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Assessment of the Economic Burden and Quality of Life in Patients With Chronic Obstructive Pulmonary Disease*

Burak SAYAR

bsayar@beu.edu.tr

Bitlis Eren University

İsmail AĞIRBAŞ

Ankara University

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ASSESSMENT OF THE ECONOMIC BURDEN AND QUALITY OF LIFE IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE*

Corresponding Author

[1]Assist. Prof. Burak SAYAR, Bitlis Eren University, Vocational School of Health Services, Department of Medical Services and Techniques, Bitlis, Türkiye, bsayar@beu.edu.tr, 0000-0002-7652-8392

Author

[2]Prof. Dr. İsmail AĞIRBAŞ, Ankara University, Faculty of Health Sciences, Department of Health Management, agirbas@ankara.edu.tr, 0000-0002-1664-5159

Abstract

Background: Chronic Obstructive Pulmonary Disease (COPD) represents not only a clinical condition but also a substantial economic and social burden.

Aims: This study aimed to examine the relationship between quality of life and economic burden among individuals with Chronic Obstructive Pulmonary Disease (COPD).

Methods: The research was designed as a descriptive and cross-sectional study, including 1,683 COPD patients who applied to seven public hospitals affiliated with the Ministry of Health in Bitlis Province, Türkiye, in 2022. Data were collected through hospital records and structured questionnaires. Quality of life was assessed using the St. George's Respiratory Questionnaire (SGRQ), the EQ-5D-5L Health Questionnaire, and the COPD Assessment Test (CAT). The cost of illness was calculated from three perspectives: patient and caregiver, payer (reimbursement institution), and societal.

Results: Findings revealed that 63.5% of the participants were male, with a mean age of 66.5 years, and 93% had at least one comorbid disease. The mean CAT score was 25.97, EQ-5D index score was 0.44, EQ-VAS score was 41.05, and the mean SGRQ total score was 68.07, indicating impaired health-related quality of life. There was a significant negative correlation between disease severity and quality of life, and a positive correlation between disease severity and cost. The mean total cost was calculated as 697.11 TL ($6.96) for outpatients and 9,530.32 TL ($573.48) for inpatients, with direct medical costs accounting for the largest proportion.

Conclusion: Strengthening smoking cessation programs, reducing environmental risk factors, and expanding early diagnosis and rehabilitation services are essential to alleviate this burden.

Keywords: COPD, quality of life, cost of illness, economic burden, health economics

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a chronic respiratory disease that affects millions of people worldwide and imposes a significant burden on healthcare systems due to its high mortality and morbidity rates. The disease is considered a serious public health problem not only from a clinical perspective but also in terms of its economic and social impacts. The economic burden of COPD is examined under two main categories: direct medical costs (such as hospitalizations, medications, and physician visits) and indirect costs (such as loss of productivity, early retirement, and premature death).

Considering COPD-related mortality rates in Türkiye, in 2021 the rates were reported as 17.64 per 100,000 among men, 5.65 among women, and 11.48 overall. In 2022, these rates were 16.49 among men, 4.71 among women, and 10.44 overall. Approximately 4% of the 504,839 deaths recorded in

*This study was derived from the PhD thesis entitled "Determining the cost and quality of life of chronic obstructive pulmonary disease: the case of Bitlis province."

Türkiye in 2021 were attributed to COPD. In OECD countries, 3% of the 12,818,369 deaths recorded in 2021 were due to COPD. According to data from the Turkish Statistical Institute (TURKSTAT), the population of Türkiye is 85,229,553, and 6.5% of the population has been diagnosed with COPD. This rate is 7.8% among women and 5.2% among men (1). These data indicate that COPD constitutes a serious epidemiological and economic burden in Türkiye.

COPD is a chronic lung disease characterized by long-term and recurrent airflow limitation resulting from exposure to harmful particles and gases. Tobacco smoke and environmental pollutants are the most important etiological factors of the disease. The non-microbial inflammatory process caused by these agents results in airway narrowing, increased mucus production, and irreversible changes in alveolar structure (2).

Due to the progressive nature of the disease, age is also an important risk factor, with most cases occurring in individuals over 40 years of age. In the absence of alpha-1 antitrypsin deficiency, occurrence before the age of 40 is rare (3). In addition, respiratory tract infections experienced during childhood, particularly latent adenovirus infections, have been associated with the development of COPD later in life (4). Smoking is the strongest and most common cause of COPD, leading to airway obstruction by increasing mucus production. However, smoking cessation slows disease progression and reduces functional decline (5).

The most commonly used perspectives in cost-of-illness analyses are the societal perspective, healthcare system perspective, patient and relatives' perspective, and reimbursement institution perspective (6). The societal perspective includes the costs and benefits of all individuals related to the disease, whereas the reimbursement institution perspective evaluates direct medical costs and third-party expenditures (7). The patient and relatives' perspective covers out-of-pocket expenditures and indirect costs (8).

Cost-of-illness studies involve different methodological approaches. These studies may use prevalence-based or incidence-based, retrospective or prospective approaches. The "bottom-up" approach estimates population-level costs based on individual patient costs, while the "top-down" approach derives individual costs from macro-level statistics (9). Economic modelling compares costs in the presence and absence of disease and generates estimates for alternative scenarios (10).

METHODS

Aim and Design of the Study

This study was conducted to determine disease-specific quality of life in individuals with Chronic Obstructive Pulmonary Disease (COPD), to calculate the cost of illness from different perspectives, and to examine the relationship between quality of life and disease cost. The study was carried out using a descriptive and cross-sectional research design. The specific objectives of the study were: (i) to assess disease-specific quality of life in individuals with COPD, (ii) to calculate the cost of COPD from the societal, reimbursement institution, and patient–patient relative perspectives, and (iii) to analyze the relationship between disease cost and quality of life.

Study Population

No sampling was performed, and the entire population was included in the study. Of the total 1,872 patients retrospectively identified through hospital records over a one-year period, 1,683 patients were reached, corresponding to 89.9% of the population.

Inclusion criteria: voluntary participation, residence within the provincial borders of Bitlis, sufficient contact information, and absence of mental disorders that would prevent completion of the study questionnaires.

Exclusion criteria: residence outside Bitlis province, refusal to participate, death, insufficient contact information, presence of mental disorders such as Alzheimer's disease or schizophrenia that would prevent questionnaire completion, and being detained or convicted.

Data Collection Instruments

Various data collection instruments prepared in line with the literature and previous studies were used.

Patient Information Form: This 16-item form was developed by the researcher based on a literature review and includes sociodemographic and clinical characteristics such as gender, age, educational status, occupation, place of residence, family history of COPD, smoking status, comorbidities, income level, and use of tandoor ovens.

St. George's Respiratory Questionnaire (SGRQ): Developed by Jones et al. (1991) and validated in Turkish by Polatlı (35), this questionnaire consists of three subscales—symptoms, activity, and impact—and a total of 50 items. The scale includes five-point Likert-type and yes–no responses. Scores range from 0 (best health status) to 100 (worst health status) (11).

Patient and Patient Relative Cost Form: This form was developed by the researcher based on the literature. The patient cost form includes six items covering examination co-payments, medication costs, transportation, nutrition, accommodation, and income loss, while the patient relative cost form consists of five items including transportation, nutrition, caregiving, accommodation, and income loss.

EQ-5D-5L Health Questionnaire: This instrument consists of five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension is scored between 1 and 5, resulting in a five-digit health profile (12). Evaluation is performed using country-specific value sets; German value sets were used for Türkiye (13, 14, 15, 16, 17,18). In the VAS section, individuals rate their health status on a scale from 0 to 100 (12).

COPD Assessment Test (CAT): Developed by Jones et al. (2009) and adapted into Turkish by Yorgancıoğlu (19) this test consists of eight items measuring dyspnea, cough, sputum, sleep, and daily activities. Each item is scored from 0 to 5, with total scores ranging from 0 (best health status) to 40 (worst health status) (19-20).

Data Collection Process

Data collection commenced after obtaining institutional permissions and approval from the Bitlis Eren University Ethics Committee. Questionnaire administration was conducted between 20 May and 20 October 2023. Data were collected in two stages. First, patients' identity, address, contact information, medications used, prescription and invoice records, and diagnostic information were obtained from the hospital information management system. In the second stage, questionnaires were administered face-to-face by the researcher, and by telephone for patients who were not available at home.

Collection and Calculation of Cost-of-Illness Data

COPD-related costs were calculated from the perspectives of patients and their relatives, the reimbursement institution, and society. Patient and relative costs included direct medical costs, non-medical costs, and income losses. Reimbursement institution costs were determined based on Social Security Institution (SSI) invoices, and non-COPD-related procedures were excluded based on expert

opinion. Invoice data were categorized under pharmacy, laboratory, radiology, outpatient examination, bed, service, and treatment items.

Societal cost was calculated as the sum of direct medical, direct non-medical, and indirect costs. Data were obtained from hospital information systems and the "Patient and Patient Relative Cost Form." Co-payments, transportation and nutrition expenses, and income losses were determined based on participant self-reports. The outpatient examination co-payment was set at 8 TL per visit, and medication co-payments were calculated according to the Turkish Drug Guide prices and the General Health Insurance Regulation (10–20%). All costs were calculated using the "bottom-up costing" approach (21). Costs were calculated in Turkish Lira, and for international comparisons, the average exchange rate of the Central Bank of the Republic of Türkiye for 2022 (1 USD = 16.6185 TL) was used (22).

Budget Impact Analysis

Within the scope of the budget impact analysis, the impact of COPD on the national budget was calculated. This analysis was conducted based on outpatient, inpatient, and total patient numbers using 2022 Turkish Statistical Institute (TURKSTAT) data. Total COPD cost was obtained by multiplying the number of patients by the average cost according to perspective. The total cost was then proportioned to total health expenditures for 2022 to determine the share of COPD within the health budget.

Statistical Analysis

Data were analyzed using SPSS version 22.0. Since the sample size exceeded 100, the distribution was assumed to approximate normality, and parametric tests were preferred without performing a normality test (41). Descriptive statistics included frequencies, means, and standard deviations. Independent Samples t-tests were used for comparisons between two groups, and One-Way Analysis of Variance (ANOVA) was used for comparisons among more than two groups. When homogeneity of variances was met, the source of differences was identified using the Tukey test. Relationships between variables were examined using Pearson Correlation Analysis. Correlation coefficients were interpreted as low (<0.30), moderate (0.30–0.70), and high (>0.70) (23). Simple Linear Regression Analysis was conducted to determine the effects between variables, and the level of significance was set at $p<0.05$.

Ethical Approval

Ethical approval was obtained from the Bitlis Eren University Ethics Principles and Ethics Committee with decision number 2023/03-18 and document number E.3596 prior to the commencement of the study. All procedures performed in this study involving human participants were conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments.

RESULTS

Table 1. Descriptive Findings of the Study Group (Appendix): Sociodemographic and clinical characteristics of the 1,683 COPD patients included in the study. Of the participants, 36.5% were female and 63.5% were male. The age distribution was predominantly between 66 and 70 years. A total of 80.8% of the patients were receiving outpatient treatment, and the vast majority were married (98.9%). At least one COPD risk factor was present in 75.9% of the participants, and 40.8% had a family history of COPD. According to the GOLD classification, more than half of the patients were in the GOLD 3 group. Most participants resided in district centers, and the income level was predominantly between 0 and 9,999 TL. A total of 46.6% of the participants were illiterate, and 33% were smokers. Additionally, 23.6% had previously had COVID-19. The majority of participants had more than one comorbid disease,

and 78.9% of women reported using a traditional bread-baking practice known as a tandoor oven. According to CAT scores, symptoms were mostly at high or very high levels.

Table 2. Independent Samples t-Test Findings According to Selected Variables of the Participants

Variables	N	CAT TS	EQ-5D Index	EQ-VAS	SGRQ-TS	TPTHM
Gender		$\bar{x}$±ss	$\bar{x}$±ss	$\bar{x}$±ss	$\bar{x}$±ss	$\bar{x}$±ss
Female	615	28,47±6,09	,31±,30	34,69±19,08	75,62±16,52	2506,92±8302,79
Male	1068	24,54±7,40	,51±,30	44,70±21,86	63,73±20,61	2326,41±20816,44
Test value		11,18	-13,568	-9,47	12,223	,206
P value		,001*	,001*	,001*	,001*	,837
Patient Type						
Outpatient	1360	25,43±7,12	,46±,31	42,53±21,25	66,71±20,23	
Inpatient	323	28,24±7,13	,35±,33	34,80±21,10	73,82±18,22	-
Test value		-6,36	5,505	5,91	-5,787	
P value		,001*	,001*	,001*	.001*	
Risk Factor						
Yes	1277	26,68±6,87	,40±,31	39,06±20,54	70,25±18,69	2515,66±19388,92
No	406	23,76±7,77	,54±,31	47,31±22,97	61,24±22,54	2009,26±7854,78
Test value		7,22	-8,123	-6,84	8,032	.512
P value		,001*	,001*	,011*	.001*	,608
Family History of COPD						
Yes	687	27,02±6,66	,40±,30	38,34±20,14	71,48±17,59	1966,08±5794,90
No	996	25,25±7,48	,47±,32	42,91±22,10	65,72±21,28	2686,41±21997,01
Test value		5,11	-4,555	-4,32	5,844	-,838
P value		,001*	,001*	,001*	,001*	,402
History of Covid-19 Infection						
Yes	397	26,72±8,17	,42±,33	38,81±22,78	67,94±20,93	4059,51±6605,04
No	1286	25,74±6,86	,44±,31	41,70±20,96	68,11±19,78	1877,71±22060,47
Test value		2,36	-1,255	-2,27	-,144	1,286
P value		,018*	,210	,023*	,886	,199

Table 2 presents the comparison of mean values of the COPD Assessment Test total score (CAT-TS), EQ-5D index, EQ-VAS, total SGRQ score (SGRQ-TS), and cost of illness from the patient and patient relative perspective (TPPRC) according to selected variables of the participants. In the gender analysis, women had significantly higher CAT-TS and SGRQ-TS scores than men, whereas men had higher EQ-5D and EQ-VAS scores ($p<0.001$). According to patient type, inpatients had higher CAT-TS and SGRQ-TS scores, while EQ-5D and EQ-VAS scores were lower compared to outpatients ($p<0.001$). Individuals with risk factors had significantly higher CAT-TS and SGRQ-TS scores and lower EQ-5D and EQ-VAS scores ($p<0.001$). Participants with a family history of COPD had higher CAT-TS and SGRQ-TS scores and lower EQ-5D and EQ-VAS scores ($p<0.001$). Among those who had experienced COVID-19, the CAT-TS score was significantly higher, while the EQ-VAS score was lower ($p<0.05$). No significant differences were found between groups in terms of cost of illness (TPPRC) ($p>0.05$).

Table 3 ANOVA Test Results According to Selected Variables of the Participants (Appendix) shows the comparison of mean values of CAT-TS, EQ-5D index, EQ-VAS, SGRQ-TS, and cost of illness from the patient–patient relative perspective (TPPRC) according to age, GOLD stage, place of residence, smoking status, CAT grouping, and number of exacerbations. According to the analysis results, as age increased, CAT-TS and SGRQ-TS scores increased significantly, while EQ-5D and EQ-VAS scores

decreased (p<0.001). As GOLD stage progressed, disease severity increased (higher CAT-TS and SGRQ-TS), and quality of life decreased (lower EQ-5D and EQ-VAS) (p<0.001). A significant difference was found in SGRQ-TS scores according to place of residence, with the highest scores observed among individuals living in rural areas (p<0.001). According to smoking status, non-smokers had higher CAT-TS and SGRQ-TS scores and lower quality of life scores (p<0.001). Based on CAT grouping, as symptom level increased, CAT-TS and SGRQ-TS scores increased and quality of life decreased (p<0.001). As the number of exacerbations increased, disease severity increased and quality of life decreased (p<0.001). In terms of TPPRC, limited differences were observed according to age, place of residence, smoking status, CAT level, and number of exacerbations; however, the level of significance was mostly p>0.05.

Table 4 presents the results of the correlation analysis showing the relationships between variables. Significant negative and strong correlations were found between the CAT total score and the quality of life indicators EuroQol index ($r = -0.695$; $p < 0.01$) and EuroQol VAS ($r = -0.630$; $p < 0.01$). The CAT score showed strong positive correlations with the SGRQ subscales and total score, which reflect disease severity ($r = 0.693–0.778$; $p < 0.01$). A strong positive correlation was identified between the EuroQol index and VAS scores ($r = 0.750$; $p < 0.01$), while very strong positive correlations were found among the SGRQ subscales ($r = 0.667–0.961$; $p < 0.01$). In terms of disease cost, weak but significant positive correlations were observed between the CAT score and cost from the patient and patient relative perspective ($r = 0.088$; $p < 0.01$), reimbursement institution perspective ($r = 0.081$; $p < 0.01$), and societal perspective ($r = 0.089$; $p < 0.01$). A very strong positive correlation was found between societal and reimbursement institution costs ($r = 0.996$; $p < 0.01$). These findings indicate that as COPD severity increases, quality of life decreases and disease-related costs increase.

Table 4. Correlation Findings Between Variables

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CAT Total (1)	1									
EuroQol Index (2)	-,695**	1								
EuroQol VAS (3)	-,630**	,750**	1							
SGRQ Symptom Score (4)	,693**	-,585**	-,518**	1						
SGRQ Aktivite Score (5)	,705**	-,642**	-,593**	,667**	1					
SGRQ Impact Score (6)	,749**	-,715**	-,653**	,712**	,827**	1				
SGRQ Total Score (7)	,778**	-,720**	-,659**	,812**	,915**	,961**	1			
Cost of Illness from the Patient and Caregiver Perspective (8)	,088**	-,069**	-,056*	,057*	,106**	,128**	,116**	1		
Cost of Illness from the Reimbursement Agency Perspective (9)	,081**	-,089**	-,083**	,066**	,058*	,069**	,070**	,017	1	
Cost of Illness from the Societal Perspective (10)	,089**	-,095**	-,087**	,071**	,067**	,080**	,080**	,105**	,996**	1

Table 5 summarizes the regression analysis examining the impact of the total SGRQ score on quality of life indicators and disease costs. The total SGRQ score was strongly and negatively associated with EuroQol VAS ($\beta = -0.659$, $p < 0.001$) and EuroQol index scores ($\beta = -0.720$, $p < 0.001$), indicating a

marked decline in quality of life with increasing disease severity. A strong positive association was observed between the total SGRQ score and health-related activity limitation ($\beta = 0.651$, $p < 0.001$). Regarding economic outcomes, higher total SGRQ scores were significantly associated with increased disease costs from the patient and caregiver perspective ($\beta = 0.116$, $p < 0.001$), payer perspective ($\beta = 0.070$, $p = 0.004$), and societal perspective ($\beta = 0.080$, $p = 0.001$). The total SGRQ score explained a substantial proportion of variance in the EuroQol index ($R^2 = 51.9\%$), EuroQol VAS ($R^2 = 43.4\%$), and activity limitation due to health ($R^2 = 42.4\%$). Overall, higher SGRQ scores were associated with poorer quality of life and greater economic burden in individuals with COPD.

Table 5. Findings Regarding the Effect of the Total SGRQ Score on Other Variables

	B	**Standard Error**	**β**	**t**	**p**
(Constant)	88,969	1,392	-,659	63,916	,000
SGRQ Total Score	-,704	,020		-35,891	
R=,659	R^2= ,434			F= 1288,142	
Dependent Variable: EuroQol Visual Analogue Scale (VAS) Score					
	B	**Standard Error**	**β**	**t**	**p**
(Constant)	1,209	,019	-,720	63,986	,000
SGRQ Total Score	-,011	,000		-42,575	
R=,720	R^2= ,519			F= 1812,639	
Bağımlı Değişken: EuroQol Index Puanı					
	B	**Standard Error**	**β**	**t**	**p**
(Constant)	14,127	1,464	,651	9,650	,000
SGRQ Total Score	,726	,021		35,202	
R= ,651	R^2= ,424			F= 1239,208	
Dependent Variable: Cost of Illness from the Patient and Caregiver Perspective					
	B	**Standard Error**	**β**	**t**	**p**
(Constant)	-2327,875	1483,642	,070	-1,569	,004
SGRQ Total Score	60,379	20,908		2,888	
R=,070	R^2=,005			F=8,340	
Dependent Variable: Cost of Illness from the Reimbursement Agency Perspective					
	B	**Standard Error**	**β**	**t**	**p**
(Constant)	-2316,326	1490,517	,080	-1,554	,001
SGRQ Total Score	69,172	21,005		3,293	
R=,080	R^2=,006			F=10,845	
Dependent Variable: Cost of Illness from the Societal Perspective					

Findings Related to Disease Cost

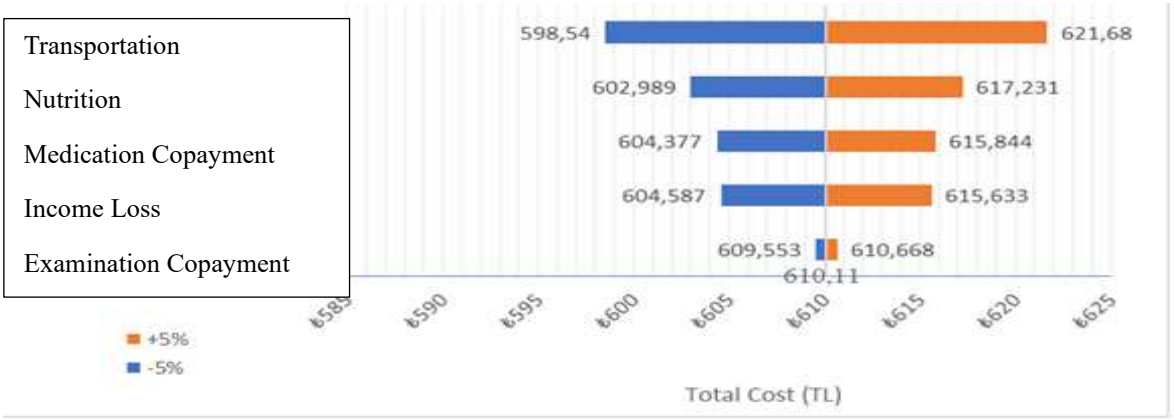


Figure 1. Tornado Diagram Results (Patient and Patient Relative Perspective: Patient Costs for All Patients)

Figure 1 illustrates the impact of increasing and decreasing each of the parameters—examination co-payment, medication co-payment, transportation, nutrition, and income loss—that constitute the cost of illness from the patient and patient relative perspective for all patients by 5%, while keeping the other parameters constant. The average total patient cost from the patient and patient relative perspective was calculated as 610.11 TL. As a result of the sensitivity analysis, the average disease cost ranged between 585 TL and 625 TL. The tornado diagram demonstrates which of these parameters has a greater impact on disease cost. When the effects of the parameters on disease cost were examined, transportation was identified as the cost component with the greatest impact, followed by nutrition, medication co-payment, income loss, and examination co-payment, respectively.

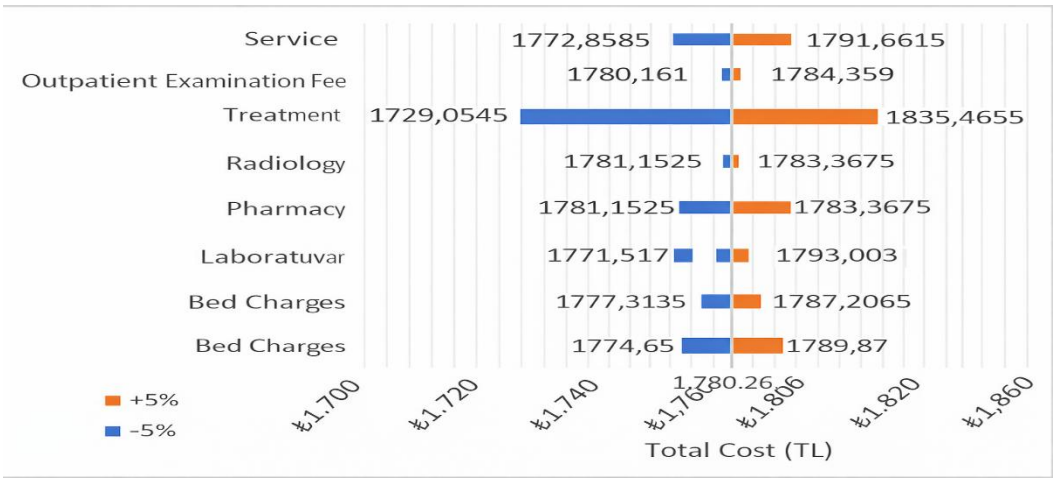


Figure 2. Tornado Diagram Results (Reimbursement Institution Perspective: Patient Costs for All Patients)

Figure 2 presents the impact of increasing and decreasing each of the parameters—service, examination fee, treatment, radiology, pharmacy, laboratory, and bed charges—that constitute the cost of illness from the reimbursement institution perspective for all patients by 5%, while keeping the other parameters constant. The average total patient cost from the reimbursement institution perspective was calculated as 1,782.26 TL. As a result of the sensitivity analysis, the average disease cost ranged between 1,700 TL and 1,860 TL. The tornado diagram demonstrates which of these parameters has a greater impact on disease cost. When the effects of the parameters on disease cost were examined, treatment was identified

as the cost component with the greatest impact, followed by service, pharmacy, bed charges, laboratory, examination fee, and radiology, respectively.

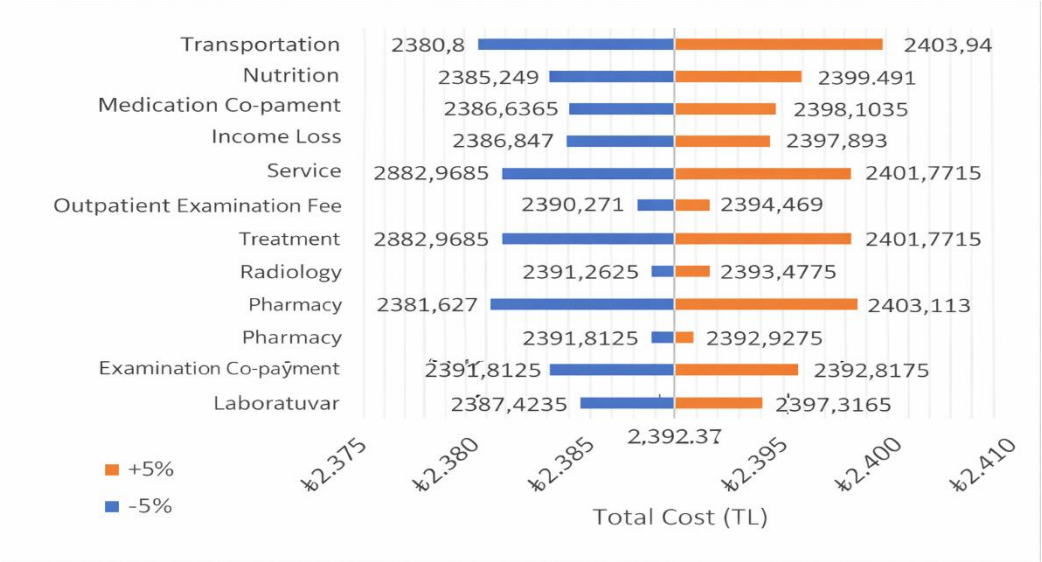


Figure 3. Tornado Diagram Results (Societal Perspective: Patient Costs for All Patients)

Figure 3 presents the impact of increasing and decreasing each of the parameters—examination co-payment, medication co-payment, transportation, nutrition, income loss, service, examination fee, treatment, radiology, pharmacy, laboratory, and bed charges—that constitute the cost of illness from the societal perspective for all patients by 5%, while keeping the other parameters constant. The average total patient cost from the societal perspective was calculated as 2,392.37 TL. As a result of the sensitivity analysis, the average disease cost ranged between 2,375 TL and 2,410 TL. The tornado diagram demonstrates which of these parameters has a greater impact on disease cost. When the effects of the parameters on disease cost were examined, transportation was identified as the cost component with the greatest impact, followed by pharmacy, treatment, service, bed charges, nutrition, laboratory, medication co-payment, income loss, examination fee, radiology, and examination co-payment, respectively.

Findings of the Budget Impact Analysis

The burden of COPD on the national budget was calculated from the patient and patient relative, reimbursement institution, and societal perspectives for outpatient, inpatient, and total patients. The findings of the budget impact analysis are presented in Table 3. According to these findings, from the societal perspective, the burden of healthcare expenditures for individuals with COPD was 0.64% for outpatients and 8.7% for inpatients. Considering the population projections of the Turkish Statistical Institute (TURKSTAT), the population of Türkiye is estimated to reach 100,331,233 in 2040 and 107,664,079 in 2069. In light of these projections, it is estimated that by 2040 the number of individuals with COPD will reach 6,521,530, and the total COPD cost for inpatients from the societal perspective will amount to 62,152,269,171.50 TL. As of 2069, the number of individuals with COPD is expected to increase to 6,998,165, and the total COPD cost for inpatients from the societal perspective is estimated to be 66,694,753,149.39 TL.

Table 6 evaluates the economic burden of Chronic Obstructive Pulmonary Disease (COPD) from the patient and patient relative, reimbursement institution, and societal perspectives. According to the findings, the total cost for outpatients was calculated as 3.02 billion TL from the patient and patient relative perspective, 840 million TL from the reimbursement institution perspective, and 3.86 billion TL

from the societal perspective. These amounts correspond to 0.50%, 0.14%, and 0.64% of total health expenditures, respectively. In the inpatient group, costs were markedly higher, amounting to 4.88 billion TL from the patient and patient relative perspective, 47.9 billion TL from the reimbursement institution perspective, and 52.8 billion TL from the societal perspective, accounting for 0.81%, 7.89%, and 8.70% of total health expenditures, respectively. When all patients were evaluated together, the total cost reached 13.25 billion TL from the societal perspective, corresponding to 2.18% of total health expenditures.

Table 6. Findings of the Cost-of-Illness and Budget Impact Analysis

Outpatient			
	Patient and Caregiver Perspective	**Payer Perspective**	**Societal Perspective**
Number of Patients	5.539.921	5.539.921	5.539.921
Total Health Expenditure	545,43 TL 32,82 $	151,68 TL 9,13 $	697,11 TL 6,96 $
Total Cost	3.021.639.111,03 TL 181.820.207,22 $	840.295.217,3 TL 50.579.478,73 $	3.861.934.328,31 TL 38.557.850,16 $
Total Health Expenditure	606.835.228.153,8 TL	606.835.228.153,8 TL	606.835.228.153,8 TL
Share of Total Health Expenditure (%)	0,50	0,14	0,64
Inpatient			
	Patient and Caregiver Perspective	**Payer Perspective**	**Societal Perspective**
Number of Patients	5.539.921	5.539.921	5.539.921
Total Health Expenditure	882,44 TL 53,10 $	8.647,88 TL 520,38 $	9.530,32 TL 573,48 $
Total Cost	4.888.647.887,24 TL 294.169.805,10 $	47.908.572.017,48 TL 2.882.864.089,98 $	52.797.219.904,72 TL 3.177.033.895,08 $
Total Health Expenditure	606.835.228.153,8 TL	606.835.228.153,8 TL	606.835.228.153,8 TL
Share of Total Health Expenditure (%)	0,81	7,89	8,70
All Patients			
	Patient and Caregiver Perspective	**Payer Perspective**	**Societal Perspective**
Number of Patients	5.539.921	5.539.921	5.539.921
Average Cost per Patient	610,11 TL 36,71 $	1.782,261 TL 107,25 $	2.392,37 TL 143,96 $
Total Cost	3.379.961.201,31 TL 203.370.499,91 $	1.190.307.426,06 TL 71.631.178,53 $	13.253.540.802,77 TL 797.527.027,16 $
Total Health Expenditure	606.835.228.153,8 TL	606.835.228.153,8 TL	606.835.228.153,8 TL
Share of Total Health Expenditure (%)	0,56	0,20	2,18

DISCUSSION

In this study, the cost of illness and quality of life were evaluated together in individuals with COPD. The findings indicate that COPD is a significant health problem at both individual and societal levels, with a marked reduction in patients' quality of life and a high economic burden.

The mean COPD Assessment Test (CAT) score was found to be 25.97, indicating a high symptomatic burden. This average score reflects that the study population consisted largely of symptomatic individuals with frequent active COPD exacerbations. The literature shows that CAT scores vary across

countries. For example, Nolan (24) reported a mean score of 20.7, Miravitlles (25) reported 17.5, and Altunışık (26) reported 30.58. These differences may be explained by variations in disease severity, age distribution, access to healthcare services, and socioeconomic conditions. The high CAT scores observed in Türkiye may be associated with advanced age, a high prevalence of comorbidities, and a predominantly symptomatic patient population.

In this study, the EuroQol index score was 0.44 and the EuroQol VAS score was 41.05, indicating low quality of life. Wu (27) reported an index score of 0.77 and a VAS score of 70 in China, while Choi (28) reported 0.74 and 63 in South Korea. Hansen (29) found an index score of 0.66 and a VAS score of 49.2 in Denmark. These differences may be related to better access to healthcare, patient education, and early diagnosis in developed countries. The low quality of life scores in Türkiye may be attributed to lower health literacy levels and a high prevalence of comorbidities.

Regarding SGRQ scores, this study found values of 69.18 for the symptom domain, 81.70 for activity, 59.67 for impact, and 68.07 for the total score. These scores indicate that COPD severely restricts daily life activities. Nolan (24) reported a total score of 51.1, Sciriha (30) reported 43.4, and Altunışık (26) reported 75.9. While consistent with international studies in terms of symptom burden and reduced quality of life, the present study reflects a more severe clinical picture.

The impact of comorbidities on COPD is noteworthy. In this study, 93% of patients had at least one comorbid condition, most commonly hypertension (58.1%), heart disease (32.5%), and diabetes (26.9%). Miravitlles (25) reported a hypertension rate of 63.7%, while Rehman (31) reported a comorbidity rate of 76.8%. A high burden of comorbidities increases both direct medical costs and negatively affects quality of life, highlighting the importance of effective management of comorbid conditions in COPD care.

The present study found that as CAT scores increased, SGRQ and EuroQol scores decreased. This inverse relationship demonstrates the direct impact of symptom severity on quality of life. Similar findings have been reported by Rehman (31) and Hansen (29), indicating that COPD management should address not only clinical symptoms but also quality of life dimensions.

Geographical factors and healthcare system characteristics play a significant role in disease burden. High SGRQ and CAT scores in Türkiye may be explained by environmental exposures, smoking prevalence, and delayed diagnosis. Rocha (32) in Portugal and Kawayama (33) in Japan reported lower scores, attributing these findings to strong healthcare systems, early diagnosis, and high health literacy. This underscores the importance of healthcare system effectiveness in COPD management.

The observed cost differences between inpatient and outpatient groups highlight the importance of early diagnosis and exacerbation prevention programs. COPD exacerbations impose substantial economic burdens at both individual and systemic levels. Shah (34) similarly reported that exacerbations are a major determinant of cost. Therefore, strengthening preventive healthcare services and expanding interventions aimed at reducing exacerbation frequency are essential.

International comparisons show substantial variation in COPD-related costs across countries. Foo (36) reported annual per-patient costs of USD 30,826 in the United States, USD 18,803 in the United Kingdom, and USD 11,066 in Germany, compared with USD 3,796 in Mexico and USD 1,721 in Russia. In Europe, Merinom (37) reported a cost of EUR 3,757 in Spain, while Stafyla (38) reported EUR 1,034 in Greece. These differences are attributable to variations in healthcare systems, insurance structures, economic conditions, and COPD management protocols. Although costs in Türkiye are relatively lower due to publicly funded healthcare services and medication policies, this does not diminish the overall burden of the disease on society.

Analysis of cost components revealed that direct medical costs constituted the largest share. In this study, direct medical costs were calculated as 1,908 TL (USD 114), non-medical costs as 373 TL (USD 22), and indirect costs as 110 TL (USD 6). Kim (39) reported a total cost of USD 1,245 in South Korea, while Fang (40) reported costs ranging from USD 1,964 to 3,449 in China. Although costs in Türkiye are lower due to public financing, they still represent a substantial economic burden for patients when income levels are considered.

Overall, the findings demonstrate that COPD imposes not only a clinical but also a significant economic and social burden. Factors such as smoking, age, comorbidities, and access to healthcare services play decisive roles in both quality of life and cost. Although the healthcare system in Türkiye has made important progress in COPD treatment, the persistently low quality of life, high symptom burden, and substantial economic costs indicate the need for multidimensional management strategies.

Strengths and limitations

- The exclusion of individuals with insufficient contact information and those who had died from the study population can be considered a natural limitation.
- Limiting the study to data from 2022 and to the province of Bitlis (city center and districts) constitutes a limitation.
- From the societal perspective, the exclusion of indirect costs other than income losses of patients and their relatives is another limitation.

CONCLUSIONS

This study is one of the pioneering investigations to comprehensively examine the relationship between disease cost and quality of life in individuals with COPD. The findings demonstrate that COPD is not only a clinical condition but also a serious economic and social burden. A total of 1,683 individuals were included in the study; most participants were male (63.5%) and outpatients (80.8%). The mean age was 66.5 years, and 93% of participants had at least one comorbid condition, with hypertension being the most common (58.1%). According to the cost analysis, the average cost was 697.11 TL (USD 6.96) for outpatients and 9,530.32 TL (USD 573.48) for inpatients. In inpatients, the majority of costs (92.05%) were attributable to direct medical care. Positive associations were found between CAT and SGRQ scores and disease costs, while negative associations were observed with quality of life indicators. Increases in CAT and SGRQ scores indicate simultaneous increases in symptom burden and economic cost.

The geographical and socioeconomic characteristics of the study region, access to healthcare services, and levels of health literacy contributed to outcomes that differed from national averages. Environmental factors such as tandoor use among women and smoking among men were identified as prominent risk factors that increased COPD severity. Based on these findings, increasing social support to reduce indirect costs such as transportation and nutrition, providing transportation assistance through healthcare institutions, strengthening rational drug use policies to reduce unnecessary services and treatment costs, expanding smoking cessation programs, reducing exposure to tandoor smoke among women, improving environmental air quality, increasing continuous training for healthcare professionals, and implementing national campaigns to enhance COPD awareness are recommended.

Furthermore, developing policies for early diagnosis, rehabilitation, and chronic disease management, reducing environmental risks, and adopting a holistic approach within healthcare systems will both improve quality of life and reduce economic burden. Future studies conducted with multicenter and

larger samples that consider regional differences will contribute to a more accurate assessment of the clinical and economic burden of COPD.

Abbreviations

COPD: Chronic Obstructive Pulmonary Disease

CAT: COPD Assessment Test

SGRQ: St. George's Respiratory Questionnaire

EQ-5D-5L: EuroQol Five-Dimension Five-Level Questionnaire

EQ-VAS: EuroQol Visual Analogue Scale

GOLD: Global Initiative for Chronic Obstructive Lung Disease

SSI: Social Security Institution

TURKSTAT: Turkish Statistical Institute

Ethics approval and consent to participate

Ethical approval was obtained from the Bitlis Eren University Ethical Principles and Ethics Committee (Decision No: 2023/03-18; Document No: E.3596; April 4, 2023). All procedures involving human participants were conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments. Written informed consent was obtained from all participants prior to their inclusion in the study.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

B.S. and I.A. conceived the study. B.S. designed the study, supervised the research process, collected and processed the data, performed the statistical analyses, interpreted the findings, and drafted the manuscript. I.A. contributed to the literature review and critically revised the manuscript. Both authors read and approved the final manuscript.

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REFERENCES

1. Turkish Statistical Institute (TURKSTAT). Distribution of major diseases/health problems experienced by individuals in the last 12 months by sex. https://data.tuik.gov.tr/Bulten/Index?p=Turkiye-Saglik-Arastirmasi-2022-49747
2. Turkish Thoracic Society. Chronic obstructive pulmonary disease (COPD). Ankara: MİKİ Printing Industry and Trade Ltd Co; 2019. Turkish Thoracic Society Educational Books Series.
3. Bellamy D, Booker R. Chronic obstructive pulmonary disease in primary care. London: Class Publishing; 2004.
4. Hansel TT, Barnes PJ. *An atlas of chronic obstructive pulmonary disease (COPD)*. London: The Parthenon Publishing Group; 2004.
5. Barnes P, Godfrey S. Chronic obstructive pulmonary disease. New York: Taylor & Francis Group; 2000.
6. Saha S, Gerdtham UG. Cost of illness studies on reproductive, maternal, newborn and child health: a systematic literature review. *Health Econ Rev* 2013;3:24. doi:10.1186/2191-1991-3-24
7. Uyl-de Groot CA. Economic evaluation of cancer therapies: more and better studies will lead to better choices in cancer care. *Eur J Cancer* 2006;42:2862–6. doi:10.1016/j.ejca.2006.08.008
8. Noyes K, Holloway RG. Evidence from cost-effectiveness research. *NeuroRx* 2004;1:348–55. doi:10.1602/neurorx.1.3.348
9. Konnopka A, Leichsenring F, Leibing E, König HH. Cost-of-illness studies and cost-effectiveness analyses in anxiety disorders: a systematic review. *J Affect Disord* 2009;114:14–31. doi:10.1016/j.jad.2008.07.014
10. Segel JE. Cost-of-illness studies: a primer. Research Triangle Park (NC): RTI–UNC Center of Excellence in Health Promotion Economics; 2006.
11. Jones PW. *St. George's Respiratory Questionnaire manual*. London: University of London, Division of Cardiac and Vascular Science; 2022.
12. EuroQol Group. EQ-5D-5L. https://euroqol.org/information-and-support/euroqol-instruments/eq-5d-5l/. Accessed 10 Jan 2024.
13. Aslan DT. Prostat kanseri tedavisinde robotik ve açık radikal prostatektomi yöntemlerinin maliyet etkililik analizi. (PhD thesis). Ankara: Ankara Üniversitesi; 2020.
14. Işıkçelik F, Ağırbaş İ, Kaya CT. An analysis of cost-effectiveness of stents used in the treatment of coronary artery disease. *Balkan Med J* 2019;36:276–82.
15. Işıkçelik F. Akut miyokard infarktüsünde hastalık maliyeti ve yaşam kalitesinin değerlendirilmesi. (PhD thesis). Ankara: Ankara Üniversitesi; 2023.
16. Kutlu G. Kalça kırıklarının tedavisinde uygulanan proksimal femoral çivi ve bipolar kalça protezi yöntemlerinin maliyet etkililik analizi. (PhD thesis). Ankara: Ankara Üniversitesi; 2022.
17. Saygılı M. Üç farklı palyatif bakım hizmet modelinin kanserli hastaya bakım veren aile üyeleri açısından değerlendirilmesi ve maliyet-etkililik analizi. (PhD thesis) Ankara: Hacettepe Üniversitesi; 2016.
18. Yiğit V, Erdem R. Türkiye'de diyaliz ve böbrek transplantasyonu tedavisinin maliyet etkililik analizi. *Mehmet Akif Ersoy Univ Sos Bilim Enst Derg* 2016;1:182–205.
19. Yorgancıoğlu A, Polatlı M, Aydemir Ö, Demirci Yılmaz N, Kırkıl G, Atış Naycı S, *et al*. KOAH değerlendirme testinin Türkçe geçerlilik ve güvenilirliği. *Tuberk Toraks* 2012;60:314–20.
20. Jones PW, Harding G, Berry P, Wiklund I, Chen WH, Kline Leidy N. Development and first validation of the COPD Assessment Test. *Eur Respir J* 2009;34:648–54. doi:10.1183/09031936.00102509
21. Jo C. Cost-of-illness studies: concepts, scopes and methods. *Clin Mol Hepatol* 2014;20:327–37. doi:10.3350/cmh.2014.20.4.327

22. Central Bank of the Republic of Türkiye. Indicative exchange rates of the Central Bank. https://evds2.tcmb.gov.tr/index.php?/evds/serieMarket/#collapse_2. Published 19 Feb 2024.
23. Büyüköztürk Ş, Çokluk Ö, Köklü N. Sosyal bilimler için istatistik. Ankara: Pegem Akademi; 2016.
24. Nolan CM, Longworth L, Lord J, Canavan JL, Jones SE, Kon SS, *et al*. The EQ-5D-5L health status questionnaire in COPD: validity, responsiveness and minimum important difference. *Thorax* 2016;71:493–500. doi:10.1136/thoraxjnl-2015-207782
25. Miravitlles M, Koblizek V, Esquinas C, Milenkovic B, Barczyk A, Tkacova R, *et al*. Determinants of CAT (COPD Assessment Test) scores in a population of patients with COPD in Central and Eastern Europe: the POPE study. *Respir Med* 2019;150:141–8. doi:10.1016/j.rmed.2019.03.007
26. Altunışık B. (2023). KOAH'lı bireylerde dispne, sosyal destek ve yaşam kalitesinin belirlenmesi (Master's thesis). Amasya Üniversitesi, Amasya.
27. Wu M, Zhao Q, Chen Y, Fu C, Xu B. Quality of life and its association with direct medical costs for COPD in urban China. *Health Qual Life Outcomes* 2015;13:57. doi:10.1186/s12955-015-0241-5
28. Choi HS, Yang DW, Rhee CK, Yoon HK, Lee JH, Lim SY, *et al*. The health-related quality of life of chronic obstructive pulmonary disease patients and disease-related indirect burdens. *Korean J Intern Med* 2020;35:1136–44. doi:10.3904/kjim.2018.398
29. Hansen H, Beyer N, Frølich A, Godtfredsen N, Bieler T. Inter-day test–retest reproducibility of the CAT, CCQ, HADS and EQ-5D-3L in patients with severe and very severe COPD. *Patient Relat Outcome Meas* 2021;12:117–28. doi:10.2147/PROM.S306352
30. Sciriha A, Lungaro-Mifsud S, Scerri J, Magro R, Camilleri L, Montefort S. Health status of COPD patients undergoing pulmonary rehabilitation: a comparative responsiveness of the CAT and SGRQ. *Chron Respir Dis* 2017;14:352–9. doi:10.1177/1479972317694622
31. Rehman A ur, Hassali MAA, Harun SN, Abbas S, Muneswarao J, Ali IABH, *et al*. Validation and clinical interpretation of the St George's Respiratory Questionnaire for COPD (SGRQ-C) after adaptation to Malaysian language and culture in patients with COPD. *Health Qual Life Outcomes* 2020;18:138. doi:10.1186/s12955-020-01393-1
32. Rocha V, Jácome C, Martins V, Marques A. Are in-person and telephone interviews equivalent modes of administering the CAT, the FACIT-FS and the SGRQ in people with COPD? *Front Rehabil Sci* 2021;2:729190. doi:10.3389/fresc.2021.729190
33. Kawayama T, Takahashi K, Ikeda T, Fukui K, Makita N, Tashiro N, *et al*. Exacerbation rates in Japanese patients with obstructive lung disease: a subanalysis of the prospective, observational NOVELTY study. *Allergol Int* 2024;73:71–80. doi:10.1016/j.alit.2023.08.003
34. Shah CH, Reed RM, Wastila L, Onukwugha E, Gopalakrishnan M, Zafari Z. Direct medical costs of COPD in the USA: an analysis of the Medical Expenditure Panel Survey 2017–2018. *Appl Health Econ Health Policy* 2023;21:915–24. doi:10.1007/s40258-023-00814-8
35. Polatlı M, Yorgancıoğlu A, Aydemir Ö, Yılmaz Demirci N, Kırkıl G, Naycı Atış S, *et al*. St. George Solunum Anketinin Türkçe geçerlilik ve güvenilirliği. *Tuberk Toraks* 2013;61:81–7.
36. Foo J, Landis SH, Maskell J, Oh YM, van der Molen T, Han MK, *et al*. Continuing to confront COPD international patient survey: economic impact of COPD in 12 countries. *PLoS One* 2016;11:e0152618. doi:10.1371/journal.pone.0152618
37. Merino M, Villoro R, Hidalgo-Vega Á, Carmona C. Social economic costs of COPD in Extremadura (Spain): an observational study. *Int J Chron Obstruct Pulmon Dis* 2018;13:2501–14. doi:10.2147/COPD.S167357

38. Stafyla E, Geitona M, Kerenidi T, Economou A, Daniil Z, Gourgoulianis KI. The annual direct costs of stable COPD in Greece. *Int J Chron Obstruct Pulmon Dis* 2018;13:309–15. doi:10.2147/COPD.S148051
39. Kim C, Kim Y, Yang DW, Rhee CK, Kim SK, Hwang YI, *et al*. Direct and indirect costs of chronic obstructive pulmonary disease in Korea. *Tuberc Respir Dis (Seoul)* 2019;82:27–34. doi:10.4046/trd.2018.0035
40. Fang L, Gao P, Bao H, Tang X, Wang B, Feng Y, *et al*. Chronic obstructive pulmonary disease in China: a nationwide prevalence study. *Lancet Respir Med* 2018;6:421–30. doi:10.1016/S2213-2600(18)30103-6
41. Coşkun, R., Altunışık, R., Yıldırım, E. (2020). Sosyal bilimlerde araştırma yöntemleri SPSS uygulamaları. Sakarya: Sakarya Yayıncılık.

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