

Childhood epilepsy: a critical review of cost-of-illness studies

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ABSTRACT – Epilepsy is an illness with multiple consequences and costs for children, families and society. There are only a few studies published on the cost of childhood epilepsy. The different methodologies used in these studies make it difficult to compare them or even to compare the cost of childhood epilepsy treatment with that of adult epilepsy. Nevertheless, studies highlight important differences in the distribution of costs associated with childhood epilepsy and epilepsy in adults. It is understandable that direct costs represent the higher percentage of the total cost associated with childhood epilepsy treatment, given the higher number of hospital admissions and investigations, as well as the complexity of therapeutic trials, while indirect costs represent the greater proportion in adult epilepsy treatment. In addition to age, the total cost associated with epilepsy also depends on other factors such as seizure frequency, the moment at which the illness cost is estimated and the local health care system. In summary, chronic illnesses not only have an influence on the physical and psychological development of children, they also impose costs on the family and society. Childhood epilepsy has greater economic costs than those generated by more prevalent, chronic illnesses.

KEY WORDS: cost, epilepsy, childhood, cost-of-illness

The healthcare, diagnostic, and therapeutic needs of children and adults with epilepsy are different; this also implies a difference in the costs generated by the epilepsy, based on the age of the patient. Whereas in the early stages of life, direct costs – i.e., those associated with medical management of the illness – make up a higher percentage of the total cost, during the adult years, indirect costs – primarily associated with the loss of productive capacity – represent the higher percentage of the total cost burden associated with epilepsy.

Studies carried out during the early 1990s in several countries, revealed the economic impact of this illness, and led to the creation, in 1993, of the

Commission on Economic Aspects of the International League Against Epilepsy (ILAE) [1]. The Commission's primary objective was to define the necessary methodological and conceptual bases for conducting pharmacoeconomic studies in the epilepsy field, which would make it possible to more accurately compare different populations. Thanks to the Commission's efforts, interest in the economics of epilepsy has been steadily growing, as reflected in different publications [2]. However, there are still few studies focussed exclusively on the costs associated with childhood epilepsy.

The aim of the bibliographical research of the studies on costs ("cost-of-illness") is to provide an overview of

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the economic consequences of childhood epilepsy and to compare them to the cost of adult epilepsy. Furthermore, factors which have an influence on the final cost of epilepsy, no matter the age, are also described.

Studies on the cost of epilepsy

Most of the published studies on the economic aspects of epilepsy are “cost-of-illness” studies, aimed at quantifying the costs generated by epilepsy (*table 1*), including: 1) direct costs, related to healthcare services; 2) indirect costs, secondary to changes in the professional productive capacity of individuals or their families; and 3) intangible costs, related to patients’ pain and suffering. Although the importance of these last two is undeniable, they are difficult to quantify and this makes it impossible to include them in an overall estimate [3].

The costs to be included depend on the perspective of the study, i.e., the point of view from which the assessment is carried out – which is, preferably, that of society as a whole, including all costs, regardless of who generates them or pays for them. Researchers also consider the costs generated during one year or over longer periods of time, in which case they should be calculated using standardised pricing and discount rates. Finally, the application of epidemiological data makes it possible to calculate costs associated with prevalence and incidence.

There are few published studies on the costs generated by childhood epilepsy (*table 2*). If children with epilepsy are considered as a whole, without taking into account seizure frequency, the annual cost per patient ranges from € 2042 [5] and 2916 [7] (€ 1 worthed approximately US\$ 1 in 2002). However, the costs generated by treatment-resistant childhood epilepsy can exceed € 16.000 per year [4].

When assessing the annual costs reported in studies conducted on adults (*table 3*), the figures are not easily com-

parable. The wide range of results offered by these studies not only depend on the different ways of treating epilepsy in each country, but more importantly, on the wide range of methodologies used, including differences in inclusion criteria, age ranges, types of costs considered, and discount rates [13].

All of the studies in the literature include the costs occasioned by days in hospital and pharmacological treatment (*table 4*), but few studies have calculated the costs of the adverse effects of antiepileptic drugs (AEDs) or the treatment of seizures themselves [10, 11]. Although cost of consultation with epilepsy specialists is included, visits to primary care physicians are usually not quantified, nor are visits to other types of specialists. The number of diagnostic tests included in the assessment also varies widely, although the most expensive imaging techniques (e.g. SCAN, MRI) tend to be included, as well as measurement of the plasma levels of antiepileptics. Very few studies assess the costs associated with the need for psychoeducational or rehabilitational support, which can represent a large percentage of the costs associated with childhood epilepsy. Most studies include the occupational impact associated with epilepsy among its indirect costs to the patients themselves, although none of the studies available in the literature has included the occupational consequences for other members of the family. The study by Cockerell *et al.* [10], is the only one so far to assess associated mortality rates, an important aspect considering the fact that those suffering from epilepsy have a risk of death 2-3 times higher than that of the general population [14].

Regarding inclusion criteria, Cockerell *et al.* [10] assessed only those patients undergoing antiepileptic treatment, and excluded patients whose symptoms were under control and who therefore no longer had any treatment, and undiagnosed patients – who may constitute 30% of the childhood epileptic population.

Table 1. Types of costs considered in childhood epilepsy cost-of-illness studies.

Direct costs	Direct medical costs	• Specialist consultations (neuropaediatrician, neurologist) • General practitioner consultations (paediatrician, family doctor) • Emergency Room consultations • Consultations with other specialists • Diagnostic tests: e.g., imaging, laboratory, AED levels • Pharmacological treatment: AED, rectal DZP, treatment of AED side effects
	Direct non-medical costs	• Healthcare transport • Rehabilitation and physiotherapy • Psychological and psychoeducational support • Speech therapist • Social support: social worker • Nursing
Indirect costs	• Parents’ lost work-days • Unemployment or underemployment of parents • Mortality	

AED = antiepileptic drugs; DZP = diazepam

Table 2. Studies on the cost of childhood epilepsy (€ [at 2002 rate]/patient/year).

Author(s) (reference)	Country and year	Population (n)	Study design	Total cost	Direct costs (% of total cost)	Indirect costs (% of total cost)
Silfvenius [4]	Sweden, 1991	Children operated on for treatment- resistant epilepsy (70)	Patient sample Retrospective	16 140	11 980 (74)	4 160 (26)
Berto [5]	Italy, 1996	Children recently diagnosed with epilepsy (929)	Patient sample Retrospective	2 042	1 931 (95)	111 (5)
Zelicourt [6]	France, 1998	Children recently diagnosed with epilepsy (717)	Patient sample Prospective	–	880 (2nd year)	–
Argumosa and Herranz [7]	Spain, 1998	Children diagnosed with epilepsy (225)	Patient sample Retrospective	2 916	2 665 (91)	251 (9)
Guerrini [8]	Italy, 1998	Children diagnosed with epilepsy (189)	Patient sample Prospective	–	869 (seizure-free patients) 3 366 (treatment-resistant epilepsy)	–
Tetto [9]	Italy, 1998	Children diagnosed with epilepsy (128)	Patient sample Prospective	–	434	–

n = number of patients

Table 3. Studies on the cost of epilepsy in adults (€ [at 2002 rate]/patient/year).

Author(s) (reference)	Country and year	Population (n)	Study design	Total cost	Direct costs (% of total cost)	Indirect costs (% of total cost)
Cockerell [10]	UK, 1994	Adults (1628)	Patients under treatment with AEDs. Retrospective	7 027	2 127 (30)	4 900 (70)
Murray [11]	USA, 1994	Adults	Hypothetical cohort of patients with treatment- resistant epilepsy (prevalence)	12 043	2 815 (23)	9 228 (77)
Mak [12]	China, 1996	Adults (745)	Sample of patients with epilepsy Retrospective	549	234 (43)	315 (57)
Berto [5]	Italy, 1996	Adults (2307)	Sample of patients with epilepsy Retrospective (incidence)	1 361	1 132 (83)	229 (17)
Zelicourt [6]	France, 1998	Adults (1039)	Sample of patients with epilepsy. Prospective (incidence)	–	562 (2 nd year)	–

n = number of patients

Table 4. Costs included in epilepsy cost-of-illness studies

Author(s) (reference)	Pop.	Consultations			Hospital admission	FAEs	Tests		Support			Physio./ Rehab.	Health Trans.	Indirect costs	Other
		Sp	Gen	ER			Imaging	Lab	Psych.	Special Ed.	Speech Therapy				
Silfvenius [4]	C	+	?	+	+	+	+	+						+	SW
Berto [5]	A+C	+			+	+	+							+	
Zelicourt [6]	A+C	+	+	+	+	+	+	+							
Argumosa [7]	C	+	+	+	+	+	+	+	+	+	+	+	+	+	
Guerrini [8]	C	+	+	+	+	+	+	+				+			
Tetto [9]	A+C	+	?	+	+	+		+							Nurse
Cockerell [10]	A	+	+	+	+	+	+			+				+	Nurse
Murray [11]	A	+	+	+	+	+	+	+						+	N, SW
Mak [12]	A	+		+	+	+		Levels						+	

Pop. = population; **A** = adults; **C** = children; **Sp.** = consultations with an epilepsy specialist; **Gen.** = consultations with general physician or paediatrician; **ER** = Emergency Room consultations; **N** = nurse; **SW** = social worker; + = cost included; ? = not noted

Given that the costs generated by epilepsy are inversely proportional to the degree of seizure control, and that healthcare costs are higher during the first year after diagnosis than subsequent ones, investigators need to clearly define the population of epileptic patients on whom the study is to be conducted, so that the resulting data can be easily extrapolated to similar groups of patients.

It is also important to differentiate costs related to epilepsy itself from those generated by concomitant pathologies, although these may be a cause or consequence of the epileptic illness. If not, a very serious bias is generated, since the prevalence of other pathologies can be high in some patients with epilepsy [15].

The variation in the *per capita* cost of epilepsy can also be due to economic factors associated with the currencies in which the different studies express their findings. In an attempt to eliminate differences in buying power from one currency to another, Kotsopoulos *et al.* [16] carried out a cost-of-illness comparison using various epilepsy studies with similar inclusion criteria and methodologies, applying economic ratios capable of evening out the buying power of the populations under study. Their results using this method indicate that the direct costs associated with epilepsy represent from 0.12% to 1.12% of the total healthcare spending in each country. Figures for Spain show that in 1998, the total cost associated with childhood epilepsy represented 0.55% of the total healthcare budget for that year [7].

Epilepsy cost depending on age

Direct costs

In studies carried out on children with epilepsy, direct costs (DC) represent more than 80% of the total, with an annual cost per patient ranging from € 869, for children without any seizures during the year of observation, to € 11,980, for those with treatment-resistant epilepsy requiring surgery (table 2). Conversely, the percentage represented by DC falls to only 23-43% of the total cost in studies carried out exclusively on adults with epilepsy, for whom indirect costs (IC) associated with unemployment and mortality represent some two-thirds of the total cost (table 3).

Hospital admissions

In the majority of these cost-of-illness studies, whether involving children or adults, the costs generated by hospital admissions represent the majority of the direct medical costs (figure 1). Currie *et al.* [17] analysed admissions due to epilepsy at an English general hospital, highlighting that although the group of patients with epilepsy accounted for 2.8% of the total annual admissions, they annually occupied 7.3% of available beds because of their longer-than-average stays. According to the results of a study by Jacoby *et al.* [18], 18% of the children and 8% of the adults had

been admitted to hospital at least once for epilepsy-related reasons. In the study by Guerrini *et al.* [8], hospital admissions represented the highest percentage of the total costs in all groups of children with epilepsy, especially in those children whose condition had been recently diagnosed, for whom 30% of annual direct costs were attributable to hospitalisation, as opposed to 46% in the group of children with controlled seizures. Parallel data were reported by Zelicourt *et al.* [6] in a group of children with ages ranging from 1 month to 15 years, for whom hospital services (i.e., admission to a neurology unit and/or visits to the emergency room) represented 71% of the total direct costs during the first year after epilepsy was diagnosed, falling to 53% the second year. Similar rates were reported in a study by Berto *et al.* [5], which also showed that childhood-onset epilepsy produces higher hospital admission costs than focal epilepsy. Additionally, admissions for children with treatment-resistant epilepsy generate costs 20 times higher than those children whose seizures are under control [7].

Pharmacological treatment

The second factor in terms of economic importance is pharmacological treatment. Annual costs for children's medication ranged from € 250 to more than € 900 *per annum* (figure 1), which is actually higher than the figure for adults, whose annual costs associated with pharmacological treatment fluctuate between a low of € 105 and a high of € 361. Regardless of age, medication is responsible for a quarter of direct medical costs generated over the course of a year.

Recently, new AEDs have come onto the market, which are effective for treating various kinds of epileptic seizures. However, due to their high cost, they are mainly administered only after the classic AEDs have failed. According to Jacoby *et al.* [18], 16% of children are treated with at least one new-generation AED, whereas they are used in only 6% of adults. The percentage of pharmacological costs attributable to the new AEDs varies according to the degree of seizure control. The study by Guerrini *et al.* [8] reported that new AEDs represent 52% of the pharmacological costs in recently diagnosed children, 56% of the cost in children with controlled seizures, 37% in those with occasional seizures, and 85% of the cost associated with children having treatment-resistant epilepsy.

Few studies have explicitly assessed the cost of adverse side effects associated with AEDs, despite the fact that certain patients require treatment with various medications simultaneously, at high doses, leading to a higher rate of adverse effects and additional costs. Schlienger *et al.* [19] studied the direct costs due to severe skin conditions or hypersensitivity reactions in children and adults, directly related to the treatment with AEDs, which either required patients' admission to hospital or prolonged their stay, estimating that they reached an average of € 2 159 per patient. Nevertheless, in cases where childhood epi-

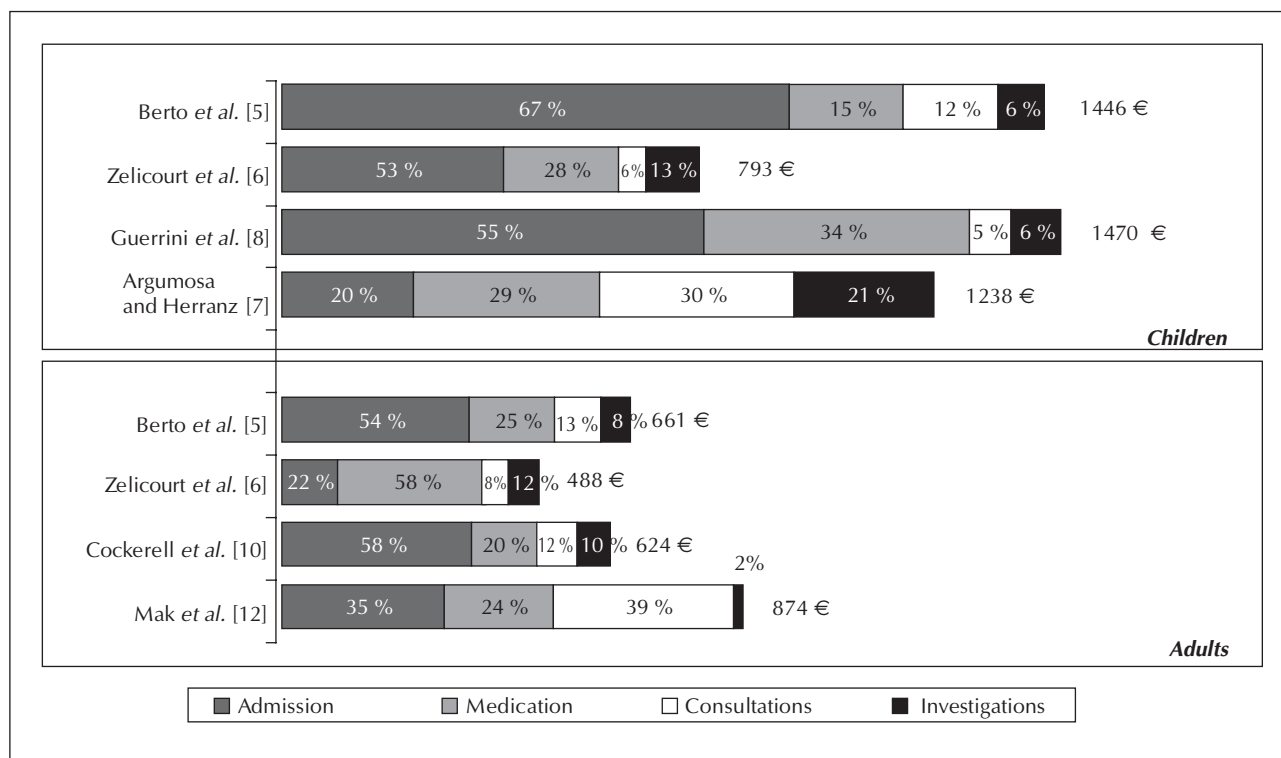


Figure 1. Direct medical costs in children and adults. Component distribution of direct medical costs. Expressed in euros (€) at the 2002 exchange rate, per patient and year.

lepsy is associated with mental deficiency or behavioural disturbances, it may be difficult to discern if these kinds of costs are linked to epilepsy as such or to these concomitant manifestations.

Consultations

The annual costs associated with consultations range from € 50-370 per child with epilepsy, representing 5-30% of the total direct medical costs. In adults, annual consultation costs vary from € 41-340 per patient, or 8-39% of direct medical costs. These figures are not easily comparable, because studies often fail to assess visits to paediatricians or general practitioners. In many countries, most follow-up with epileptic patients is carried out by general practitioners; therefore, the cost of these visits should also be included. The study by Zelicourt *et al.* [6] found that 86% of children and 83% of adults who had been recently diagnosed, visited their paediatrician or family doctor an average of 3.6 times annually as a result of the epilepsy or its treatment. During the second year after diagnosis, between 25% [6] and 40% [18] of children and adults with epilepsy made such visits, with an annual average of three visits for children, and two visits for adults. In economic terms, this represents approximately 1% of the total costs generated by epilepsy [18].

All of the studies assessed costs generated by visits to neurologists. During the first year after diagnosis, almost

100% of children and adults made such visits, with an annual average of 3.5 times. In later years, neuropaediatricians continue to be the physicians most visited by children with epilepsy, followed by general paediatricians (8). These visits to specialists by patients with childhood epilepsy represented 61% of all visits, accounting for 5-10% of total direct costs.

None of the studies in the literature cites neuropaediatric consulting over the telephone. Garaizar *et al.* [20] estimate that two-thirds of the total volume of consultations is carried out by telephone, and that 40% of these are related to epilepsy or its treatment. Since these telephone consultations take up some 10% of a neuropaediatrician's usual working day, their economic cost is considerable.

Most studies also fail to address the cost of emergency assistance due to epilepsy, or include this within general hospital services costs, which makes it difficult to calculate exactly.

Diagnostic investigations

Diagnostic investigations generate a higher cost in children than in adults. The annual cost per child ranges from € 87-266, or 6-21% of direct medical costs, whereas in adults they represent a maximum of 10% of direct costs, with an annual cost per patient of € 18-63. The number and type of tests included in these economic estimates varies widely from one study to another, although nearly

all of them include plasma levels of AEDs, EEGs, and the most expensive imaging tests (SCAN, MRI).

Psychoeducational support

Very few studies reflect the costs of the psychoeducational support that many children with epilepsy receive. The study by Argumosa and Herranz [7] found that psychoeducational and rehabilitational services accounted for 58% of total costs in a group of children with treatment-resistant epilepsy, and 39% of the total cost in a group of children with fully controlled seizures. Of the sample studied by Guerrini *et al.* [8], 16% presented some kind of clinical change associated with epilepsy. The need for educational support and rehabilitation can be related, at least in part, to these changes. It is possible that this cost represents a larger share of the economic burden in the group of children with more treatment-resistant epilepsy, although it may be difficult to determine whether these costs are generated by epilepsy as such, or by other pathologies that generate or are concurrent with epilepsy; Guerrini *et al.* [8] found that such costs are similar in all children with treatment-resistant epilepsy, whether or not it is associated with a psychophysical disability.

Indirect costs

Although indirect costs are given pride of place in studies involving adult epilepsy, in those focusing on children they are no longer the object of such attention.

Indirect costs in children with epilepsy are defined by the loss of economic productivity on the part of the parents when they accompany their children to consultations and while they are in hospital, or when providing special care at home, and these can account for more than 5% of the total cost of epilepsy [5, 7], reaching a rate as high as 11% in children with treatment-resistant epilepsy.

Moreover, the negative impact of epilepsy on remunerated work can sometimes affect other members of the family. For example, 20% of patients with treatment-resistant epilepsy require constant care and supervision, and so several members of their families may have to adapt their professional activities to these circumstances [11].

Finally, few studies assess excess mortality, an important factor when we consider that children with epilepsy have a risk of death five times higher than that of the general population during the first 15-20 years after the illness is diagnosed, and particularly in the first two years after onset [21, 22], which, in the long run, represents a high occupational price.

Factors with an impact on costs

In addition to age, the impact of which on costs associated with epilepsy has been mentioned earlier, other major factors determining the costs generated by childhood epilepsy are: frequency of seizures, phase of the illness's

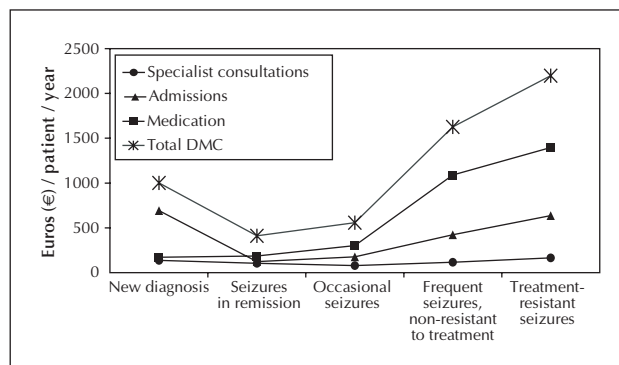


Figure 2. Direct medical costs according to phase of illness and treatment response. Expressed in euros (€) at the 2002 exchange rate, per patient and year. DMC = direct medical costs. Based on the Tetto *et al.* study [9].

development at the time when costs are calculated, and the kind of healthcare system in a given country. Figure 2, based on the study by Tetto *et al.* [9], shows that the least expensive epileptic patients are those having a prolonged remission of seizures, followed (in this order) by those with occasional seizures, recently diagnosed, patients with frequent seizures who are nevertheless not considered resistant to treatment, and finally, refractory cases. Moreover, the direct costs associated with consultations, hospital admissions, and pharmacological treatment also varies significantly, depending on the phase of the illness and response to treatment (figure 2).

Frequency of seizures

In any age group, the frequency of seizures is directly related to the costs generated by the epilepsy.

Figure 3, based on the study by Argumosa and Herranz [7] shows that the costs related to treatment-resistant epilepsy are three times higher than those generated by patients whose seizures are well under control. In addition, hospital admissions are the principal source of direct medical costs in treatment-resistant epilepsy, whereas in controlled

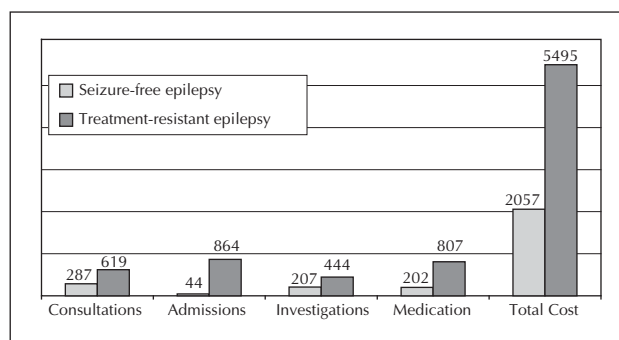


Figure 3. Direct medical costs and total costs in children [7] according to seizure-control level. Expressed in euros (€) at the 2002 exchange rate, per patient and year.

epilepsy, consultations represent the higher cost percentage. Costs differences depending on the degree of control of the epilepsy remain the same in adulthood. In the Cockerell *et al.* study [10], the cost of refractory epilepsy is 2.5 times higher than that generated by well controlled epileptic adults, while the Mark *et al.* study [12] comes to the conclusion that poor control of the illness may involve a cost that is four times higher.

Children with treatment-resistant epilepsy are admitted to hospital six times more often than those whose seizures are under control [8], and they require more frequent admission to an intensive care unit, where daily costs are higher. Therefore, costs resulting from hospital admissions in children with treatment-resistant epilepsy are nearly nine times higher than in children whose seizures are in remission.

The costs generated by pharmacological treatment are also noticeably higher in cases of treatment-resistant epilepsy. More than 80% of these children require polypharmacological therapy, whereas this is necessary in only a quarter of those children with fully controlled seizures [8]. In addition, the new AEDs are generally administered to this group of children, for whom the classic AEDs have failed, so that the costs associated with pharmacological treatment is four times higher in cases of treatment-resistant epilepsy.

In addition, poor seizure control leads to an increase in the number of consultations and diagnostic tests, doubling the costs generated by these factors in the group of children whose epilepsy is more resistant to treatment [7].

The costs generated by psychoeducational and rehabilitational support accounts for an important part of direct total costs. However, epilepsy in many children is just one symptom of a complex condition also featuring mental retardation, brain damage, behavioral disorders, all of which contribute to the necessity for support by psychoeducational and rehabilitational intervention. In Spain, stimulation and rehabilitation for a child suffering from refractory epilepsy costs € 1021 per year. That amount is four times lower in children in whom the illness is in remission (€ 263 per patient and year) [7].

Incident cases/prevalent cases

As shown by Cockerell *et al.* [10] in their population-based study, estimated costs during the year in which an epilepsy diagnosis is made fall by one-third in following years. The largest part of these initial costs is generated by diagnostic tests and periods of hospitalisation, but, as time passes, the highest costs are generated by AEDs, mainly by the increase in costs associated with the use of new AEDs in patients whose condition is more difficult to treat.

Figure 4 shows the conclusions taken from the studies by Berto *et al.* [5], Zelicourt *et al.* [6], and Guerrini *et al.* [8] involving 1898 children, showing that the costs associated with the first year after a diagnosis of childhood

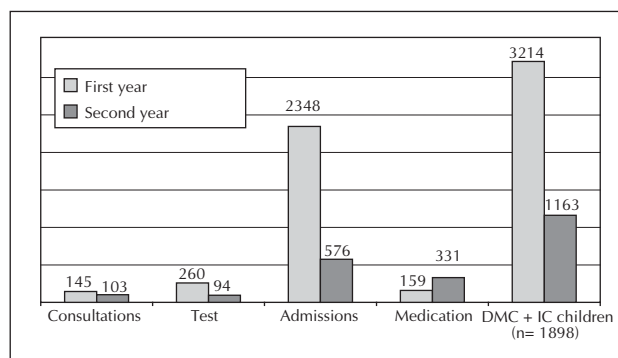


Figure 4. Costs according to phase of illness in children [5, 6, 8]. Expressed in euros (€) at the 2002 exchange rate, per patient and year.

epilepsy fall significantly in later years. In the children enrolled in a longitudinal study by Begley *et al.* [23], costs during the fourth year after a diagnosis of epilepsy were € 2378 less in a group of children from 5-14 years old, and € 1626 less in a group of 15-24 year-olds, than the costs generated by the group of children under five.

During the first year after an epilepsy diagnosis, costs associated with hospital admissions account for two-thirds of the total costs. However, and in contrast to the results reported by Cockerell *et al.* [10], in children with epilepsy, admissions to hospital continue to generate the highest costs, although total costs fall to a quarter of those associated with the first year after diagnosis.

The difference between the costs generated during the first and subsequent years after diagnosis is less significant when the child, or adult, suffers from treatment-resistant epilepsy, as shown in figure 5, which reflects data from the longitudinal study by Begley *et al.* [23]. However, there appears to be no significant difference in the reduction of initial costs with regard to such variables as the idiopathic,

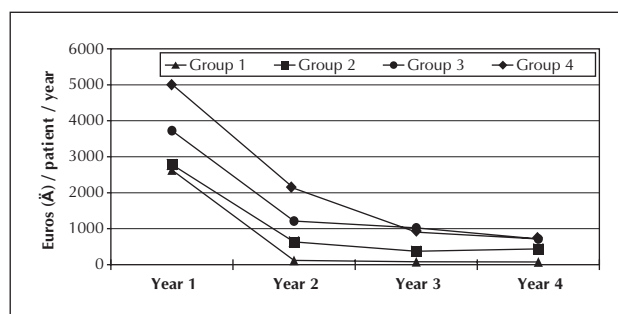


Figure 5. Cost per person (expressed in euros [€] at the 2002 exchange rate, per patient and year) according to year of developing the epilepsy and prognostic group [23]. **Group 1:** patients with one seizure upon being diagnosed, without recurrence during the follow-up; **Group 2:** patients with various epileptic episodes, although without any seizures for at least 12 months during the follow-up; **Group 3:** patients with at least one seizure per month over the last year; **Group 4:** patients with more than one seizure per month during the last year.

cryptogenic, or symptomatic aetiology of epilepsy [6], or the type of seizure [23].

Type of healthcare system and economic development

As occurs in the case of other chronic illnesses, the care given to patients with epilepsy depends a great deal on economic factors, so that their management is directly related to the availability of qualified personnel and accessibility to new diagnostic and therapeutic techniques which, in turn, are influenced by the level of economic development of the country. In addition, cultural factors and scientific resources can be major determinants of a country's national consumption of healthcare resources.

Whereas in many countries, costs are assumed totally or partially by a state healthcare system, in others they are the responsibility of the individual families, which, particularly in developing countries, is a major limitation. In Colombia, for example, epilepsy sufferers must spend the equivalent of 24 days' pay on treatment with vigabatrin, so that most patients, or their families, cannot afford the latest generation of AEDs [24].

The cost of chronic illness in children

Studies conducted in the USA and the UK show that 5-30% of children suffer from at least one chronic illness [25, 26, 27]. Most of them have only mild problems, but 2-4% suffer from illnesses that interfere with their daily activities. The costs engendered by medical care in children with chronic illnesses is 2.5-20 times higher, depending on the illness, than those generated in other children [28] and, overall, may represent up to 8% a country's entire healthcare budget [29].

With regard to other chronic childhood illnesses (*figure 6*), epilepsy [7] generates more costs than some, such as moderate asthma (30), atopic dermatitis [31], or type-1 diabetes [32] (which generate lower overall costs although their prevalence is higher), but fewer costs than others, including cystic fibrosis [33], non-terminal chronic kidney

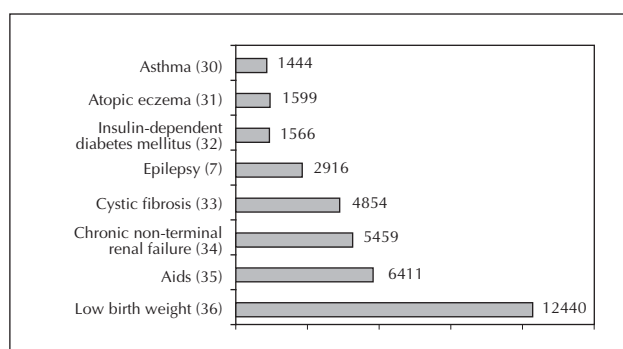


Figure 6. Costs of chronic illnesses during childhood. Expressed in euros (€) at the 2002 exchange rate, per patient and year.

disease [34], AIDS [35], or management during the first year of life of children with a very low birth weight [36].

Discussion

The cost of childhood epilepsy is higher than that of adult epilepsy, mainly due to the higher rate of hospital admissions, the need for more, and more complex, diagnostic tests, and the use of higher-priced AEDs. The child with epilepsy grows to adulthood within a family, academic, social, and occupational environment, so that the costs associated with the medical management of epilepsy may gradually give way to a higher burden of indirect costs associated with an epileptic patient's loss of productive and occupational capacity.

The highest percentage of the total cost of childhood epilepsy is generated by hospital services, particularly during the year after diagnosis. The studies by Guerrini *et al.* [8] and Halpern *et al.* [37] showed that the costs associated with epilepsy are lower when patients are treated by general practitioners. Therefore, if optimal communication could be achieved among the primary, secondary, and tertiary healthcare levels, the principal cost generated by the illness could be reduced if patients with uncomplicated epilepsy are followed by general practitioners or paediatricians, and only those with more complicated or treatment-resistant cases received care from more specialised hospital services. In addition, the use of day hospitals could be a good strategy for solving, quickly and economically, certain problems of patients with epilepsy. However, various studies [38, 39] have shown that primary care paediatricians are not completely aware of all of the psychosocial and other types of services required by a child with epilepsy or other chronic illnesses, when compared with the concerns identified by the children and their parents. Therefore, it is important for the paediatrician and the family to work together, in order to provide the most efficient assistance to these children, so that they can achieve the highest degree of personal and social integration.

As in adults, the frequency of seizures is the principal factor determining the total cost of childhood epilepsy, both in the first years of the illness and in the long run. Despite the effectiveness of the classic AEDs, 25-30% of patients are unable to totally control their seizures, even with polypharmacological treatments. However, the need for the new AEDs is not limited simply to this one-third of patients having treatment-resistant epilepsy, there is also a need to correct problems of tolerance and adverse affects associated with the classic AEDs. The cost of new-generation AEDs is nearly 10 times higher than that of their classic counterparts. Their introduction involves a high economic cost, but the specific costs generated by the 30% of patients with treatment-resistant epilepsy should not be forgotten – patients who, in addition, fre-

quently suffer adverse side effects when taking classic AEDs. Pharmacoeconomic assessment of the new AEDs is needed in order to determine whether their higher costs can be accepted in order to achieve higher effectiveness and improved quality of life, both in children with treatment-resistant epilepsy and in those who, although their seizures are under control, suffer from adverse side effects as a result of treatment with classic AEDs.

Conclusion

Children and adults with epilepsy have different needs as regards care and medical attention, with different, final, economic costs.

Due to the frequency and duration of their hospital admissions, their use of new-generation AEDs, and their need for psychoeducational and rehabilitational support, children with epilepsy generate higher costs than adults with epilepsy. Efforts to reduce the costs associated with childhood epilepsy should focus on these three points.

Greater participation by paediatricians and general practitioners in the management of the illness, a more efficient pharmacoeconomic assessment of effective, but expensive, new-generation AEDs, and knowledge of the social and educational needs of children with epilepsy will help these patients to become well-integrated, employable adults, leading to lower personal and social costs in the long run. □

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