

Cost of illness of atopic asthma and seasonal allergic rhinitis in Germany: 1-yr retrospective study

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ABSTRACT: The purpose of this study was to evaluate the cost of illness of moderate-to-severe atopic asthma and/or seasonal allergic rhinitis (SAR) in Germany from the perspective of third-party payers (TPP) and patients.

Five-hundred patients (276 children/adolescents) with moderate-to-severe asthma and/or SAR were included in this cross-sectional study. Information was collected using a specific patient questionnaire and the abstraction of patient records.

Overall, annual costs per patient increased with the severity of atopic asthma and if it was associated with SAR. The average annual cost of SAR was €1,089 per child/adolescent and €1,543 per adult. Annual costs of severe asthma plus SAR increased to €7,928 per child/adolescent and to €9,287 per adult. For TPPs, the main cost drivers were medication, hospitalisation, and rehabilitation. The most significant costs for patients were household modifications. For children/adolescents, 60–78% of the expenditures were direct costs, while in adults, 58% of expenditures were indirect costs. It was also observed that patients with moderate and severe asthma used inhaled corticosteroids less frequently than recommended by treatment guidelines.

In summary, the total cost for patients increases with the severity of atopic asthma and/or seasonal allergic rhinitis and indirect costs represent a large proportion of the total cost.

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International studies have shown an increase in the prevalence of allergic diseases [1, 2]. Nasal allergies, including seasonal allergic rhinitis (SAR), afflict 13.4% of adults (20–44 yrs) in East Germany (Erfurt) and 23% in West Germany (Hamburg) [3]. In comparison, 2.1% of adults in the East and 4.4% in the West have bronchial asthma. Particularly significant, however, is the high prevalence of bronchial asthma in children. The International Study of Asthma and Allergies in Childhood observed that 14% of German children aged 13–14 yrs had self-reported asthma [4]. More than 70% of asthma patients report nasal symptoms [5] and 20% of SAR patients develop bronchial asthma later in life [6]. Thus, SAR and bronchial asthma rank among the most common chronic and allergic diseases. Most allergic persons are sensitised to more than one common allergen. Thus, symptoms may present episodically or persistently.

From the societal perspective, the economic impact of asthma in Germany was €2.62 billion in 1992 [7] and €2.97 billion in 1996 [8], of which 61.4% were direct costs [7]. Analysis of 1992 data shows a positive correlation between illness severity and total cost. Total annual cost per patient ranges from €184 for mild asthma to €7,567 for severe asthma [9]. The most recent empirical data, for 1995–1996, clearly show increased costs depending upon illness severity [10]. These are the first published data that reveal the total

cost of atopic asthma/SAR in Germany and the personal expenses of patients.

Clinical studies demonstrate that intranasal steroids, antihistamines and decongestants relieve nasal symptoms in SAR patients. Furthermore, treatment reduces the severity of asthma symptoms and increases peak flow rates [11, 12]. Innovative therapies are often expensive and therefore must be effective, efficient and improve quality of life. Prospective analytical studies are therefore justified. The objective of this study was to describe the burden due to SAR and atopic asthma for children/adolescents and adults in Germany.

Methods

Research design

This was a retrospective cross-sectional study. All direct medical and nonmedical costs were evaluated from the perspective of third-party payers (TPPs) and patients. Indirect costs were also evaluated.

Recruitment

Five areas (urban and rural), evenly distributed across Germany, were selected to account for the

effect of sociodemographical status on the prevalence of atopic diseases [13]. Urban areas were cities with >400,000 inhabitants and rural areas were towns with <50,000 inhabitants. Pulmonologists and paediatricians (n=205) were randomly selected from the local telephone register. Subjects were recruited by 36 doctors, who were each asked to enrol up to 25 patients fulfilling the inclusion criteria. Patients who agreed to complete a patient questionnaire received the questionnaire by mail and returned it directly to the Medical Economics Research Group, Munich, Germany. If patients gave their informed consent, data was obtained from their records.

Criteria for inclusion and exclusion

Patients (aged 6–70 yrs) with moderate-(asthma 3) to-severe (asthma 4) atopic asthma and/or SAR were included. Classification of asthma severity was based on Global Initiative for Asthma (GINA) recommendations [14]. Patients were only included during the study period (March 1, 1999 to February 29, 2000) if treatment was initiated prior to March 1, 1999. Patients with a hypersensitivity to analgesic drugs indistinguishable from atopic asthma were excluded. Written informed consent was obtained from patients.

Data collection

The following data were collected using a specific patient questionnaire: demographical characteristics, consultations with doctors (family physicians and specialists), hospitalisations (including emergencies), rehabilitation care, sickness benefits, *ad hoc* expenses (e.g. over-the-counter (OTC) medication), co-payments (inpatient care and physiotherapy), household modifications (e.g. renovations, replacement of carpets with washable floors, purchase of beddings for patients sensitised against house dust mites), auxiliary devices and nonrefundable therapies. Questions regarding day care for asthmatic children, absence from work and disability were also answered. Patients were interviewed directly regarding absence from work for less than 3 days, since this requires no doctor's note in Germany. Information regarding total workdays missed due to incapacity longer than 3 days, usage of outpatient resources, prescribed medication and medication co-payments was documented by trained medical staff from patients' records into an access database. The appropriateness of this database has been tested by pilot documentation.

Costing

The burden of asthma and SAR care is due to direct medical costs (e.g. health services used for treatment) and direct nonmedical costs (e.g. caregiver costs and household modifications). Indirect costs from disability, early retirement and loss of work by patients and caregivers were also of interest.

To evaluate costs from the perspective of TPPs, the

average frequency of a diagnostic or treatment service was used and multiplied by the charge. Charges for outpatient services are based on points published in the German tariff list [15], multiplied by the average value per point for medical services: pulmonologists €0.03; paediatricians €0.04.

The prescribed medications were documented from patients' records and multiplied by the reimbursable prices recorded in the German pharmaceutical index [16]. These figures were then reduced by the subtraction of patients' co-payments and statutory health insurance.

Inpatient costs were calculated using an average of the daily rate reimbursed by German TPPs for accommodation (year 2000: €70.94), medical services (€157.61–240.28) [17], and rehabilitative therapies (€121.50). Emergency transport by car cost €370.94 and €46.22 per minute by helicopter. The human capital approach was applied to calculate indirect costs arising from lost productivity [18]. The monetary value of productivity for employees was calculated from the data on gross income and number of employees [19] in the Statistical Yearbook of 1999 and was €89.48 per day. To calculate productivity losses arising from reduced working time or early retirement, the mean time loss of all patients was multiplied by €89.48 and by 220 annual working days. The productivity lost if asthma or SAR led to early retirement was calculated in a similar manner (€89.48 multiplied by 220 annual working days). Costs for asthma and SAR-related loss of work were calculated exclusively for patients and parents/caregivers employed during the observation period. Lost productivity due to school absences was disregarded.

Patients retrospectively estimated their own expenses for OTC medication, home modifications, auxiliary devices and nonrefundable therapies over a 12-month period. The co-payments for medication ranged from €4.00–5.00 and co-payments for inpatient accommodation were €9.00 per day.

Statistics

Patients were stratified by age (children and adolescents aged 6–17 yrs and adults aged 18–70 yrs) and illness severity.

Results

Doctor and patient sample

A total of 20 pulmonologists and 16 paediatricians recruited 885 patients. Written informed consent and a completed questionnaire were obtained from 500 patients.

Patient characteristics

Table 1 shows demographical data for the 500 patients (53% male, 47% female), of which 55% (276) were between 6–17 yrs (64% males). Only 39% of the adults

Table 1. – Demographical characteristics

	Children/ adolescents [#]	Adults [†]
Subjects n	276	224
Sex M	64%	39%
Age yrs	12±3	43±14
Age range yrs	6–17	18–70
Disease diagnosed since		
SAR yrs	6±2	14±9
Asthma yrs	7±3	18±13
SAR and asthma yrs	SAR for 8±3 Asthma for 7±3	SAR for 23±13 Asthma for 15±11

Data are shown as mean±SD unless otherwise stated. M: male; SAR: seasonal allergic rhinitis. #: 6–17 yrs; †: 18–70 yrs.

Table 2. – Level of illness severity

	All patients	Children/ adolescents	Adults
SAR	161 (32)	98 (36)	63 (28)
Asthma 3	107 (21)	71 (26)	36 (16)
Asthma 3+SAR	147 (29)	65 (23)	82 (37)
Asthma 4	41 (8)	20 (7)	21 (9)
Asthma 4+SAR	44 (9)	22 (8)	22 (10)
Total	500 (100)	276 (100)	224 (100)

Data are presented as n (%). SAR: seasonal allergic rhinitis; Asthma 3: moderate asthma; Asthma 4: severe asthma.

(18–70 yrs) were male. Children/adolescents had suffered from their illness an average of 6–8 yrs and adults 14–23 yrs. Patients with both SAR and asthma generally developed SAR first.

Table 2 shows stratification according to age, illness and illness severity. Patients originated equally from rural areas (47%) and urban areas (53%) as well as from Eastern (45%) and Western Germany (55%). Employment status was declared by 86% (370 of 430) of patients and caregivers. Of 430 respondents, 28 had to change their job due to illness: 11 became part-time, 10 retrained, and seven resigned due to their own or their child's asthma/SAR. Thirteen respondents of 430

(3%) retired early. The mean number of days lost due to reduced productivity was 2.6 days per year.

Resource utilisation

Table 3 shows resource utilisation, such as consultations and medical services. On average, children and adolescents visited their pulmonologist or paediatrician 11 times per year and adults nine times. Other doctors were consulted by 32.5% (n=67) of children/adolescents and 47.3% (n=95) of adults. Children/adolescents with moderate asthma required medical services an average of 15.7 times per year and adults 11.4 times. This rose to an average of 22.0 and 21.3 times per year, respectively, as illness severity increased. If children and adolescents had only asthma, they consulted paediatricians/pulmonologists more often and required more medical services than patients with asthma and SAR.

The proportion of children/adolescents and adults with SAR receiving immunotherapy was 35% (15 of 43) and 65% (20 of 31), respectively. A few hospitalisations occurred during the study. Overall, 4% (n=18) were treated as inpatients (for an average of 12.1 days (sd 11.6), 6% were treated as outpatients, and 6% required emergency transport. Inpatient treatment (seven of 116 children) and emergency transport (12 of 125) were mainly required by children of 6–11 yrs. Rehabilitation was prescribed for 7% of all patients.

Pharmacotherapy use

Prescribed medication was received by 37% of children and adolescents with SAR but by 94% with severe asthma and SAR. Nearly all adults received prescribed medications. Figures 1 and 2 show prescribed medication use. The most common agents used by asthma patients were inhaled sympathomimetics (including short- and long-acting sympathomimetics), followed by inhaled corticosteroids (ICS). SAR patients were mainly treated with oral antihistamines. Patients suffering from both illnesses often received intranasal agents (e.g.

Table 3. – Medical resource utilisation per patient per year (children/adolescents and adults)

Resource	Percentage (n)	Frequency per patient					
		Total	SAR	Asthma 3	Asthma 3+SAR	Asthma 4	Asthma 4+SAR
Children and adolescents							
Consultations with paediatrician/pulmonologist [#]	100.0 (160)	10.6	8.9	11.5	10.5	13.9	9.9
Consultations with others [†]	32.5 (67)	2.2	2.7	1.6	1.6	1.6	4.6
Medical services (outpatient) [#]	94.4 (151)	13.8	10.3	15.7	11.2	22.0	17.1
Adults							
Consultations with paediatrician/pulmonologist	100.0 (145)	8.9	11.7	7.5	7.6	10.1	8.2
Consultations with others [†]	47.3 (95)	3.8	3.4	3.7	2.7	5.4	8.7
Medical services (outpatient) [#]	95.9 (139)	16.6	19.5	11.4	14.6	21.3	18.9

SAR: seasonal allergic rhinitis; Asthma 3: moderate asthma; Asthma 4: severe asthma. #: calculations according to patient chart; †: calculations according to patient questionnaire, medical services (outpatient), including all diagnostic procedures (e.g. allergen testing), and therapeutic treatments (e.g. hyposensitisation) in the office. Pharmacotherapy is shown separately.

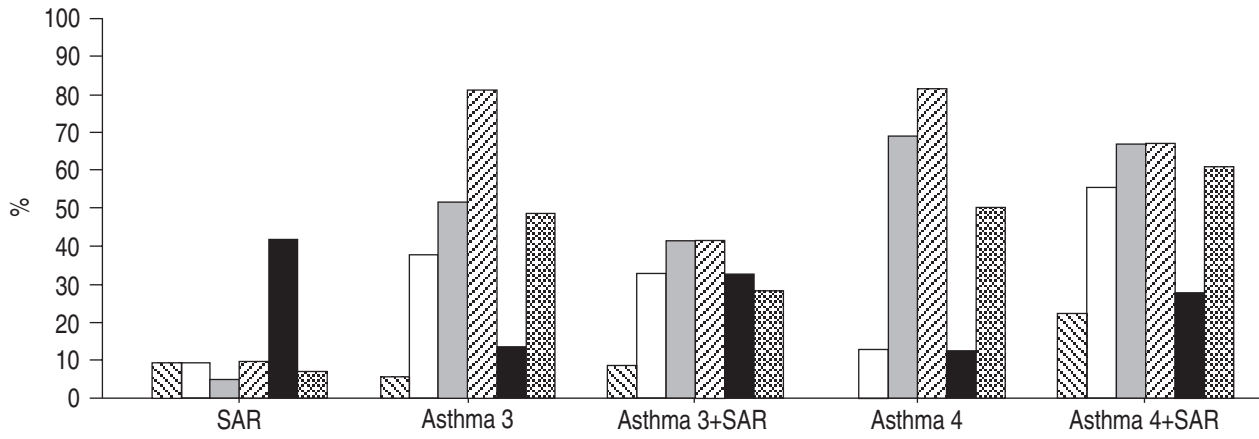


Fig. 1.—Pharmacotherapy use (%) in children and adolescents (aged 6–17 yrs). ▨: intranasal agents; □: disodium cromoglycate, nedocromil sodium (inhaled); ■: corticosteroids (inhaled); ▩: sympathomimetics (inhaled); ■: antihistamines (oral); ■: others (oral sympathomimetics, corticosteroids, theophylline, leukotriene antagonists, anticholinergic agents). SAR: seasonal allergic rhinitis; Asthma 3: moderate asthma; Asthma 4: severe asthma.

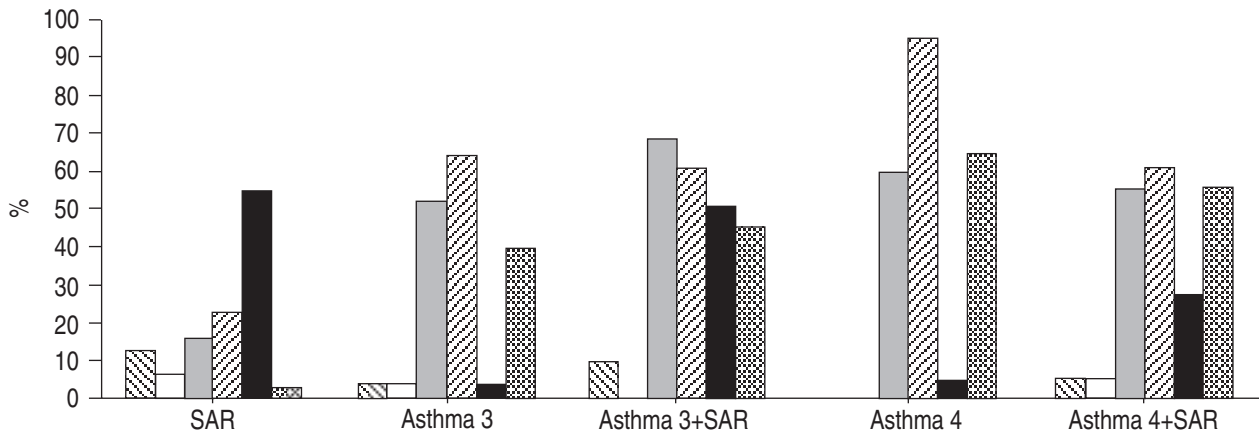


Fig. 2.—Pharmacotherapy use (%) in adults (aged 18–70 yrs). ▨: intranasal agents; □: disodium cromoglycate, nedocromil sodium (inhaled); ■: corticosteroids (inhaled); ▩: sympathomimetics (inhaled); ■: antihistamines (oral); ■: others (oral sympathomimetics, corticosteroids, theophylline, leukotriene antagonists, anticholinergic agents). SAR: seasonal allergic rhinitis; Asthma 3: moderate asthma; Asthma 4: severe asthma.

beclometasone dipropionate or disodium cromoglycate) and inhaled disodium cromoglycate/nedocromil. Use of prescribed inhaled sympathomimetics and corticosteroids increased proportionately to illness severity.

Comparing asthma patients with those also suffering from SAR revealed that inhaled sympathomimetics were used by 81% of children/adolescents with severe asthma but only by 67% with severe asthma and SAR, whereas inhaled sympathomimetics were used by 95% and 61% of adults, respectively.

ICS therapy was used more by children/adolescents with asthma (69% of patients with severe asthma) than by children with SAR (5%). ICS use by adults ranged between 69% (moderate asthma and SAR) and 16% (SAR).

OTC medications were used by 15% (n=41) of children/adolescents and 26% (n=57) of adults. In both groups, patients with SAR or both asthma and SAR required OTC medication twice as often as patients who only had asthma.

Annual direct medical and nonmedical costs

Figure 3 shows annual direct and indirect costs. Annual direct costs for TPPs ranged from €569 per adult with SAR to €2,048 per adult with severe asthma and SAR. Cost drivers of direct medical costs for children/adolescents were rehabilitation (36%) followed by drug costs (24%), whereas for adults, drug costs predominated (52%) followed by medical services (23%).

The financial burden on patients ranged from €122 (adults with moderate asthma) to €1,889 (children/adolescents with severe asthma and SAR) and was principally due to household modifications (e.g. replacing carpets with washable floors), the purchase of beddings (for patients sensitised to house dust mites) or special vacuum cleaners. The average cost of the above for children/adolescents was €535, followed by the cost of additional therapies (e.g. acupuncture, physiotherapy, biofeedback; €11) and OTC medication

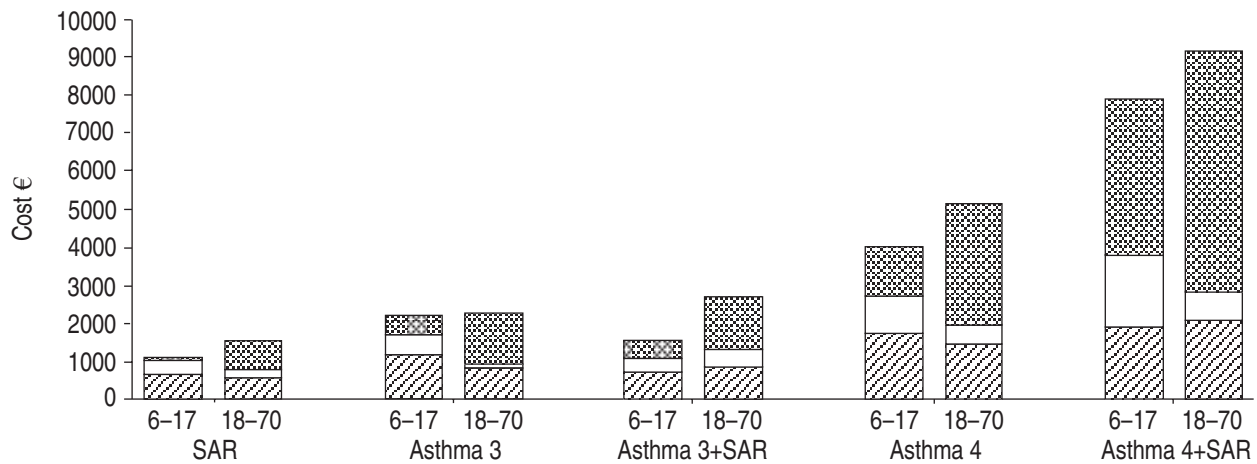


Fig. 3.—Total annual cost per patient with atopic asthma and seasonal allergic rhinitis (SAR) in Germany. ▨: direct costs, third-party payers; □: direct costs, patient; ■: indirect costs. Asthma 3: moderate asthma; Asthma 4: severe asthma.

(€9). Expenses for adults averaged €244 for household modifications, €40 for additional therapies and €32 for medication co-payment. Adults paid 12% of their total costs privately, whereas 26% of the total costs for children/adolescents were paid privately.

Total costs

Overall, total annual costs per patient (including direct as well as indirect costs) rose as asthma severity increased and if asthma was combined with SAR (fig. 3). The total average cost for children/adolescents with SAR was €1,089 (€1,543 for adults). Total costs rose to €2,202 per child/adolescent with moderate asthma and €2,745 per adult, and rose further to €7,928 per child/adolescent with severe asthma plus SAR and to €9,286 per adult. Comparison of direct and indirect costs revealed that the latter were a major component of total costs: 6% of total costs for children/adolescents with SAR and as much as 69% for adults with severe asthma and SAR. The principal indirect cost was lost productivity due to occupational disability and premature retirement of patients and caregivers (adults, 83%; children/adolescents, 76%). The portion of lost productivity due to absence from work was 17% in adults and 24% in children and adolescents.

Discussion

This study assessed the average cost of atopic asthma and SAR per patient in Germany and compared illness severity to costs. The findings show an enormous increase in total costs as asthma severity increases and when combined with SAR. On average, the total annual cost was €1,089 for children/adolescents with SAR and €1,543 for adults. Annual costs for children/adolescents with severe asthma plus SAR increased to €7,928 per patient and to €9,286 for adults.

The calculated atopic asthma costs are in line with

published European cost-of-illness studies. Variations in total average cost per patient between these economic studies are partly due to differences between inclusion/exclusion criteria, cost assessment, treatments and healthcare systems. The financial burden of allergic asthma and/or SAR from the TPPs perspective is further comparable to other chronic diseases, such as diabetes mellitus type 2, in Germany [20, 21].

SCHULENBURG *et al.* [10] collected data from 216 German patients. The total average cost per patient per year was €2,689 for an adult with moderate asthma and €6,144 for an adult with severe asthma. The annual direct medical cost for children was €1,649 for moderate asthma and €2,460 for severe asthma. The disregard of nonmedical expenditures may have affected these findings. SCHULENBURG *et al.* [10] described how asthma-related costs more than doubled as severity increased, a finding confirmed by SERRA-BATLLES *et al.* [22] and GODARD *et al.* [23].

The present authors identified rehabilitation, inpatient care (particularly for children) and indirect costs as the main cost factors for patients with severe asthma. The average hospital stay for all patients was 12.1 days, which is in line with official German data [19].

The occupational disability and premature retirement of asthma patients and caregivers account for the largest proportion of indirect costs. SCHULENBURG *et al.* [10] show hospitalisation and indirect costs to increase disproportionately to increases in illness severity. Since the costs of patients with severe asthma are high, overall expenditure could be reduced by preventive medical treatment, which slows progression of the illness.

A Spanish study included 333 patients, aged ≥ 14 yrs [22]. The average annual asthma-related costs were estimated to be €3,251 per patient (ranging from €2,718 for moderate asthma to €7,219 for severe asthma). A prospective French study conducted over 1 yr calculated direct costs per patient (excluding hospitalisation) to be between €1,196 (moderate asthma) and €2,782 (severe asthma) [23].

A 1996–1997 cost of illness study of 589 Swiss

patients calculated the following total annual asthma costs: €558 per child, €2,064 per adult and €1,766 overall. An asthma attack increased the overall annual cost to €2,869 [24]. In contrast, the average cost of €609 per British patient suffering from an asthma attack (HOSKINS *et al.* [25]) seems comparatively small, but indirect costs, personal expenses and direct nonmedical costs were not included. This study also demonstrated that poorly controlled asthma has considerable impact on healthcare costs; the average cost for a patient with an attack was >3.5 times that for a patient without one.

Use of prescribed inhaled sympathomimetics and corticosteroids increased with severity of illness. ICS and inhaled sympathomimetics were used more frequently by children/adolescents with only asthma than by those with concomitant SAR, suggesting that the former is more serious. However, intranasal agents and antihistamines are used more frequently by patients with concomitant SAR suggesting that allergic symptoms predominate in these patients. Asthma guidelines [14, 26] recommend ICS as standard therapy for moderate and severe asthma, yet only 56–60% of severe (adult) asthmatics were treated with ICS by their pulmonologist. However, the frequency of ICS use may be underestimated since, on average, adults had four further appointments per year with other doctors (*e.g.* general practitioners). Paediatricians prescribed ICS for 46–68% of children/adolescents. This also indicates that ICS is underutilised. On average, children/adolescents had two further appointments per year with other doctors. A recent German report also indicated that pharmacotherapy for bronchial asthma is underused or inadequate. In particular, treatment with inhaled corticosteroids is insufficient, whereas short-term sympathomimetics are excessively prescribed. Only one-third of asthma patients were treated according to asthma guidelines [27].

Possible limitations of the study presented here include retrospective documentation of patients' expenses, which introduces a potential recall bias. Personal expenses of German asthma patients have not been previously published. The data are a starting point for further research. A selection bias favouring doctors interested in asthma/SAR care may also be present and a further selection bias may be introduced because study subjects were recruited by these doctors. Since illness severity was classified by these doctors, according to GINA recommendations, no physical examination was required. The use of the human capital approach is the traditional method of calculating indirect costs in the form of overall production losses. This is morally questionable, since it discriminates against unemployed persons, pensioners and housewives because they have no market value. However, the human capital approach assesses the abilities and knowledge of an individual or group that can be used in the production process. This study makes no claim to be representative of Germany as a whole.

In summary, the high average annual costs per patient, especially for the treatment of severe asthma, indicate poor control of asthma, especially in terms of

medications. This is also reflected by the high indirect costs of early retirement and occupational disability in severe asthma. In line with previous studies, these results strongly suggest that costs may be significantly reduced by improved illness control. Investment in asthma education programmes and innovative pharmacotherapies that treat the aetiology and slow progression of the illness may reduce costs.

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