

*Çolak T. – writing a review, counseling.*

*Öztok Tekten B. - literature search, writing a review.*

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