






Economic Burden of Pediatric Asthma in Turkey: A Cost of Illness Study from Payer Perspective

Bülent Enis Şekerel¹ , Haluk Türктаş² , Sevim Bavbek³ , Ergün Öksüz⁴ , Simten Malhan⁵ 

¹Department of Pediatrics, Hacettepe University School of Medicine, Ankara, Turkey

²Department of Chest Diseases, Gazi University School of Medicine, Ankara, Turkey

³Department of Chest Diseases, Ankara University School of Medicine, Ankara, Turkey

⁴Department of Family Medicine, Başkent University School of Medicine, Ankara, Turkey

⁵Department of Health Care Management, Başkent University Faculty of Health Sciences, Ankara, Turkey

Cite this article as: Şekerel BE, Türктаş H, Bavbek S, et al. Economic burden of pediatric asthma in Turkey: A cost of illness study from payer perspective. Turk Thorac J 2020; 21(4): 248-54.

Abstract

OBJECTIVES: To estimate economic burden of pediatric asthma in Turkey from payer perspective.

MATERIALS AND METHODS: This cost of illness study was based on identification of per patient annual direct medical costs for the management of pediatric asthma in Turkey from payer perspective. Average per patient direct medical cost was calculated based on cost items related to outpatient visits, laboratory and radiological tests, hospitalizations and interventions, drug treatment and equipment, and co-morbidities/complications.

RESULTS: Based on total annual per patient costs calculated for outpatient admission (\$113.14), laboratory-radiological tests (\$35.94), hospitalizations (\$725.92), drug treatment/equipment (\$212.90) and co-morbidities/complications (\$144.62) cost items, total per patient annual direct medical cost related to management of pediatric asthma was calculated to be \$1,232.53 from payer perspective. Hospitalizations and interventions (58.9%) was the main cost driver. Direct cost for managing controlled and uncontrolled pediatric asthma were calculated to be \$530.17 [key cost driver: drugs/equipment (40.0%)] and \$1,023.16 [key cost driver: hospitalization/interventions (59.0%)], respectively.

CONCLUSION: Our findings indicate that managing patients with pediatric asthma pose a considerable burden to health economics in Turkey, with hospitalizations identified as the main cost driver and two-fold cost increment in case of uncontrolled disease.

KEYWORDS: Pediatric asthma, asthma control, practice patterns, direct costs, cost analysis

Received: 22.03.2019

Accepted: 06.08.2019

INTRODUCTION

Asthma is one of the most common chronic childhood diseases, characterized by recurrent clinical manifestations and associated with bronchial hyper-responsiveness or airflow obstruction and underlying inflammatory process [1-4].

Pediatric asthma shows heterogeneity in phenotypes, genetic background, risk factors, severity, and co-morbidities that may necessitate individually tailored therapeutic and monitoring approaches to prevent exacerbations and to control symptoms [5-7]. Pediatric asthma is considered one of the leading causes of pediatric hospitalizations [2, 4, 8] and a challenge to public health due to its prevalence, severity, morbidity, and economic impact [9, 10] with estimated annual direct costs of €7.9 billion in Europe [11], \$19.7 billion in USA [13], and US \$1.03 billion in Turkey [14-17].

As consistently reported in the Asthma Insights and Reality (AIR) surveys across US, Europe, Asia-Pacific, Japan, and Latin America [18-22], a significant number of asthmatic children remain symptomatic despite currently available treatment regimens, and disease control is far below the levels recommended by guidelines [9, 23-26]. This seems notable given the association of uncontrolled asthma with increased morbidity and mortality, impaired quality of life, and a further increase in medical and societal costs [8, 9, 13]. Nonetheless, it should be noted that definitions for asthma and its severity and control as well as treatment steps are not uniform across the guidelines including Global Strategy for Asthma Management and Prevention (GINA) guidelines [24], the International Consensus on Pediatric Asthma (ICON) guidelines for the pediatric population [27], European Respiratory Society/American Thoracic Society (ERS/ATS) [26], and the World Health Organization guidelines [28].

According to past studies in the allergic and non-allergic pediatric asthma population (age range 5 to 18 years) in Turkey, the prevalence of pediatric asthma in Turkey was estimated to be 7.4%. Patients with controlled and uncontrolled asthma were estimated to comprise 60.0% and 15.0% of the overall pediatric asthma population, respectively (15-17, 22, 29-34).

Address for Correspondence: Simten Malhan, Department of Health Care Management, Başkent University Faculty of Health Sciences, Ankara, Turkey

E-mail: simtenmalhan1@gmail.com

©Copyright 2020 by Turkish Thoracic Society - Available online at www.turkthoracj.org

Overall, 10% of the pediatric patients with controlled asthma and 35% of patients with uncontrolled asthma were considered to be hospitalized in a ward once (for 2 days) and 2.5 times (for 4 days per admission) per year, respectively [15-17, 22, 29]. Moreover, ICU hospitalizations were estimated to occur in 2% of patients with controlled asthma once a year and in 30% of the patients with uncontrolled asthma 2.5 times per year, respectively, for 1 day per admission in each [15-17, 22, 29].

Despite various studies determining the economic impact of pediatric asthma in improving health policies for better disease management [15], limited data are available on the cost of childhood asthma in Turkey [14-17, 29, 35]. This cost of illness study was therefore designed to determine the economic burden of pediatric asthma in Turkey from a payer perspective and with respect to disease control.

MATERIALS AND METHODS

Design

This cost of illness study was based on identification of per patient annual direct medical costs for the management of pediatric asthma in Turkey based on national demographic/health data and literature data and/or expert panel opinion on practice patterns in clinical practice. Direct medical cost was calculated based on cost items related to outpatient visits, laboratory and radiological tests, hospitalizations/interventions/training, drug treatment/equipment, and co-morbidities/complications. Our study was written in accordance with the Declaration of Helsinki.

Data on Real Life Clinical Practice

Data on real-life practice patterns in the management of pediatric patients with asthma in Turkey including outpatient clinic admission rates, laboratory and radiological investigations, selected medications, hospitalizations, and interventions were obtained from the findings provided in the past studies on asthma patients in Turkey as well as expert panel opinion [15-17, 22, 29-34].

Cost Analysis

Average per patient direct medical costs were calculated based on cost items, outpatient visits, laboratory and radiological tests, hospitalizations/interventions/training, drug treatment/equipment, and co-morbidities/complications from a payer perspective (only direct medical costs using prices of the public payer "Social Security Institution (SSI)" in Turkey), using the cost of illness method developed by WHO. For drugs, retail prices from the updated price list and updated institution discount list of SSI for May 2016 were taken into account in calculation of the unit costs. Costs related to diagnostic tests were calculated considering the Health Implementation Notification by SSI. Physician visit costs were

calculated using unit prices based on the same SSI notification. Salaries and labor force of healthcare staff giving service to pediatric asthma patients were provided by the Healthcare Organization Questionnaire composed of Staff Inventory Form and Information Form on the Labor Force Spent during an intervention filled for each study center. Hospitalization costs were calculated using unit prices based on Healthcare Organization Price List in Health Practice Declaration and Treatment Assist Practice Declaration. Monetary results were converted by using 2.97 USD/TL May 2016 exchange rate. Direct non-medical costs of different origin (e.g., transfers of patient and caregivers for examinations and/or hospitalization, home care, etc.) and indirect costs were not included in the cost analysis.

Statistical Analysis

Descriptive statistics were used to summarize results on practice patterns for the pediatric asthma management. Expenses related to management of pediatric asthma were the main cost-analysis related parameter of the study. Cost model was based on the following equation: "Cost = \sum (Frequency; %) X (Unit price; TL) X (patient ratio; %)".

RESULTS

Outpatient Admission Cost Item

Outpatient admissions were estimated to occur in 100.0% of patients for 5 times per patient per year at Pediatrics Outpatient clinics, in 90.0% of patients for 5 times per patient per year at Family Medicine Outpatient clinics, in 40.0% of patients for twice a year per patient at Ear Nose and Throat Outpatient clinics, and in 30.0% of patients for 3 times per patient per year at Immunology and Allergic Diseases Outpatient clinics [15-17, 22, 29] (Table 1).

Based on unit costs, total annual cost per patient related to outpatient admissions was calculated to be \$113.14 (Table 1).

Laboratory and Radiological Tests Cost Item

Blood biochemistry (100.0%), PA/lateral chest XR (90.0%), and oximetry (80.0%) were estimated to be done in the majority of pediatric asthma related admissions in Turkey, while complete blood count, serum total IgE measurement, and skin prick test were done in half of the patients. Annual rates for respiratory function test, reversibility test, tuberculin test, and sweat test were estimated to be 40%, 30%, 30%, and 20%, respectively of the total cost [15-17, 22, 29] (Table 2).

Based on unit costs, total annual cost per patient related to laboratory and radiological tests was calculated to be \$35.94 (Table 2).

Hospitalizations and Interventions/Training Cost Item

Overall, 10% of pediatric patients with controlled asthma and 35% of patients with uncontrolled asthma were considered to be hospitalized in a ward once (for 2 days) and 2.5 times (for 4 days per admission) per year, respectively [15-17, 22, 29].

ICU hospitalizations were estimated to occur in 2% of patients with controlled asthma once a year and in 30% of the patients with uncontrolled asthma 2.5 times per year for 1 day per admission in each. Patient education was imparted to

MAIN POINTS

- Uncontrolled asthma creates big cost.
- The main cost driver is generally hospitalization.
- Prevention strategies can be reduce cost of illness.

Table 1. Per patient outpatient admission cost item: Clinical practice, unit costs and total cost [15-17, 22]

Outpatient admissions	Annual visit percentage (%)	Annual visit # per patient	Unit cost per admission (\$)	Total cost (\$)
Pediatrics	100.0	5	9.72	48611.11
Family Medicine	90.0	5	9.39	42234.85
Emergency	25.0	2	37.00	18502.00
Ear Nose and Throat	40.0	2	2.02	1616.16
Endocrinology	1.0	1	2.02	20.20
Gastroenterology	5.0	1	2.02	101.01
Infectious Diseases	1.0	1	2.02	20.20
Cardiology	1.0	1	2.02	20.20
Allergy-Immunology	30.0	3	2.02	1818.18
Cardiovascular Surgery	1.0	3	2.02	60.61
Nephrology	0.1	3	2.02	6.06
Eye Diseases	1.0	1	2.02	20.20
Nutrition and Diet	1.0	1	11.20	111.95
Total	113142.74			
Per patient outpatient admission costs (\$)	113.14			

all patients once a year [15-17, 22, 29] (Table 3).

Based on unit costs, total annual cost per patient related to hospitalizations and interventions/training was calculated to be \$725.92 (Table 3).

Drug Treatment and Equipment Cost Item

Based on prescription rates in Turkey [15-17, 22, 29-34], maintenance doses, annual dose, unit cost per box for each drug regimen, and unit costs of equipment, total annual cost per patient related to drug treatment and equipment was calculated to be \$212.90 (Table 4).

Co-Morbidities/Complications Cost Item

Based on prevalence of comorbid disorders in pediatric asthma patients in Turkey [15-17, 22, 29-34], and related unit costs, total annual cost per patient related to co-morbidities and complications was calculated to be \$144.62 (Table 5).

Total Annual Direct Medical Cost Per Patient

Based on total annual costs per patient calculated for outpatient admission (\$113.14), laboratory-radiological tests (\$35.94), hospitalizations (\$725.92), drug treatment/equipment (\$212.90), and co-morbidities/complications (\$144.62) cost items, total annual direct medical cost per patient related to management of pediatric asthma was calculated to be \$1,232.53 from a payer perspective. Hospitalizations and interventions (58.9%) was the main driver of costs in the management of pediatric asthma in Turkey followed by drug treatment/equipment costs (17.3%) and costs of co-morbidities/complications (11.7%) (Table 6).

Prevalence of pediatric asthma was estimated to be 7.4%, while patients with controlled and uncontrolled asthma were estimated to comprise 60.0% and 15.0% of overall pediatric asthma population, respectively [15-17, 22, 29-34]. Accordingly, total annual direct medical costs per patient related to management of controlled and uncontrolled pediatric asthma

were calculated to be \$530.17 [key cost driver: drugs/equipment (40.0%)] and \$1,023.16 [key cost driver: hospitalization/interventions (59.0%)], respectively (Table 6).

DISCUSSION

Our findings revealed annual direct medical cost per patient of pediatric asthma in Turkey to be \$1,232.53 from a payer perspective with hospitalizations/interventions (\$725.92; 58.9%) as the major cost driver. Managing uncontrolled pediatric asthma was associated with almost a two-fold cost increase when compared with controlled asthma (\$1,023.16 vs. \$530.17), mainly due to higher hospitalization costs in case of uncontrolled disease (\$726.13 vs. \$30.84, comprising 59% vs. 5% of total costs, respectively).

Based on our findings, the annual population-level economic burden of the pediatric asthma was estimated to be \$1.08 billion and the ratio to gross national product (GNP) as 0.19%, supporting the statement that total annual costs in Turkey is comparable to costs reported in developed countries [15, 17].

While outpatient treatment and drug prescriptions were identified as the major cost driver in pediatric asthma in Europe (46-48%) [12], our findings revealed that hospitalization (\$725.92; 58.9%) was the main cost driver in the management of pediatric asthma in Turkey, followed by medications [17.3%]. This seems consistent with the estimated annual cost per patient reported for hospitalization cost of US \$955.5 reported for pediatric asthma in Turkey (35).

Notably, uncontrolled asthma was associated with a two-fold cost increase as compared with controlled asthma in our study (\$1,023.16 vs. \$530.17), while hospitalization and medication items accounted for 5% and 40% of the total cost in controlled asthma and 59% and 17% of total cost in uncontrolled pediatric asthma, respectively. Similarly, di-

Table 2. Per patient laboratory and radiological tests cost item: Clinical practice, unit and total cost [15-17, 22, 29-34]

Laboratory/ radiological tests	Annual implementation rate (%)	Annual test # per patient	Unit cost (\$)	Total cost (\$)
Blood biochemistry	100.0	1	0.00	0.00
Complete blood count	50.0	2	0.00	0.00
PA/lateral chest X-ray	90.0	3	0.00	0.00
Respiratory function test	40.0	3	8.42	10101.37
Reversibility test	30.0	2	10.55	6327.73
Bronchial provocation test	3.0	1	12.90	387.07
Sputum smear	1.0	1	0.00	0.00
Sweat test	20.0	1	11.41	2282.95
Exhaled NO measurement	1.0	1	0.00	0.00
Exhaled CO measurement	1.0	1	2.59	25.92
Specific IgE measurement	20.0	1	7.14	1427.59
Serum total IgE measurement	50.0	1	0.00	0.00
Skin Prick Test	50.0	1	20.21	10102.96
Lung CT	5.0	1	18.52	925.94
High resolution lung CT	5.0	1	18.52	925.94
Lung MRI	1.0	1	21.89	218.85
Bronchoscopy	1.0	1	50.34	503.37
Tuberculin test	30.0	1	0.51	151.55
Sputum culture	5.0	1	0.00	0.00
Bronchial biopsy	1.0	1	72.16	721.63
Electrocardiography	5.0	1	0.00	0.00
Echocardiography	5.0	1	0.00	0.00
Lung volume diffusing capacity	1.0	1	78.57	785.69
Oximetry	80.0	2	0.00	0.00
Arterial blood gas analysis	10.0	1	1.72	171.71
Exercise test	5.0	1	10.00	499.96
Alpha-1 antitrypsin test	1.0	1	2.79	27.95
Theophylline level	1.0	1	1.72	17.17
Endoscopy	1.0	1	33.70	337.05
Total	35942.39			
Per patient laboratory and radiological tests cost (\$)	35.94			

CO: carbon monoxide; CT: computerized tomography; Ig: immunoglobulin; MRI: magnetic resonance imaging NO: nitric oxide; PA: posteroanterior

Table 3. Per patient hospitalization/interventions cost item: Clinical practice, unit costs and total cost [15-17, 22, 29-34]

Hospitalization at ward	Annual #of hospitalization	Percentage (%)	LOS per admission (days)	Unit daily cost (\$)	Total cost (\$)
Controlled asthma	1	10	2	73.19	14637.37
Uncontrolled asthma	2.5	35	4	73.19	256151.52
Hospitalization at ICU					
Controlled asthma	1	2	1	314.64	6292.93
Uncontrolled asthma	2.5	30	1	343.70	257775.76
# per patient Unit cost Total cost					
Patient education		1	2.63	2627.57	
	725925.21	725.92			

CO: carbon monoxide; CT: computerized tomography; Ig: immunoglobulin; MRI: magnetic resonance imaging NO: nitric oxide; PA: posteroanterior

Table 4. Per patient treatment and equipment cost item: Clinical practice, unit costs and total cost [15-17, 22, 29-34]

Equipment	Patients (%)	Duration	# of equipment	Unit cost (\$)	Total cost (\$)
Peak flow meter	5.0	1	1	16.84	841.75
Medical device	100.0	1	1	19.08	19079.69
Drugs	Prescription (%)	Daily dose	Duration	Unit cost (box/year; \$)	Total cost (\$)
SABA	30.0	1	1	8.38	2514.75
LABA + ICS	15.0	1	1	159.04	23856.03
Inhaled corticosteroids	60.0	1	1	74.94	44965.02
Leukotriene antagonists	50.0	1	1	108.54	54268.24
Nasal steroids	30.0	1	1	27.20	8160.19
Antihistamines	20.0	1	1	27.69	5537.10
Terbutaline Oral	1.0	1	1	14.02	140.20
Salbutamol Oral	1.0	1	1	18.34	183.43
Oral corticosteroid	0.50	1	1	17.21	86.05
Omalizumab	1.0	1	1	.00	22835.15
Ipratropium+Salbutamol	1.0	1	1	17.56	175.55
Calcium –vitamin D	0.1	1	1	28.97	28.97
Clarithromycin	70.0	1	1	4.62	3235.02
Immunotherapy	10.0	1	1	.00	50853.46
Acupuncture	1.0	1	12	.00	.00
Total	212904.58				
Per patient drug/equipment cost (\$)	212.90				

ICS: inhaled corticosteroids LABA: Long-acting beta-2 agonists, SABA: Short-acting beta-2 agonists

Table 5. Per patient co-morbidities/complications cost item: Clinical practice, unit costs and total cost [15-17, 22, 29-34]

Comorbidities / complications	Patients (%)	Duration of treatment	# of treatments per year	Unit cost (\$)	Total cost (\$)
Rhinosinusitis	90.0	1	1	21.46	19317.17
Allergic rhinitis	60.0	1	1	122.59	73556.56
Sinusitis	40.0	1	1	26.04	10414.59
Polyp	1.0	1	1	317.27	3172.73
Gastroesophageal reflux	20.0	1	1	190.80	38160.26
Total	144621.30				
Per patient comorbidities/complications cost (\$)	144.62				

Table 6. Per patient annual direct medical cost related to management of pediatric asthma

Cost items	Total		Controlled asthma		Uncontrolled asthma	
	Per patient annual cost (\$)	Contribution to total cost (%)	Per patient annual cost (\$)	Contribution to total cost (%)	Per patient annual cost (\$)	Contribution to total cost (%)
Outpatient admission	113.14	9.2	113.14	21.0	113.14	9.0
Laboratory test	35.94	2.9	35.94	7.0	35.94	3.0
Hospitalization/intervention	725.92	58.9	30.84	5.0	726.13	59.0
Drug/equipment	212.90	17.3	212.90	40.0	212.90	17.0
Comorbidities/complications	144.62	11.7	144.62	27.0	144.62	14.0
Total direct per patient cost (\$)	1,232.53	530.17	1,023.16			

rect cost of pediatric asthma per patient in Turkey was reported to be 8542.97 in controlled asthma and 1047.86 in uncontrolled asthma with medications and hospitalizations

accounting for 40% and 4% of the total cost, respectively in case of controlled asthma and for 50% and 21% of total cost in case of uncontrolled asthma [29]. This seems consistent

with data from Spain, which indicated a child with asthma generates a mean annual cost of €1149, ranging broadly from €403 in the case of mild asthma to €5,380 in patients with severe asthma [36]. The mean annualized asthma direct cost per child was reported to be €929.35 in Portuguese children, and the authors also noted higher mean annual costs for partly controlled (adjusted coefficient: 1.46) and uncontrolled (adjusted coefficient: 2.25) asthma [37].

Indeed, in an analysis of asthma control by the Turkish Asthma Control Survey Study Group in 2336 patients with asthma from seven geographical districts in Turkey, rates for controlled and uncontrolled asthma in adults were reported to be 51.5% and 48.5%, respectively [38]. Moreover, a past study from Turkey estimated the mean annual asthma cost per patient to be €558.41 and €1040.63 for controlled and uncontrolled asthma, respectively [39]. Hence, the direct cost increment with identification of hospitalization as the key cost driver in uncontrolled asthma in the pediatric asthma population in Turkey seems notable given the higher prevalence of uncontrolled asthma in the pediatric population (60%) as compared with adult population (48.5%) in Turkey.

Identification of hospitalizations as the main cost driver in managing pediatric asthma in our study seems consistent with the consideration of asthma as a leading cause of hospitalizations in children in both developed and developing countries as responsible for one-third to one-half of all hospitalizations in children aged 1-9 years [10]. Increase in in-hospital admissions for childhood asthma was also reported in Turkey with asthma accounting for 73.2% of all readmissions of childhood diseases.

Given that almost 40% of pediatric asthma hospitalizations are repeat hospitalizations, identification of hospitalization cost as the major cost driver in case of uncontrolled asthma in our study seems to support the association of higher readmission rates with poor asthma control and emphasizes the fact that the likelihood of reduction of repeat hospitalizations will significantly reduce costs of health care in addition to improving patient outcomes [40].

Significant contribution of in-hospital admissions to per patient direct cost in case of uncontrolled pediatric asthma is notable given the low level of asthma control among asthma patients in Turkey as in other international AIR surveys that is far below levels recommended in guidelines, despite the availability of effective therapies [22].

Indeed, hospitalization was reported to account for nearly one-third of the national pediatric asthma costs alongside higher utilization of healthcare resources with increasing age and disease severity, not only in terms of drugs but also inpatient care [16]. Since asthma severity is considered amongst the most significant determinants of asthma control [31], treatment strategies that minimize exacerbations are considered likely to avoid the disproportionate share of asthma healthcare resources by sub-optimally controlled disease by decreasing the number of unscheduled physician visits and reducing asthma-related hospitalizations.

Hence, our findings support the fact that the direct cost of

pediatric asthma in Turkey increases based on the level of disease control level [29], and hospitalization in addition to frequent physician visits and asthma severity is among the major predictors of total annual costs related to asthma in Turkey [15, 35].

Given the annual hospitalization rates (30-35%) for uncontrolled asthma in the present analysis, the impact of deciding on appropriate timing of hospitalization as well as maintenance treatment with inhaled corticosteroids on hospitalization rates [30] needs to be further investigated in the pediatric asthma population in Turkey.

Certain limitations of this study should be considered. First, being focused only on direct costs, lack of data on indirect costs (loss of productivity due to the illness) or intangible costs of illness (costs of suffering for the patient and his/her family) seems to be the major limitation of the present study which will likely result in a downward bias in our estimates of the economic cost of pediatric asthma. Second, the use of epidemiological studies published to date rather than the national database to obtain data on practice patterns that were used to identify direct medical costs might raise a concern with the validity and reliability of the data. Nevertheless, by providing cost estimates for management of pediatric asthma patients with respect to disease control in Turkey, our findings represent a valuable contribution to the literature.

In conclusion, our findings indicate that managing patients with pediatric asthma pose a considerable healthcare cost burden in Turkey, with hospitalizations as the main cost driver and a two-fold cost increment in case of uncontrolled disease. In this regard, our findings emphasize the need for cost-effective prevention strategies to reduce the financial burden of pediatric asthma and the likelihood of potential cost savings by better disease control with reduced frequency of hospitalizations.

Ethics Committee Approval: N/A.

Informed Consent: N/A.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - B.E.S., H.T., S.B.; Design - B.E.S., H.T., S.B., E.O., S.M.; Supervision - B.E.S., H.T., S.B. ; Resources - B.E.S., H.T., S.B., E.O., S.M.; Materials - E.O., S.M.; Data Collection and/or Processing - B.E.S., H.T., S. B., E.O. A.M.; Analysis and/or Interpretation - E.O., S.M.; Literature Search - E.O., S.M.; Writing Manuscript - E.O., S.M.; Critical Review - B.E.S., H.T., S.B.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The creation of the model used in this study, statistics and editorial support were sponsored by GlaxoSmithKline, Turkey in the context of unconditional scientific support. GlaxoSmithKline, Turkey has not contributed to the content of the study. Authors would like to thank to Cagla Ayhan (MD) and Sule Oktay (Prof., MD, PhD) from KAPPA Consultancy Training Research Ltd (Istanbul, Turkey) who provided editorial support; Yalcin Seyhun (MD, PhD, Senior Medical Lead) and Gizem Saribas (Market Access & Pricing Manager) from GlaxoSmithKline, Turkey.

REFERENCES

1. World Health Organization. Asthma fact sheet. 2013. Available from: URL: <http://www.who.int/mediacentre/factsheets/fs307/en/>
2. Akinbami LJ, Moorman JE, Garbe PL, et al. Status of childhood asthma in the United States, 1980-2007. *Pediatrics* 2009;123(Suppl):S131-45. [\[CrossRef\]](#)
3. Trent CA, Zimbro KS, Rutledge CM. Barriers in asthma care for pediatric patients in primary care. *J Pediatr Health Care* 2015;29:70-9. [\[CrossRef\]](#)
4. Glick AF, Tomopoulos S, Fierman AH, et al. Disparities in Mortality and Morbidity in Pediatric Asthma Hospitalizations, 2007 to 2011. *Acad Pediatr* 2016;16:430-7. [\[CrossRef\]](#)
5. Cowan K, Guilbert TW. Pediatric asthma phenotypes. *Curr Opin Pediatr* 2012;24:344-51. [\[CrossRef\]](#)
6. Pijnenburg MW, Szefer S. Personalized medicine in children with asthma. *Paediatr Respir Rev* 2015;16:101-7. [\[CrossRef\]](#)
7. Zilae M, Hosseini SA, Jafarirad S, et al. An evaluation of the effects of saffron supplementation on the asthma clinical symptoms and asthma severity in patients with mild and moderate persistent allergic asthma: a double-blind, randomized placebo-controlled trial. *Respir Res* 2019;20:39. doi: 10.1186/s12931-019-0998-x. [\[CrossRef\]](#)
8. Beck AF, Huang B, Wheeler K, et al. The child opportunity index and disparities in pediatric asthma hospitalizations across One Ohio Metropolitan Area, 2011-2013. *J Pediatr* 2017;190:200-6. [\[CrossRef\]](#)
9. Perry R, Braileanu G, Palmer T, et al. The economic burden of pediatric asthma in the United States: Literature review of current evidence. *Pharmacoeconomics* 2019;37:155-67. [\[CrossRef\]](#)
10. Eum Y, Yoo E, Bowen E. Socioeconomic determinants of pediatric asthma emergency department visits under regional economic development in western New York. *Soc Sci Med* 2019;222:133-44. [\[CrossRef\]](#)
11. Polk BI, Dinakar C. Management of acute loss of asthma control: yellow zone strategies. *Curr Opin Allergy Clin Immunol* 2019;19:154-60. [\[CrossRef\]](#)
12. European Respiratory Society. European Lung White Book. Sheffield, UK: European Respiratory Society, 2003.
13. American Lung Association. Trends in asthma morbidity and mortality. 2012. Available from: URL: <http://www.lung.org/finding-cures/our-research/trend-reports/asthma-trend-report.pdf>
14. "Population, demography, housing and gender statistics" and "national accounts statistics" Available from: URL: <http://www.turkstat.gov.tr/>.
15. Beyhun NE, Soyer OU, Kuyucu S, et al. A multi-center survey of childhood asthma in Turkey - I: The cost and its determinants. *Pediatr Allergy Immunol* 2009;20:72-80. [\[CrossRef\]](#)
16. Çelik GE, Bavbek S, Paşaoğlu G, et al. Direct medical costs of asthma in Ankara, Turkey. *Respiration* 2004;71:587-93. [\[CrossRef\]](#)
17. Civelek E, Cakir B, Boz AB, et al. Extent and burden of allergic diseases in elementary schoolchildren: a national multicenter study. *J Investig Allergol Clin Immunol* 2010;20:280-8.
18. Lai K, Shen H, Zhou X, et al. Clinical Practice Guidelines for Diagnosis and Management of Cough-Chinese Thoracic Society (CTS) Asthma Consortium. *J Thorac Dis* 2018;10:6314-51. [\[CrossRef\]](#)
19. Lai CK, De Guia TS, Kim YY, et al. Asthma control in the Asia-Pacific region: the asthma insights and reality in Asia-Pacific study. *J Allergy Clin Immunol* 2003;111:263-8. [\[CrossRef\]](#)
20. Adams RJ, Fuhlbrigge A, Guilbert T, et al. Inadequate use of asthma medication in the United States: results of Asthma in America national population survey. *J Allergy Clin Immunol* 2002;110:58-64. [\[CrossRef\]](#)
21. Adachi M, Morikawa A, Ishihara K. Asthma insights & reality in Japan (AIR). *Arerugi* 2002;51:411-20.
22. Sekerel BE, Gemicioglu B, Soriano JB. Asthma insights and reality in Turkey (AIRET) study. *Respir Med* 2006;100:1850-4. [\[CrossRef\]](#)
23. Chapman KR, Boulet LP, Rea RM, et al. Suboptimal asthma control: prevalence, detection and consequences in general practice. *Eur Respir J* 2010;31:320-5. [\[CrossRef\]](#)
24. Global initiative for asthma. Global strategy for asthma management and prevention 2014. Available from: URL: http://www.ginasthma.org/local/uploads/files/GINA_Report_2014_Aug12.pdf
25. Reddel HK, Bateman ED, Becker A, et al. A summary of the new GINA strategy: a roadmap to asthma control. *Eur Respir J* 2015;46:622-39. [\[CrossRef\]](#)
26. ChungKF, Wenzel SE, Brozek JL, et al. International ERS/ATS guidelines on definition, evaluation and treatment of severe asthma. *Eur Respir J* 2014;43:343-73. [\[CrossRef\]](#)
27. Papadopoulos NG, Arakawa H, Carlsen K-H, et al. International consensus on (ICON) pediatric asthma. *Allergy* 2012;67: <https://doi.org/10.1111/j.1398-9995.2012.02865.x> [\[CrossRef\]](#)
28. Bousquet J, Mantzouranis E, Cruz AA, et al. Uniform definition of asthma severity, control, and exacerbations: document presented for the World Health Organization Consultation on severe asthma. *J Allergy Clin Immunol* 2010;126:926-38. [\[CrossRef\]](#)
29. Sekerel B, Malhan S. Estimation of the cost of childhood asthma in Turkey. *Value Health* 2014;17:A593. doi: 10.1016/j.jval.2014.08.2036. Epub 2014 Oct 26. [\[CrossRef\]](#)
30. Buyuktiryaki AB, Civelek E, Can D, et al. Turkish Pediatric Asthma Research Group (TURPEDAS). Predicting hospitalization in children with acute asthma. *J Emerg Med* 2013;44:919-27. [\[CrossRef\]](#)
31. Soyer OU, Beyhun NE, Demir E, et al. A multicenter survey of childhood asthma in Turkey. II: Utilization of asthma drugs, control levels and their determinants. *Pediatr Allergy Immunol* 2009;20:172-9. [\[CrossRef\]](#)
32. Soyer OU, Civelek E, Sekerel BE. Physicians' perception of childhood asthma in Turkey: more appropriate practice among female physicians. *BMC Health Serv Res* 2008;8:155. doi: 10.1186/1472-6963-8-155. [\[CrossRef\]](#)
33. Civelek E, Soyer OU, Gemicioglu B, et al. Turkish physicians' perception of allergic rhinitis and its impact on asthma. *Allergy* 2006;61:1454-8. [\[CrossRef\]](#)
34. Demir AU, Karakaya G, Bozkurt B, et al. Asthma and allergic diseases in schoolchildren: third cross-sectional survey in the same primary school in Ankara, Turkey. *Pediatr Allergy Immunol* 2004;15:531-8. [\[CrossRef\]](#)
35. Beyhun NE, Cilingiroğlu N, Sekerel BE. The cost of childhood asthma and its determinants in Ankara, Turkey. *Turk J Pediatr* 2007;49:179-88.
36. Blasco Bravo AJ, Pérez-Yarza EG, Lázaro y de Mercado P, et al. Cost of childhood asthma in Spain: a cost evaluation model based on the prevalence An *Pediatr (Barc)* 2011;74:145-53. [\[CrossRef\]](#)
37. Ferreira de Magalhães M, Amaral R, Pereira AM, et al. Cost of asthma in children: A nationwide, population-based, cost-of-illness study. *Pediatr Allergy Immunol* 2017;28:683-91. [\[CrossRef\]](#)
38. Turktas H, Mungan D, Uysal MA, et al. Turkish Asthma Control Survey Study Group. Determinants of asthma control in tertiary level in Turkey: a cross-sectional multicenter survey *J Asthma* 2010;47:557-62. [\[CrossRef\]](#)
39. Turktas H, Bavbek S, Malhan S. The direct cost of asthma in Turkey. *Value Health* 2014;17:A593. doi: 10.1016/j.jval.2014.08.2040. Epub 2014 Oct 26. [\[CrossRef\]](#)
40. Saraçlar Y, Sekerel BE, Kalayci O, et al. Prevalence of asthma symptoms in school children in Ankara, Turkey. *Respir Med* 1998;92:203-7. [\[CrossRef\]](#)