

EU Forum

Evaluation of cost of disease: Assessing the burden to society of asthma in children in the European Union

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Asthma and allergies have become increasingly prevalent over the last few decades throughout the WHO European Region, with an average of more than 10% of children suffering from asthmatic symptoms. Asthma is one of the most common chronic diseases and it is a complex and heterogeneous disorder where genetics and environment play an interacting role.

Childhood asthma is a major global health problem, which exerts a substantial burden on family, health care, and society as a whole. In decision-making on interventions to reduce the burden of childhood asthma an overview of the cost-of-illness of childhood asthma is an essential first step.

In this report the cost-of-illness of childhood asthma in the countries of the European Union is assessed by order of the European Commission. Also the countries that will enter the European Union at the 1st of May 2004 are included. The 25 countries of the European Union (EU25) from May 1st 2004 onwards are Austria*, Belgium*, Cyprus, Czech Republic, Denmark*, Estonia, Finland*, France*, Germany*, Greece*, Hungary, Ireland*, Italy*, Latvia, Lithuania, Luxembourg*, Malta, Poland, Portugal*, Slovenia, Slovakia, Spain*, Sweden*, The Netherlands* and the United Kingdom*.

Prevalence of asthma in the European Union

To assess the prevalence of asthma, data from the ISAAC (International Study of Asthma and Allergies in

Childhood) (1, 2) and KIDSCREEN (Screening and promotion for health-related quality of life in children and adolescents) (3) study were used. These are both large, international studies, in which many European countries are included.

There is, as yet, no accepted definition of asthma. We used three different methods to assess prevalence: the self-reported prevalence of wheeze in the last 12 months, the self-reported prevalence of having asthma ever and the self-reported prevalence of having asthma during the last 12 months (currently).

ISAAC used standardized simple surveys to rate the prevalence of asthma symptoms in two age groups (6–7 years and 13–14 years) in 155 centres of 56 countries. In each centre approximately 3000 children were studied. Data from the 13–14 year age group were self-reported, data from the 6–7 year age group were parent-reported. Data collection took place in 1997.

In the KIDSCREEN study also surveys were used to assess HRQL in 14 European countries. In 10 countries it was asked whether the child suffered from asthma during the last 12 month. The age groups were from 8 to 11 years and from 12 to 18 years. In each country approximately 2000 children/adolescents were studied. The prevalence data were parent-reported. Data collection took place in 2003 (see Table 1 for the prevalence of wheeze and self-reported asthma).

The total prevalence of wheeze and self-reported asthma for children and adolescents in the EU25 is 12.3 and 7.2 respectively.

To estimate the number of children and adolescents with wheeze and with self-reported asthma within each country, the figures in Table 1 were combined with population data

*These countries were already members of the European Union (EU15)

Table 1. The prevalence (%) of wheeze and self-reported asthma for children and adolescents in EU25

	Children			Adolescents			Children and adolescents		
	wheeze*	ever asthma*	currently asthma*	wheeze	ever asthma	currently asthma	wheeze†	currently/ever	asthma‡
Austria	8.9	3.9	2.7	11.6	6.0	3.1	10.3		2.9
Belgium	7.3	4.2		12	8.1		9.7		6.2
Cyprus							5.7		3.7
Czech Republic			3.3			2.9	9.5		3.1
Denmark							11.7		9.2
Estonia	9.3	1.4		10.8	3		10.1		2.2
Finland				16	6.6		13.2		7.3
France	8.1	9.3	7.7	13.5	12.6	9.8	10.8		8.8
Germany	8.5	3.6	3.7	13.8	5.7	3.9	11.2		3.8
Greece	7.6	5.4		3.7	4.5	2.1	5.7		3.7
Hungary			3.1			2.9	9.5		3.0
Ireland				29.1	15.2		23.7		11.5
Italy	7.3	8.6		8.9	9.9		8.1		9.3
Latvia	7.3	1.6		8.4	4.3		7.9		2.9
Lithuania							10.1		2.2
Luxembourg							9.7		6.2
Malta	8.8	7.5		16	11.1		12.4		9.3
Poland	10.9	2.5	7.7	8.1	2.4	5.7	9.5		6.7
Portugal	13.2	11		9.5	12.1		11.4		11.5
Slovenia							9.5		3
Slovakia							9.5		3.1
Spain	6.2	6.2	4.4	10.3	10.5	5.6	8.3		5
Sweden	10.4	8.0		12.9	10.4		11.7		9.2
Netherlands			7.6			5	9.7		6.3
United Kingdom	18.4	22.9	10.8	32.2	20.7	12.9	25.3		11.9
Total							12.3		7.2

* Prevalence data of wheeze and asthma ever are generated from the ISAAC study, prevalence data of asthma during the last 12 month from the KIDSCREEN study.

† When no data were available for wheeze, data were imputed from countries with similar geographic/cultural characteristics: Finland imputed from Sweden, Ireland imputed from UK, Netherlands imputed from Belgium, Hungary, Slovenia, Slovakia, Czech Republic imputed from Poland. Imputed data are written in italics.

‡ When no data were available for asthma currently, asthma ever was used, because of the long-term period of this illness. When no data were available for asthma at all, data were imputed from countries with similar geographic/cultural characteristics: Cyprus imputed from Greece, Denmark imputed from Sweden, Lithuania imputed from Estonia, Luxembourg imputed from Belgium, Slovenia imputed from Hungary, Slovakia imputed from Czech Republic. Imputed data are written in italics.

from Eurostat, the Statistical Office of the European Communities. The Eurostat population category for children is until 15 years of age. As we expected that the prevalence of wheeze and self-reported asthma of children until the age of 18 would be comparable to children until 15, prevalence data of children until 18 were used to assess the number of children with asthma in the EU countries (see Table 2).

Cost-of-illness of childhood asthma

Methodology

Two types of cost-of-illness studies can be distinguished: prevalence and incidence (4). In a prevalence cost-of-illness study, the cost of an illness in a population is measured over a defined period of time, usually a year. Both incident and prevalent cases are included in this type of analysis. In an incidence cost-of-illness study, lifetime costs for a certain disease are estimated for all cases with onset of the disease in a given base year. To estimate the

cost-of-illness of childhood asthma 2004, the prevalence based approach is used.

A distinction can be made between direct and indirect costs of a disease. Direct costs include both medical and non-medical expenses associated with the disease. Direct medical costs include for example costs of GP visits, hospitalisation and medications. Non-medical direct costs include amongst others, transportation to and from the health provider and household modifications. Indirect costs refer to the value of resources lost as a result of time absent from school, work or other daily activity as a result of illness. Both the costs of the patient as the costs of caretakers must be taken into account. Indirect costs can be monetised by assigning an economic value to the time lost due to the disease, or measured in terms of quality of life.

In this report the indirect costs related to time of caregivers (family and others not considered to be formal health care providers) will be monetised, while the indirect costs of the children with asthma together with the intangible costs arising from patients' pain and suffering will be expressed in terms of quality of life.

Table 2. Estimation of population in countries of the EU25 (in millions)

	population < 15 years (millions) (EUROSTAT)	% children and adolescents wheeze	% children and adolescents asthma	population < 15 years Wheeze (millions)	population <15 years asthma (millions)
Austria	1.3	10.3	2.9	0.13	0.04
Belgium	1.8	9.7	6.2	0.17	0.11
Cyprus	0.2	5.7	3.7	0.01	0.01
Czech Republic	1.6	9.5	3.1	0.15	0.05
Denmark	1.0	11.7	9.2	0.12	0.09
Estonia	0.2	10.1	2.2	0.02	0.00
Finland	0.9	13.2	7.3	0.12	0.07
France	11.1	10.8	8.8	1.20	0.98
Germany	12.6	11.2	3.8	1.41	0.48
Greece	1.7	5.7	3.7	0.10	0.06
Hungary	1.6	9.5	3.0	0.15	0.05
Ireland	0.8	23.7	11.5	0.19	0.09
Italy	8.2	8.1	9.3	0.66	0.76
Latvia	0.4	7.9	2.9	0.03	0.01
Lithuania	0.6	10.1	2.2	0.06	0.01
Luxembourg	0.08	9.7	6.2	0.01	0.00
Malta	0.08	12.4	9.3	0.01	0.01
Poland	7.0	9.5	6.7	0.67	0.47
Portugal	1.7	11.4	11.5	0.19	0.20
Slovenia	0.3	9.5	3	0.03	0.01
Slovakia	1.0	9.5	3.1	0.10	0.03
Spain	5.9	8.3	5	0.49	0.30
Sweden	1.6	11.7	9.2	0.19	0.15
Netherlands	3.0	9.7	6.3	0.29	0.19
United Kingdom	11.2	25.3	11.9	2.83	1.33
Total	75.8	12.3	7.2	9.3	5.5

The largest number of children with wheeze and self-reported asthma is in the UK.

Economic data

Material and methods

To obtain data on the cost-of-illness the literature was searched for information. A review with the purpose of capturing all economic evaluations that have been published in asthma from 1985 to June 2002 was published by Sculpher and Price (5). However, they focussed on economic evaluations. Economic evaluations are comparisons of alternative options in terms of their costs and consequences. Results from economic evaluations are of little use in cost-of-illness studies as they usually focus on special groups of patients and specific treatments. Cost-of-illness studies, on the contrary, concern the general population and the current treatment policy of the disease.

Therefore, we performed an additional literature search in MEDLINE (1985-2004). The search was done using the following MeSH terms: (Asthma/Economics) AND (Child, Preschool OR Child OR Adolescent) AND (Cost and Cost Analysis). The search resulted in 176 articles. From this literature search result we selected the articles on cost-of-illness of asthma in children. In addition to the literature search reference lists of articles were scrutinized for additional literature on the cost-of-illness of asthma in children. Furthermore, authors of economic studies on asthma were asked whether they are aware of studies or registries from which information on the cost-of-illness of

childhood asthma in their country or neighbouring countries could be derived. In this way the available information on the cost-of-illness of asthma in the European Union was obtained. As estimates for the cost-of-illness for children are available for all countries, assumptions are made on the cost-of-illness of asthma for these countries. For these countries, PubMed was searched for studies on costs of asthma in adults. If available, the drug costs per adult with asthma were multiplied by 0.438 (9), representing the lower costs of drugs used by children compared to adults. Other direct costs were assumed to be the same for children and adults. Indirect costs of asthma differ strongly between adults and children, as children have no working days lost themselves. Parents of children with asthma however may experience working days lost caused by the illness of their children. Costs of lost productivity for parents with asthma were imputed on the basis of estimates of indirect costs from other countries (see below). If no estimates for adults were available, we assumed the average annual costs per child with asthma of other countries for which estimates were available to be representative. For countries for which data were available, studies differed in several respects – cost components included, estimation methods, data sources, practice of diagnosis, age category etcetera.- a fact which makes direct comparisons among studies difficult or even impossible. To correct for part of such differences, estimations based on assumptions were

Table 3. Percentage of total direct and indirect costs by costs category for studies on cost of asthma in childhood that included all cost categories

Study (Author, year)	% direct medical costs	% direct non medical costs	% indirect costs
Schramm et al. (2003) ^{6*}	40%	24%	36%
Stevens et al. (2003) ⁷	76%	6%	18%
Ungar et al. (2001) ⁸	87%	1%	12%

* Additional information obtained by the author.

necessary. The impact of these assumptions was assessed by means of sensitivity analyses. We estimated the total costs for countries for which one or more of the cost categories direct medical costs, direct non-medical costs or indirect costs were missing using information from other studies. In Table 3 studies on cost of childhood asthma that included all cost categories and for which data are presented separately for the specific cost categories, are listed, together with the percentage of the total costs per cost category. On the basis of this overview we assumed the direct medical costs to comprise 70% of the total costs, direct nonmedical costs 10% and indirect costs 20%. These percentages were used for the imputation of costs in case of missing cost categories.

When costs were from other years, the effect of price inflation was removed by using the harmonised annual average consumer price indices of the different countries to inflate the data to the year 2004. If no price level year was mentioned in the article, the year before publication of the article was used, assuming that performing analyses, writing the article and publication of the article will take 1 year. Also when costs were in other currencies than Euros, costs were converted into Euros. In this study the societal perspective is used. So, all costs are incorporated regardless of who incurs the costs.

Two sensitivity analyses were performed to assess the impact of our assumptions on the final estimate of the cost-of-illness of childhood asthma for the European Union. 1) Instead of using the average costs of asthma for countries for which no estimate was available, the minimum and maximum costs were used. 2) Instead of using the mean percentages of the total costs of the available studies as estimates for respectively direct medical costs, direct non medical costs and indirect costs, the percentages as found by Schramm et al. (6) and Ungar et al. (8) were used as extremes in a sensitivity analysis (see Table 3).

Published data on the cost-of-illness for asthma in the different member states of the European Union

Denmark. For Denmark the cost of illness of asthma was estimated for the year 2000 by Mossing et al. (9). They based their estimates on the studies performed by Sørensen et al. (10) and Søndergaard et al. (11), extrapolating them to the year 2000. Sørensen et al. (10) and Søndergaard et al. (11) used information from

patients aged 16 years and older for their studies. Mossing et al. (9) calculated the costs for children with asthma by multiplying the drug costs of adults by 0.438, and assuming the medical and nonmedical costs of hospitalisations, out-patients visits and physician contacts to be the same for children and adults. Furthermore, the indirect costs of asthma were assumed to be zero for children. The costs per child with asthma calculated in this way amounts to EUR 354.

Estonia. Kiivet et al. (12) described the direct costs of asthma in Estonia differentiated by age of the patient for 1997. Data were obtained from the databases of national health insurance offices. The databases contain the bills for all hospitalisations, out-patient visits, investigations, procedures and prescriptions filled in pharmacies. Persons who had been in a hospital or visited a doctor because of asthma and who purchased anti-asthmatic drugs during 1997 were identified.

The mean annual costs for out-patient visits, hospital admissions and prescription are EUR 85 for children with asthma aged 0–17 years. No estimates on direct non-medical costs and indirect costs are available for Estonia.

Finland. Data on hospitalisation of patients up to 16 years of age, treated for an exacerbation of asthma in the Department of Paediatrics, Kuopio University Hospital from January 1st to December 31st 1998 were registered prospectively. This hospital is the only one providing in-patient treatment for paediatric patients in the geographically defined area, the province of Kuopio, eastern Finland. Data on drug prescriptions were provided by the Social Insurance Institution in Finland. The number of days for which the caretaker had to stay away from work for daily visits to hospital and for care at home, was estimated by adding three additional days per hospital stay to the duration of hospital stay. Retail prices of drugs and inpatient care charges were used as proxy for costs of hospitalisation and medication. The number of days refrained from work by caretakers were multiplied by the average daily earnings. The resulting costs per patient per year were EUR 334 per child with asthma (1998 prices) (13). Direct non-medical costs were not taken into account.

A study on the inpatient resource utilisation in asthmatic children in Finland, however, revealed that Kuopio showed the highest per capita inpatient costs (14). Therefore, the estimate of Korhonen et al. (13) might overestimate the costs per child with asthma for Finland as a whole.

France. Laforest et al (15) assessed the direct costs due to asthma in French children aged 6–16 years. Data were obtained from a French database of GP prescriptions (BKL Thales), and a survey questionnaire. Data were collected on hospitalisations, visits to emergency rooms, GP visits, and anti asthma prescriptions. Costs were computed with reference prices. The median value of the

direct medical costs per year per child with persistent asthma was EUR 191.10 (price level 1998). No estimates on direct non-medical costs and indirect costs are available for French.

Germany. Weinmann et al. (16) selected children with asthma, atopic eczema and/or seasonal rhinitis diagnosis during the first 8 years of life from a multi-center cohort atopy study. Overall 8-year health care utilization (use of inpatient services, physician visits, physician telephone contacts, hospital outpatient services, outpatient drugs, appliances and devices and atopy related diagnostics) was estimated by reviewing medical records. Disease-related expenditures were estimated using market prices, or by multiplying the units of resource use by the respective charges. Asthma treatment incurs average direct medical costs of USD 627 per patient year (1996 prices).

Also Schramm et al. (6) performed a study on the costs of atopic asthma in Germany. For patients (aged 6–70 years) with moderate to severe asthma information was collected using a questionnaire on consultations with doctors, hospitalisations, rehabilitation care, sickness benefits, ad hoc expenses (e.g. over-the-counter (OTC) medication), household modifications, auxiliary devices and absence from work. To evaluate costs of diagnostic or treatment services the average frequency was multiplied by the charge. Prescribed medication were documented from patients' records and multiplied by the reimbursable prices. The human capital approach was applied to calculate indirect costs arising from lost productivity. Patients retrospectively estimated their own expenses for OTC medication, home modifications, auxiliary devices and non-refundable therapies. The average annual costs were estimated at EUR 2,870 per child (aged 6–17 years, 2000 prices).

Part of the large difference between both estimates can be explained by difference in patient population: general children with asthma during the first 8 years of life and children with moderate to severe asthma 6–17 years (6), and the inclusion of direct nonmedical costs and indirect costs by Schramm et al. (6). For this study, the estimate of Weinmann (16) was used, as the estimated costs represents the cost of a general population of children with asthma, which is the focus of this study.

Hungary. Costs of Asthma in Hungary were recently assessed by Herjavec et al. (17). Asthmatic patients were interviewed by their physicians on direct medical resource utilisation (asthma related drug therapy, asthma related physician, hospital, and emergency department visits). Indirect costs were evaluated on bases of annual work absenteeism.

Drug costs were determined by the retail price. The cost of a workday was valued using the average daily Hungarian wage. The average total annual costs (direct and indirect) per patient are EUR 833 (price level 1999) for paediatric patients aged 6–14 years.

Spain. For Spain the direct and indirect costs of asthma of patients aged 14 years and older, were determined in a northern area of Spain (18). Patients were interviewed on their asthma-related morbidity, and data were collected on the number of visits to the family physician, number of diagnostic procedures, number of visits to the specialist, number of hospitalisations and length of hospital stay, number of visits to an emergency service, medication used for asthma treatment during the past year, and work incapacity or absenteeism. Data obtained from the patients were checked with the medical record. Prices were obtained from the hospital and agreed with the governmental Catalan Health Service. Medication expenditures were calculated according to the officially registered price. Working days lost were calculated by multiplying the number of days lost by the daily cost, based on a mean interprofessional salary, and cost of temporal or permanent job invalidity were calculated using invalidity pensions. The average total annual asthma-derived cost was estimated at USD 2,879 (base year cost calculations 1995). From this estimate the direct costs per child with asthma were calculated by multiplying the drug costs (USD 400) by 0.438 9, and assuming the other direct medical cost categories (USD 485) were the same for children and adults. Adding these figures leads to an estimate of USD 660 for the direct medical costs per child with asthma in Spain.

The Netherlands. Direct medical costs of asthma have been estimated by Rutten-van Mölken for 1993 (19). Data on general-practitioner contacts, hospital inpatient days, day-care treatments, drug prescriptions were extracted from representative national registries for inpatient care and large, good quality surveys for ambulatory care. Subsequently, costs were calculated using estimated opportunity costs for each unit of resource use. Annual direct medical costs for asthma at ages 0–14 were estimated at USD 343 (price level 1993, additional information obtained from the author).

In a study which compared nurse-led outpatient management of childhood asthma to traditional medical care, direct and indirect medical costs of traditional medical care were estimated (20). Data on health care use, travelling and production loss were prospectively recorded during 12 months for patients who had been referred by their general practitioner to the outpatient clinic because of insufficient asthma control. Retail prices were used to value medication, costs of visits to specialist were calculated based on hourly wages, and cost of visits to the general practitioner, travel costs, and costs due to loss of productivity were obtained from the Dutch Manual for Costing in Economic Evaluations. Median total costs were EUR 357,20 per patient receiving the traditional treatment during 1-year follow up (price level 2000). The estimate for the Dutch situation was based on the study of Rutten-van Mölken (19). Although this is an estimate

from a long time ago, it may be a more representative estimate than the estimate from the study setting in which for a special group of patients two treatment strategies were compared (20).

United Kingdom. As reported by The National Asthma Campaign (21) the annual health care costs of diagnosed asthma in children are estimated on GBP 181 per child (0–15 years of age) with asthma. The annual cost of treating a young child (under 5 years of age) are particularly high (GBP 339), while the annual costs of children aged 5–15 years is GBP 122. These estimates were calculated from the estimated prevalence of treated asthma (22) and unpublished data from Hoskins et al. (23). Stevens et al. (7) determined the economic impact in the UK of preschool asthma and wheeze. In the context of a randomised controlled trial (RCT), the costs to the family, the health service and wider society of caring for a preschool child recently admitted to hospital with a primary diagnosis of asthma or wheeze were collected, and supplemented by a postal population survey of respiratory health in under-fives to estimate health care costs for children receiving primary care treatment alone. The value of time lost from paid employment was estimated using mean wages for male and female workers, costs of nonwaged time were estimated using the mean wage for a local authority home-care worker. Health-service costs were obtained from several sources (7). Estimated direct and indirect costs for children who received secondary care for wheeze or asthma add up to GBP 562 (price level 1999), of which 76.3% consists of direct health care costs (GBP 429). The estimated direct health care costs for all children in the UK aged 1–5 years with wheeze or asthma amount to GBP 78 per child/year.

For the United Kingdom the estimate reported by the National Asthma Campaign was used for the calculation of the average annual cost of asthma per child with asthma (20), as this estimate may be more representative than the estimate from the study setting (7).

Cost of childhood asthma for the different EU countries in 2004

The published estimates on the cost-of-illness of asthma in the European Union were converted in 2004 Euros and missing cost categories were imputed. The resulting estimates were used to calculate the average annual costs per child with asthma. These average annual costs amount to EUR 613, respectively. These amounts were used for countries for which no estimate was available. The resulting estimates of costs per child with asthma for the countries in the European Union are presented in Table 4.

Cost of childhood asthma in the European Union in 2004

To obtain an estimate for the annual costs for childhood asthma in the EU25, the costs presented in Table 4 are

multiplied by the prevalence of self-reported asthma as described in chapter 2. Additionally, also an estimate of the costs is made using the prevalence of wheeze in the last 12 month (see chapter 2). The results are presented in Table 5.

The estimated total costs of childhood asthma amounts to EUR 3,000 million. Using wheeze as definition of asthma leads to a considerable higher estimate of the total costs of EUR 5,200 million. This will be an overestimate, however. Using the definition of wheeze leads to the inclusion of cases of very mild asthma. These cases will induce low or even no costs. Multiplying this number of cases with cost estimates, which are partly derived from studies focussing on more severe asthma, will overestimate the costs.

Sensitivity analyses

In sensitivity analyses we explored the effects of our assumptions made to deal with missing data on the total costs of childhood asthma. In first instance we used annual costs per child with asthma averaged for the countries for which estimates were available, to impute for countries for which no estimates were available. In the sensitivity analyses we used the minimum and maximum estimates from the countries for which cost estimates were available. The minimum estimate for the annual costs per child with asthma was EUR 142 (Estonia). The maximum estimate was EUR 1529 (Hungary).

Furthermore, we explored the consequences of our assumption on distribution of the total cost between the cost categories: direct medical, direct nonmedical and indirect costs. In our initial calculation we assumed this distribution to be 70% direct medical costs, 10% direct nonmedical costs and 20% indirect costs. In the sensitivity analyses we used the distributions reported by Ungar et al. (8) (respectively 87%, 1% and 12%) and Schramm et al. (6) (respectively 40%, 24% and 36%).

The results of the (one-way) sensitivity analyses are presented in Table 6.

The total costs for asthma in EU25 as reported in Table 6 range from EUR 2,300 million to EUR 4,500 million. In this range only part of the uncertainty surrounding the baseline estimate is expressed. We only included the explicit assumptions we made in this study. However, this is only a small part of the assumptions made. Other assumptions are for example: the costs resulting from the economic studies applies to the age range 0–15 years, the distribution of the asthma severity in the economic studies is representative for the children with asthma in the country as a whole and estimation methods are the same for all countries. Therefore, the resulting estimate is only an indication of the cost-of-illness of childhood asthma in EU25. It is based on the information publicly available. For a more thorough estimate, additional studies are required.

Table 4. Direct medical, direct nonmedical and indirect costs for countries for which estimates on costs of asthma were available, converted into euros (EUR), inflated to 2004 and with cost categories imputed, when missing

Country	Direct medical cost		Direct non-medical costs		Indirect costs		Total costs	
	from literature	converted/ inflated/imputed	from literature	converted/ inflated/imputed	from literature	converted/ inflated/imputed	from literature	converted/ inflated/imputed
Austria								613††
Belgium								613††
Cyprus								613††
Czech Republic								613††
Denmark	DKK 2054	301	DKK 586	86		97		683
Estonia	EUR 85	100		14		28		142
Finland	EUR 311‡	360		43	EUR 23‡	27		429
France	EUR 191,10§	210		30		60		300
Germany	USD 627¶	578		83		165		826
Greece								613††
Hungary	EUR 462	720		153	EUR 421	656		1529
Ireland								613††
Italy								613††
Lithuania								613††
Latvia								613††
Luxembourg								613††
Malta								613††
Poland								613††
Portugal								613††
Slovenia								613††
Slovakia								613††
Spain	USD 660*	687		98		196		982
Sweden								613††
The Netherlands	USD 343¶	391		56		112		559
United Kingdom	GBP 122**	189		27		54		269

* No specific estimate for children available.

† DKK 100 = EUR 13.42.

‡ In article \$-sign used, this should however be a -sign (personal communication K. Korhonen).

§ Median value.

¶ USD 1 = EUR 0.82.

** GBP 1 = EUR 1.49.

†† Average annual cost per asthma patient for countries for which estimates were available: EUR 613.

Quality of life

Literature search

To assess the influence of disease and treatment on the daily life of patients with chronic disease, health-related quality of life (HRQL) as an outcome measure has been increasingly used in addition to mortality and morbidity rates. Quality of life can be defined as: ‘...individuals’ perceptions of their position in life in the context of culture and value systems in which they live, and in relation to their goals, expectations, standards, and concerns.’ (24). Assessment of HRQL enables the evaluation of the efficacy of medical interventions, the identification of secondary dysfunction or residual dysfunction of long-term survivors and the identification of groups at risk for psychological or behavioural problems. Although most HRQL instruments were developed for research in adults, during the past 10 years several instruments have become available for children (25, 26), including the CHQ, HUI, KINDL, CHIP, TACQOL. Available literature on MEDLINE was sought with the

keywords child*, asthma and health-related quality of life. Furthermore, own databases of the authors were analysed. Articles were selected when they described HRQL in children (0–19 years) with asthma, compared to HRQL of healthy children. In addition, (yet unpublished) data from the KIDSCREEN study (www.KIDSCREEN.org) were used.

Quality of life in children with asthma

In a study among 270 children between 7 to 13 years old in The Netherlands, it was found that children with asthma of 7 to 13 years old scored a lower quality of performance on physical activities than healthy children according to child and parent report. Children with asthma also had more physical complaints than healthy children according to their parents. In addition, parents and children scored a lower prevalence of social activities and a lower quality of performance on social activities than healthy children. Furthermore, children with asthma also have more negative feelings towards limitations in social activities than healthy children. (27, 28)

Table 5. Total costs of asthma for children younger than 15 years of age (in 2004 Euros) per EU country and for all EU25 countries together

Country	Total costs (EUR, millions)	
	asthma	wheeze
Austria	23	82
Belgium	68	107
Cyprus	5	7
Czech Republic	30	93
Denmark	44	57
Estonia	1	3
Finland	28	51
France	293	360
Germany	395	1165
Greece	39	59
Hungary	73	232
Ireland	56	116
Italy	468	407
Latvia	7	19
Lithuania	8	37
Luxembourg	5	8
Malta	6	8
Poland	392	556
Portugal	190	189
Slovenia	8	24
Slovakia	26	79
Spain	290	481
Sweden	90	115
The Netherlands	106	163
United Kingdom	359	763
Total EU25	3011	5182

Table 6. Sensitivity analyses on assumptions made to estimate the cost of childhood asthma in EU25

	Total costs (EUR, millions)	
	asthma	wheeze
Baseline estimate*	3,011	5,182
Minimum costs imputed for countries with missing data†	2,279	4,062
Maximum costs imputed for countries with missing data‡	3,890	6,652
Imputing missing cost categories according to distribution Ungar et al.§	2,597	4,422
Imputing missing cost categories according to distribution Schramm et al.¶	4,525	7,977

* Imputed costs for countries with missing data: EUR 613; distribution direct medical, direct nonmedical and indirect costs 70:10:20.

† Imputed costs for countries with missing data: EUR 142; distribution direct medical, direct nonmedical and indirect costs 70:10:20.

‡ Imputed costs for countries with missing data: EUR 1529; distribution direct medical, direct nonmedical and indirect costs 70:10:20.

§ Distribution direct medical, direct nonmedical and indirect costs 87:1:12; imputed costs for countries with missing data: EUR 613.

¶ Distribution direct medical, direct nonmedical and indirect costs 40:24:36; imputed costs for countries with missing data: EUR 613.

In a population survey of 12 year old children using a parent completed questionnaire in Scotland it was found that of the children reporting asthma or wheeze, 35.4%

Table 7. HRQL of children and adolescents with asthma and healthy children. (mean scores on 0-100 scale range)

	asthma (773)	perfectly healthy (9388)	p-value
Physical well-being	65.8	73.5	<0.001
Psychological well-being	76.0	78.0	0.002
Moods and emotions	77.3	80.0	<0.001
Self-perception	72.8	75.1	0.003
Autonomy	72.8	73.0	0.734
Parent relation and home life	78.3	79.1	0.228
Peers and Social Support	71.2	74.0	<0.001
School Environment	66.4	67.7	0.087
Being bullied	85.0	89.4	<0.001
Financial Resources	68.5	70.0	0.129

had missed school because of asthma or wheeze, 38.0% (246/647) had missed physical education. Thus, asthma has a significant impact on school attendance and physical activity. In addition, 62.5% of subjects with wheeze ever reported sleep disturbance. (29)

In the KIDSCREEN study 773 children with asthma and 9388 perfectly healthy children were compared. Data were available from Germany, Spain, the Netherlands, United Kingdom, France, Switzerland, Hungary, Greek, Czech Republic and Poland.

Preliminary data analysis showed that children with asthma had significantly lower scores on physical well-being, psychological well-being, moods and emotions, self-perception, peers and social support and being bullied (see Table 7).

In addition, they missed school and leisure activities more often. In conclusion, it seems that asthma has impact on the HRQL of children and adolescents. In particular, physical and social functioning seems to be compromised.

Comorbidities

Three common ambulatory respiratory conditions for which a pathophysiologic link to asthma is believed to exist are allergic rhinitis, sinusitis and otitis media. Grupp-Phelan et al. 30 have shown a relationship between children with asthma and the number of visits of allergic rhinitis, sinusitis visits and otitis media visits, which is consistent with the available pathophysiologic and clinical evidence. Allergic rhinitis shows the strongest association, followed by sinusitis and finally otitis media. Furthermore, children with both asthma and comorbidities had substantially higher utilization and costs in all categories of services (nonurgent, outpatient care, pharmacy, urgent care and inpatient care) than children with asthma but without comorbidity. This is in accordance with the observation in other studies that the costs increase by disease severity and that the majority of the costs are born by a small percentage of asthma patients (6, 7, 15–17, 18, 31).

Focussing on interventions to improve care for these children may considerably reduce the cost-of-illness of childhood asthma.

Main conclusions

This study shows that childhood asthma is a common disease in the EU25. The mean prevalence of wheeze is 12.3% and of self-reported asthma 7.2%, indicating a total of 9.3 million children with wheeze and 5.5 million children with self-reported asthma. However, there are large variations in the prevalence of wheeze and self-reported asthma throughout Europe. The self-reported 12-month prevalence of wheezing between countries varied from 5.7 (Greece) to 25.3 (United Kingdom) and self-reported asthma varied between 2.2 (Estonia) to 11.9 (United Kingdom).

The total costs of asthma for the 25 countries of the European Union are estimated at EUR 3,000 million. In the sensitivity analysis this amount varied between EUR 2,300 million to EUR 4,500 million. Using the wheeze as definition of asthma leads to considerable higher costs of EUR 5,200 million. In addition, HRQL of these children is compromised, in particular with regard to physical and social functioning. There are a number of limitations to this study. In the first place, there is, as yet, no accepted definition of asthma and the identification of asthma by means of (self-reported) questionnaires remains a contentious issue. This study clearly shows that the use of

different definitions inevitably leads to large differences in prevalence. In addition, prevalence data were not available for all European countries. It remains questionable whether imputation of data from other countries has sufficient precision. Concerning the economic data a large variation exists between cost-of-illness studies in cost components included, estimation methods, data sources, practice of diagnosis, age category, etc. Within the framework of this study only a brief overview and a rough estimate of the cost-of-illness of childhood asthma in the European Union could be deducted. For a more thorough estimate of the cost-of-illness of childhood asthma, experts from the countries involved should estimate the cost-of-illness of childhood asthma for their own country using a standardised method.

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