

Original article

The economic impact of severe asthma to low-income families

Background: To estimate the direct and indirect costs of severe asthma and the economic impact of its management to low-income families in Salvador, Brazil.

Methods: One hundred and ninety-seven patients with severe asthma and referred to a state-funded asthma center providing free treatment were evaluated. At registration, they were asked about family cost-events in the previous year and had a baseline assessment of lung function, symptoms and quality of life. During the subsequent year, they were reassessed prospectively.

Results: One hundred-eighty patients concluded a 12-month follow-up. Eighty-four percent were female patients, and the median family income was US\$ 2955/year. Forty-seven percent of family members had lost their jobs because of asthma. Total cost of asthma management took 29% of family income. After proper treatment, asthma control scores improved by 50% and quality of life by 74%. The income of the families increased by US\$ 711/year, as their members went back to work. The total cost of asthma to the families was reduced by a median US\$ 789/family/year. Consequently, an annual surplus of US\$ 1500/family became available.

Conclusions: Family costs of severe asthma consumed over one-fourth of the family income of the underprivileged population in a middle-income country. Adequate management brings major economic benefit to individuals and families.

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The prevalence of asthma has been increasing in many countries and worldwide, the economic burden of asthma is high (1). Most studies addressing this issue focused on direct and indirect costs to the public health system. Only a few reports analyzed the family's costs incurred on patients with severe asthma (2, 3).

In poor households in low- and middle-income countries, even relatively small expenditures on health can be financially disastrous (4). The situation is more difficult in chronic disabling diseases, like severe asthma. In asthma, family's costs are directly associated with the severity of the disease (5).

The primary aim of management of persistent asthma is to gain control over symptoms with regular use of inhaled corticosteroids, but studies showed that the proportion of individuals with persistent asthma reporting use of inhaled corticosteroids is only 5% in Brazil, which is as low as what has been described in various other parts of the world (6, 7). Uncontrolled asthma is associated with economic burden to families and health systems, causing loss of productivity and deterioration in quality of life (3). In Salvador, Brazil, the prevalence of

wheezing among adolescents estimated in the first International Study of Asthma and Allergies in Childhood survey was 27% (8). The standard available strategy for asthma management in the public health system in Brazil was restricted to treatment of exacerbations with bronchodilators and systemic corticosteroids. The combination of high prevalence rates and the lack of access to free secondary prevention of asthma exacerbations through effective pharmacotherapy in the public health system lead to unacceptable levels of high morbidity and costs for families and the health system (9). In 2003, a program for control of severe asthma started in an outpatient reference clinic at the School of Medicine, Federal University of Bahia, in Salvador. The program included specialized care, patient education and free inhaled medication (bronchodilators and topical corticosteroids) for control of asthma in the public health system (10).

The aim of this study was to estimate the family's direct and indirect costs with one of the family members suffering from severe asthma, before and after being enrolled in a public reference center for management of

severe asthma. In the study, a specific questionnaire was used to measure the impact of asthma on families' budgets (11).

Methods

Setting – the Program for Control of Asthma and Allergic Rhinitis in Bahia (ProAR)

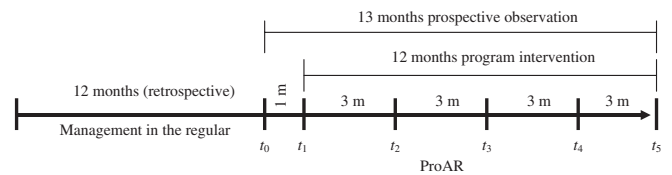
The ProAR was organized by the Federal University of Bahia, School of Medicine and supported by the Brazilian Ministry of Health, Department of Health of the City of Salvador and of the State of Bahia (10). The aims of ProAR was to assist persons with severe asthma from the underprivileged population, and to build capacity among primary care health professionals to deal with mild-to-moderate asthma. It provides a multidisciplinary, though simple and straightforward, approach to management of asthma with emphasis on secondary prevention of exacerbations. Care is provided by a team comprising physicians, nurses, pharmacists, social workers and psychologists. Patients receive free medication for asthma and rhinitis according to international guidelines: a powdered or pressurized metered-dose inhaled corticosteroid (budesonide), a nasal topical corticosteroid (budesonide) and beta-2 bronchodilators, long- and short-acting (formoterol/fenoterol) were the treatment options (12, 13).

Participants

A sample of 197 patients with severe asthma for at least 1 year, attending ProAR and aged between 12 and 75 years, was selected. The patients typically had continuous asthma symptoms, as well as daily limitation to exercise, frequent exacerbations and night symptoms, requiring daily use of a bronchodilator. The majority reported frequent emergency visits, hospitalizations, admissions to intensive care units and had a low forced expiratory volume in 1 s (FEV₁). Participants could have no contraindications for the use of the inhaled corticosteroids or long-acting beta-2 agonists, no concomitant lung disease (as assessed during clinical interview and by X-ray); had to be nonsmokers or have a smoking history <10 pack/years, and to give informed consent. Participants were recruited consecutively between April and September of 2005.

Study design

The study design was a clinical cohort of patients with severe asthma. We compared the direct and indirect costs of treatment for the families before and after joining ProAR. Patients were recruited when joining the program. At baseline, they answered three questionnaires: Asthma Family Costs Questionnaire (AFCQ), Asthma Quality of Life Questionnaire (AQLQ) and Asthma Control Questionnaire (ACQ) (14–16). A month after the baseline visit, at their first medical evaluation in ProAR, they were examined by a specialist and started using standardized treatment offered for free. The ACQ and AQLQ questionnaires were repeated during this visit. The data collected at the baseline visit provided information on the patients' status of asthma control, quality of life and direct and indirect costs related to the disease in the 12 months before they joined ProAR. After registration, information was collected prospectively for 1 year during monthly visits. Patients performed lung function tests at baseline, and at 6 and 12 months of follow-up (17). The ACQ and AQLQ were



*t*₀: self-report on morbidity, AQLQ, ACQ, AFCQ
*t*₁: self-report on morbidity, AQLQ, ACQ, lung function
*t*₂: self-report on morbidity, AQLQ, ACQ
*t*₃: self-report on morbidity, AQLQ, ACQ, lung function
*t*₄: self-report on morbidity, AQLQ, ACQ
*t*₅: self-report on morbidity, AQLQ, ACQ, AFCQ, lung function

Figure 1. Study design and follow-up schedule. AQLQ, Asthma Quality of Life Questionnaire; ACQ, Asthma Control Questionnaire; AFCQ, Asthma Family Costs Questionnaire.

answered every 3 months during the 1 year of follow-up, and AFCQ was repeated at the end of study, to measure costs to the family during the year they attended ProAR. Figure 1 shows the chronogram of the study. The same trained interviewer conducted all interviews for all cases.

The AFCQ, AQLQ and ACQ

The AFCQ was used to estimate family's costs. The questionnaire has 33 questions about direct and indirect costs for the treatment of a family member with asthma. It is divided in six sets of items (family income, financial help, transportation, loss of job or income because of asthma, medicines and other expenses). Patients were asked to bring evidence for their information, such as pay slips or bank statements, transportation or meals tickets, medicine boxes, or receipts of any purchase or expenditure. This questionnaire was adapted from a questionnaire of family costs of tuberculosis (14). The AFCQ reliability and reproducibility were evaluated and confirmed in asthma among 30 patients and is available at <http://www.pecs.ufba.br/scripts/arquivos/default.asp>. The AQLQ and ACQ are the standard instruments to measure asthma control and asthma-specific quality of life, both of which were previously translated into Portuguese and underwent linguistic validation (15, 16). The two questionnaires are available at <http://www.qoltech.co.uk>. The study was approved by the Ethics Committee for Human Research of the Federal University of Bahia School of Medicine.

The economic analysis

Family's costs of severe asthma were measured and compared for the two different treatment strategies (regular public health system care and the intervention by ProAR), using accounting procedures. Costs were brought up to current values in November of 2006 and the necessary depreciation estimated.

Statistical analysis

Data were entered onto a Microsoft Excel[®] spreadsheet and spss 11.5 (SPSS Inc., Chicago, IL, USA) package was used for statistical analysis. Two-tailed tests were carried out and *P* values <0.05 considered statistically significant. The categorical variables were reported as proportions and compared with chi-squared tests. All continuous variables were compared by using Wilcoxon's signed-rank test (18).

Results

General characteristics of patients

A total of 180 patients had complete data for the analysis. All patients lived in Salvador, came from a low socioeconomic stratum, having a median family income of US\$ 2955/year. Most worked in the unorganized sector and had a low educational level; 36 (18%) were unemployed and 135 (69%) had < 5 years of schooling. The majority of patients had mixed ethnicity of predominant African origin and 165 (84%) were female patients. They had asthma for an average of 25 years and 45% had another associated chronic disease such as hypertension, diabetes and depression. The mean age of patients was 45 ± 14 years. According to the patient's reports, asthma had caused at least one job to be lost (by patient or parents) in 47% of the families. Moreover, school days lost and early retirement was reported by 6% and 10% of patients, respectively. Two percent of the patients never worked because of their asthma. Of the 197 patients, 29 (15%) were illiterate (Table 1).

In spite of the regular treatment offered, three (1%) patients died at the start of the follow-up. A total of 14 (7%) patients did not complete the study follow-up visits. The noncompliers presented different characteristics from

Table 1. Demographic, clinical and socioeconomic characteristics of the patients included in the study (n = 197)

Age (mean ± SD)	45 ± 14
Ethnicity, n (%)	
White	33 (17)
Black or mixed	164 (83)
Female gender, n (%)	165 (84)
Occupation, n (%)	
Employed	63 (32)
Unemployed	36 (18)
Housewife	48 (24)
Retired	35 (18)
Student	15 (8)
City of residence, n (%)	
Salvador	178 (90)
Surrounding cities	19 (10)
Education, n (%)	
Illiterate	29 (15)
Elementary School	106 (54)
High school	57 (29)
University	5 (2)
Private health insurance holders, n (%)	20 (10)
Presence of comorbidities, n (%)	89 (45)
Duration of diagnosis of asthma in years (mean ± SD)	25 ± 16
Restrictions for the patient's or family activities associated with asthma, n (%)	
School absence	12 (6)
Never worked because of asthma	5 (2)
Early retirement because of asthma	19 (10)
Loss of job by the patient or family member	93 (47)
Family annual income (US\$) (median/quartiles)	2955 (1807/4656)

Data from the retrospective phase.

the compliers: they were better off economically, had more access to private health care and fewer comorbidities.

Asthma family's cost

Table 2 presents a list of documents required for patients to validate their information on each selected item of the AFCQ. The family's annual income increased by 24%, from US\$ 2955 to 3666 (US\$ 711/family/year), and the total direct and indirect family costs related with the asthma case management (expenses and loss of income), were reduced by 91% (US\$ 789/family/year), from US\$ 868 to 79, after the patients joined the ProAR. The most relevant item of the family's expenses with severe asthma was medication. This together with other direct costs involved in the treatment represented 24% and 2% of the overall family income, before and after joined ProAR, respectively. The provision of free treatment by ProAR reduced medication costs to zero. When the increase in income and the reduction of total asthma management costs were taken into consideration, the median annual incremental financial balance (family income net of direct and indirect expenses with asthma) was US\$ 1500/family (Table 3 and Fig. 2).

There was also a reduction in the median time spent with transportation related to the care of asthma per patient, from 6 to 4 h/month, and in time waiting on health services because of asthma from 4 to 2 h/month. There was also a reduction of 75% in school/work absences.

To cope with the high cost of asthma, the families relied on financial help (computed in the overall family income) but also on nonfinancial help (medication, food, habitation and health insurance), made through donations from their friends, health care professionals and relatives.

Health aspects

For the 180 patients that concluded the follow-up, comparing baseline observations with 12 months after starting treatment at ProAR, we found an increase in the regular use of inhaled corticosteroids (37–100%), in the median regular specialist visits (0–9 visits/year) and spirometries performed per year (1–2). There was also a

Table 2. Evidence required to validate each cost item of the Asthma Family Cost Questionnaire (AFCQ)

Cost items	Evidence required
Family income	Pay slips or bank statement showing the source of earning
Financial help	Pay slips, welfare card or bank statement showing the source of earning
Transport	Free ticket, student card and other tickets
Loss of job because of asthma	Job registration and government benefit registration
Medicines	Medicine's priced boxes or receipts
Other expenses	Receipts or the purchase of any goods or services related with the asthma management

Table 3. Family overall income and direct and indirect costs (in US\$) related with the severe asthma case management before and after intervention ($n = 180$)

	Year before ProAR median (quartiles)	Year in ProAR median (quartiles)	P-value*
Family annual costs of treatment and income			
Overall family income	2955 (1807/4656)	3666 (2359/5620)	<0.01
Family expenses with asthma (direct cost)	714 (407/1277)	76 (37/205)	<0.01
Proportion of family income spent directly with asthma	24%	2%	
Total family costs (direct + indirect)	868 (459/1565)	79 (40/217)	<0.01
Proportion of family income spent with asthma	29%	2%	

ProAR, Program for control of Asthma and allergic Rhinitis.

*Wilcoxon signed rank tests.

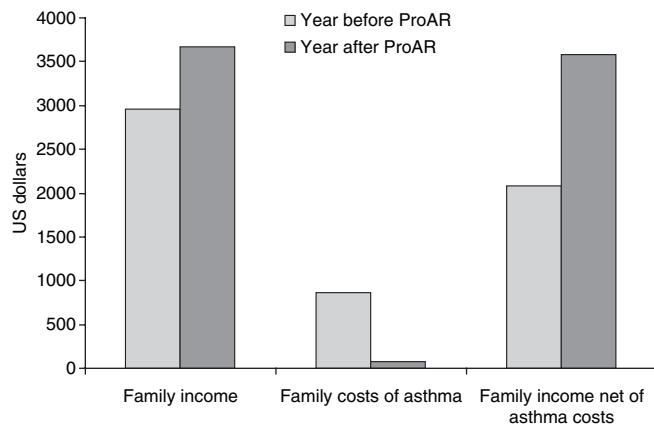


Figure 2. Family income, family direct and indirect cost/patient/year because of severe asthma and family annual net income, before and after ProAR intervention (median \pm quartiles).

substantial reduction in the median of emergency room visits per patient, from 36 to 1 per year. Lung function improved 6% in VEF_1 and 24% in the peak flow predicted values. The ACQ scores improved 50% and changes in quality of life, as measured by mean overall AQLQ scores, improved 74%. In the 1-month baseline period (between t_0 and t_1 , the two visits performed previous to intervention in ProAR), the AQLQ and ACQ scores remained stable. After 3 months of medication, the scores reached significant improvement which was maintained until the end of the 1-year period (data not shown).

Discussion

This study showed that, in Salvador, Brazil, family costs with severe asthma takes a remarkable proportion of family income, representing an important economic burden. The frequent loss of days of work, by patient or their relatives, contributes to the process of impoverishment of these families. The patients studied had severe asthma for 25 years on average, which may have contributed to aggravate the poverty situation experienced by a major part of them (19). We showed that an

intervention to provide free regular specialized care including assistance for medication, can control severe asthma, improve quality of life and markedly benefit the family's economic stability.

This study shows that when patients with severe asthma had their disease under control, there was a major reduction (89%) in family's direct cost of asthma, and a significant increase in the overall family income. A remarkable effect of the intervention was noticed in the reduction of the proportion of family income (24% vs 2%) used for the treatment of one of the members with severe asthma.

The method used in this study was beyond the direct asthma costs and took into account family's indirect costs, such as loss of income of patients and family members, house renovations and transportation. After the intervention, patients and their families had a 24% increase in their income, decreasing the effect on the family indirect costs. This increase was because of reduction in work absences of patients or family members, as the majority worked in the unorganized sector, where one does not earn when one does not work. The control of asthma had a direct favorable impact on physical performance, leading to the increase of work capability and income.

There have been efforts to define a threshold of family expenditure on health, beyond which a family will slip into deeper poverty. World Health Organization estimates that families who spend 50% or more of their nonfood expenditure fit in this category (4). Other estimates suggest this threshold at 40% of income after subsistence needs have been met or 5–20% of total income (20, 21). In this study, asthma treatment consumed on average 24% of family total income. This proportion goes up to 29% when indirect costs are included. For the low-income families evaluated in Brazil, food expenditures require over half of their total income (22). Therefore, the costs incurred by the families of subjects suffering from severe asthma in the population studied may be considered catastrophic.

A review of the impact of chronic diseases such human immuno deficiency virus (HIV)/acquired immuno deficiency syndrome (AIDS), tuberculosis and malaria on family costs in 12 low-income countries showed that

limitations in the health services such as inadequate coverage and quality contribute to increased family costs. The proportion of family income used for the healthcare varied between 2.5% and 10%, and this latter figure was considered catastrophic (23). A study in South Africa showed that families of patients with HIV/AIDS were poorer and had a higher proportion of unemployed members, and that this increased with time (24).

An Australian study estimated the annual family's costs for treatment of 238 asthmatic children. It found that the mean annual treatment cost per asthmatic child was US\$ 164 (2). In this study, the annual family costs (US\$ 868) are five times higher. Possibly, this difference is because of the degree of severity asthma in our patients and because, in the method of collection of cost data, indirect costs were also taken into consideration.

The success of asthma treatment in preventing exacerbations seems to be associated with regular control of symptoms. Patients with scores of ACQ < 1.5 (cut-off point for clinical trials) are considered to be under control (16). Within 1 year of follow-up, patients treated in ProAR reduced the ACQ mean score from 4 (poorly controlled) to 2, which is very close to adequate control. Lung function measurements (FEV₁ and peak flow) were less responsive to changes during the first year of asthma control than ACQ scores. Severe or uncontrolled asthma causes limitation and impact in physical, social and emotional well-being of patients and their families. Its control may result in remarkable change in quality of life (15). After ProAR intervention, patients left a situation of extreme limitation (AQLQ mean score of 2) to enter a mild/moderate limitation zone (AQLQ mean score of 4) during the 1 year of intervention.

A limitation of our study is that information from the year before intervention was collected retrospectively from patient reports (25). It would not be ethical to have a parallel control group of severe asthmatics followed up without access to ProAR, once free preventive inhaled medication was made available. Therefore, the only way we could study patients inside and outside the program was comparing their own profile before and after the intervention. In this study, patients apparently had no difficulty to recall hospitalizations, emergency room visits, income, financial help, medicine prices and transportation expenses. They were able to recall and to present evidence of their recent expenses on medicine, bringing priced medicine boxes or drugstore receipts, and medical reports and prescriptions from hospitalizations and emergency visits as well. In favor of findings of this report, it shall be considered any possible loss of information related with the retrospective period, acts towards decreasing the estimated economic costs during this period. Therefore, the impact of the asthma on the family income can be even greater than that presented here. The presence of an interviewer might have influenced the patient's answers.

However, this was needed as the majority of patients had low educational level and some were illiterate. The interviewer was trained to avoid influencing the answers, and was the same for all patients throughout all the visits (25).

In conclusion, this study conducted among an underprivileged population in a middle-income country showed that, cases of severe asthma constitute a heavy economic burden to families from low socioeconomic strata. Adequate and free care of these patients generate great clinical improvement and major economic benefits to their families, and, as we demonstrated elsewhere, with a great cost-effectiveness ratio (11). The investments in this asthma management program are only a small proportion of the regular public costs of ambulatory and hospital care for the same uncontrolled asthma patients.

Support statement

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Contributors

R. Franco, M. L. Barreto, A. A. Cruz and A. C. Santos designed the study, supervised field work, analyzed data, interpreted results, and wrote the paper; H F Nascimento, C. Souza-Machado, E. V. Ponte and A. Souza-Machado did field work, interpreted results and edited the paper. L. C. Rodrigues designed the study, analyzed data, interpreted results, and wrote the paper.

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Conflict of interest

All authors have no conflict of interest in relation to this report.

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