



Free asthma medications reduces hospital admissions in Brazil (Free asthma drugs reduces hospitalizations in Brazil)



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ABSTRACT

Background: Since June 2011, the Brazilian health system started providing asthma medications (beclomethasone and salbutamol), totally free of charge to patients with asthma. The aim of this study was to evaluate the impact of the provision of free asthma medications on hospital admissions for asthma in Brazil, using a national hospitalization database (DATASUS), comparing the incidence of hospital admissions before and after the free supply of these drugs.

Methods: Admissions of patients with 1–49 years of age by the Brazilian public health system with the diagnosis of asthma were compared pre (2008–2010) and post (2012–2014) provision of free medicines (beclomethasone and salbutamol). The number of hospital admissions due to asthma and non-respiratory diseases, as well as the amount spent with asthma hospitalization, were obtained from DATASUS, the Brazilian government open-access public health database system.

Results: Admission rates for asthma significantly decreased from 90.09/100.000 (2008–2010) to 59.85/100.000 (2012–2014), when the period pre and post provision of free medicines were compared [OR 0.67 (CI 0.48–0.92)]. Non-respiratory admission rates remained stable, when both periods were also compared.

Conclusion: Asthma hospitalization rates significantly decreased in the three-year period after the provision of free medicines to treat asthma. Our findings suggest that the provision of free medications for asthma may have a particular public health impact by its own in developing countries.

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1. Introduction

In many developing countries the prevalence of asthma is high [1]. Hence, specific public health strategies to protect vulnerable populations as subjects with asthma should be pursued. Although the global prevalence of asthma has been rising worldwide, some studies have shown that the number of hospitalizations tend to fall in some developed countries [2,3], at least partially explained by improved medical care and wide access to controller therapy, such as inhaled corticosteroids (ICS) [2,4].

The inhaled therapies (corticosteroids and bronchodilators) constitute the cornerstone of asthma treatment. Asthma health outcomes can be improved by pharmacologic intervention developed in partnership between patient/family/caregivers and

healthcare practitioners [4,5]. According to the guidelines for Primary Health Care in low-resource settings [6], ensuring that low-cost, good quality, ICS are readily available for all patients with persistent asthma is one of the highest priorities for asthma control in these vulnerable populations. Inhaled steroids are the treatment of choice in the management of asthma and its regular use has been associated with reductions in the rate of hospital admissions for asthma [7].

Since June 2011, the Brazilian Public Health System (SUS) provided asthma medications totally free of charge to the patients with asthma throughout national states. Among these, beclomethasone, ipratropium bromide and salbutamol were available. The drugs were offered by the Ministry of Health of Brazil through the Farmácia Popular to the population in a network of 554 drustores (managed and assembled by the government) and 20,374 private network contracted by the government. However, adherence to the program by physicians and patients take 1–2 year until the program became well known. However, there are no studies evaluating

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the impact of free provision of these drugs on the incidence of hospitalizations for asthma in a large population based study. The aim of this study is to evaluate the impact of the provision of free asthma medications on hospital admissions for asthma in Brazil, using a national hospitalization database (DATASUS), comparing the incidence of admission before and after the free supply of these drugs.

2. Methods

2.1. Extraction of data

We used observational data to examine trends in the rates of asthma hospital admission at SUS, before and after the introduction of medications for asthma completely free of charge to the population. This public health system provides a broad coverage of Brazilian population. Data were obtained from DATASUS database <http://www2.datasus.gov.br/DATASUS/index.php?area=0203> (accessed in March, 2015) a national database that contains information on epidemiology and morbidity of various diseases that impact on the health of the Brazilian population. This platform is open-access, especially used for research or health improvements in the public health system. In DATASUS, it is possible to obtain information of absolute number of hospitalizations and the amount spent with that in the public system according to the International Classification of Diseases (ICD), version 10. Data from all period studied are fully included in DATASUS since January, 2008.

2.2. Data analysis

Our study is a retrospective analysis of data from DATASUS, which is a database of the department of SUS. Hospitalizations of individuals aged from 1 to 49 years in the Brazilian public health system, with diagnosis of asthma was compared pre (2008–2010) and post (2012–2014) free asthma medication provision periods. Time series were divided into pre-implementation (2008–2010), transition (2011) and post implementation periods (2012–2014). Hospital number of admissions due to asthma and non-respiratory diseases (control group) were obtained. Codes of “asthma” were used to select the main study outcome data (in DATASUS, as ICD: J45 and J46) from 2008 to 2014. Non-respiratory admissions were used as comparison (all ICD 10, excluding chapter X: J00 to J99), during the same time frame. Two main age groups were selected: children and teenagers, aged from 1 to 19 years, and adults from 20 up to 49 years old. Additionally, data from specific age groups were extracted from DATASUS, as whole group and used to create age-stratified groups. We calculated the global and age-stratified annual incidence of hospitalizations (asthma and non respiratory diseases) per 100,000 people by dividing the number of cases of disease by the midyear population estimates, and multiplying the quotient by 100,000. For all studied years the estimation of population of the age groups was obtained from the official Brazilian Census surveyed in 2010.

We assessed the effect of the introduction of free medications for asthma on hospitalizations by calculating the percentage change in the rate of asthma admissions.

Simple relative reduction was calculated from pre- vs. post-implementation time periods as the average yearly admission rate in 2012–2014 minus the average yearly admission rate in 2008–2010, divided by the admission rate in 2008–2010, and multiplied by 100. We also calculated the absolute difference between the average rate in the three-year period before free medication provision (2008–2010), and the rate in each of the three years' post implementation of the program (2012–2014). The difference in rates and the associated Odds Ratio, with 95% confidence

intervals, were used to assess the significance of the observed changes in asthma and non-respiratory admissions.

We proceeded the analyses of the effect of the introduction of free medications for asthma on hospitalizations to calculate by simple relative reduction the impact of this measure on the amount spent by the Public Health System comparing pre- vs. post implementation time periods. We calculated the average of the amount spent with asthma hospitalizations between 2012 and 2014 minus the average of the amount spent for the same reason between 2008 and 2010.

2.3. Ethics

Since DATASUS is a free-access database and has no personal patient-identified data, our study did not require any review and approval of our institutional ethics committee.

3. Results

3.1. Overall incidence of asthma admissions

From 2008 to 2014, a number of 4,888,626 admissions due to respiratory diseases were identified in individuals from 1 to 49 years of age in Brazil, and asthma accounted for 16.77% (819,908) of these cases. The annual incidence of asthma admissions showed an important decrease (33.57%), comparing pre [2008–10] and post [2012–14] periods of governmental provision of free medicines to treat asthma. In children and teenagers younger than 19 years of age, the mean reduction was 27.42%, whereas in individuals aged 20–49 years of age, the reduction was 40.88%. Additionally, the contribution of asthma in the total number of admissions due to respiratory diseases also decreased from 19.22% in 2008 to 14% in 2014. As shown in Table 1, the annual rate of asthma hospitalizations decreased from 92.2/100,000/year in 2008–10 to 52.6/100,000/year in 2012–14 (OR: 0.67; CI = 0.48–0.92). For non-respiratory admissions, we did not find any statistically significant difference (OR: 0.96; CI = 0.92 to 1.00) (see Table 2).

3.2. Analysis between different age groups

The relative difference in rate was similar between children and teenagers, when pre and post-periods of free medication provision were compared. However, the reduction was more relevant in adulthood (NN). Fig. 1 shows the absolute number of annual asthma hospitalizations between 2008 and 2014. After 2011, asthma admission rates strongly decreased in all age groups analyzed.

Table 1

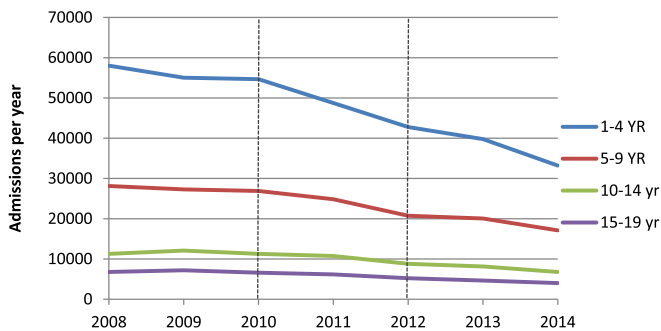
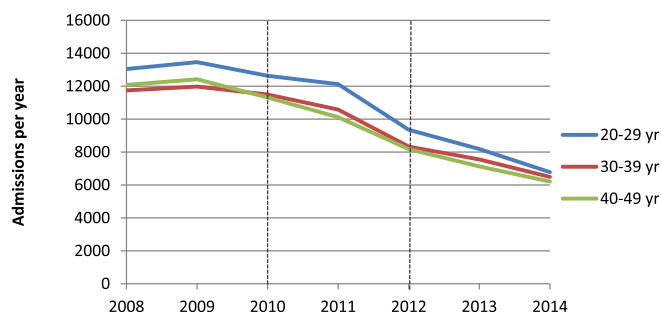
Admissions of asthma and non-respiratory diseases in Brazil from 2008 to 2014 (age: 1–49 years).

Year	Asthma admissions (incidence per 100,000 persons year)	Non-respiratory admissions (incidence per 100,000 persons year)
2008	141,077 (92.21)	6,254,288 (4088.28)
2010	134,830 (87.34)	6,462,487 (4186.41)
2011	123,331 (79.61)	6,346,368 (4097.02)
2012	103,381 (66.55)	6,222,371 (4004.84)
2013	95,499 (61.34)	6,203,633 (3985.09)
2014	80,573 (51.64)	6,119,059 (3924.05)
2008–2010, mean	90.09	4130.92
2011–2014, mean	59.85	3971.66
08–10/12–14	30.24 (–33.57)	159.26 (–3.86)
change (%) OR (CI)	0.67 (0.48–0.92)	0.96 (0.92–1.00)

Table 2

Hospitalization for asthma in Brazil before and after the provision of free medicines to treat asthma.

Age	2008–2010	2012–2014	Pre and post absolute difference in rate ^a	Pre and post relative difference in rate ^a	
	n° admissions (n° admissions per 100,000/year)	n° admissions (n° admissions per 100,000/year)		%	OR(CI)
<19 yrs					
1–4	55,910 (432.57)	38,587 (319.09)	–113.48	–26.23	0.74 (0.64–0.85)
5–9	27,434 (160.89)	19,303 (118.77)	–42.12	–26.17	0.74 (0.58–0.94)
10–14	11,543 (67.09)	7903 (46.12)	–20.97	–31.26	0.69 (0.47–1.00)
15–19	6850 (39.83)	4624 (26.97)	–12.86	–32.29	0.68 (0.41–1.10)
Mean <19 yrs	25,434 (175.09)	17,604 (126.99)	–48.10	–27.47	0.73 (0.58–0.90)
Adults					
20–29	13,045 (37.17)	8105 (23.39)	–13.78	–37.07	0.62 (0.37–1.05)
30–39	11,739 (42.39)	7458 (23.16)	–19.23	–45.36	0.55 (0.33–0.91)
40–49	11,936 (48.40)	7170 (27.57)	–20.83	–43.04	0.58 (0.37–0.93)
Mean adults	12,240 (42.66)	7578 (24.71)	–17.95	–42.08	0.58 (0.36–0.95)
Total	19,780 (118.33)	13,307 (83.15)	–35.18	–29.73	0.70 (0.53–0.93)

^a The rate of hospitalization is the number of admissions per 100,000 person-years.**A Age < 19 yr****B Age 20–49 Years****Fig. 1.** Absolute number of asthma admissions from 2008 through 2014, according to age group. The period from 2008 through 2010 constitutes the pre-free medicine. The inclusion of ipratropium bromide, beclomethasone dipropionate and salbutamol sulphate free of charge to the population was introduced in June 2011.**3.3. Reduction of hospitalizations for asthma across the country**

Regional evaluation shows no difference between the five Brazilian geographic regions in relation to decrease in absolute number of asthma admissions in stratified analysis (Fig. 2). Children and adolescents accounted for more than 70% of total asthma hospitalizations countrywide, mostly due to admissions of children 1–4 years old (near to 30% of total admissions). More importantly, the distribution of hospitalizations due to asthma, according to age, was similar across the whole country.

3.4. Financial cost of asthma admissions

The program of provision of free medications for asthma, which may have accounted for a decrease of 33.57% in hospitalizations

related to asthma, accompanied by a significant reduction in the amount spent on hospitalizations related to this disease (Fig. 3A). In 2010, the amount of hospital admissions for asthma in the age group 1–49 years was approximately US\$ 41 million, while in 2014, it was about US\$ 16 million, representing a saving of 66% to the public finances. Therefore, the reduction of one third of hospitalizations after 2011, which accompanied the dispensing of free medicine, was accompanied by a reduction of 51% in financial spending on hospitalizations related to asthma, which is a significant financial saving to the health system. As previously stated, the reduction in hospitalizations was higher in the age group between 20 and 49, which was accompanied by a greater economy of 37% against 28.7% in the age group between 1 and 19 years, as shown in Fig. 3B. The amount for hospital admissions for asthma from 2008 to 2014, comparing pre and post periods of the implementation of this free-medication program, is described in Table 3.

4. Discussion

Asthma hospitalization rates in Brazil remained stable between 2008 and 2011. After 2011, the admission rates have shown a reduction of 33.57% following the introduction of free asthma medications. To the best of our knowledge, this is the first study to evaluate countrywide data, assessing the impact after 3 years of the introduction of the provision of free medications to treat asthma in Brazil. Admission rates in Brazil are comparable to that described in countries with high asthma prevalence. Admission rates in UK = 113/100,000 and US = 138/100,000, but a bit higher than that described in other European countries Germany 46/100,000 and Canada (79/100,000). Unfortunately, it is difficult to compare asthma admissions rates worldwide due to lacking of information in developing countries [8].

We found that the decline in admission rates after the introduction of free medications in adulthood was higher, compared to the decline in children and adolescents. Although the decrease in hospitalizations has included all population groups, the average of decline in children was lower, mainly under the age of 4 years. This finding particularly in younger children were also described in other studies [3,9] and could be explained due to differences on the diagnosis of asthma in children 5 years of age and younger.

The clinical symptoms of asthma are variable and nonspecific at this age group. Episodic respiratory symptoms, such as wheezing and cough, are also common in young children who do not have asthma, particularly in those younger than 3 years, leading to a difficult diagnosis. Furthermore, neither airflow limitation nor airway inflammation, the main pathologic hallmarks of the

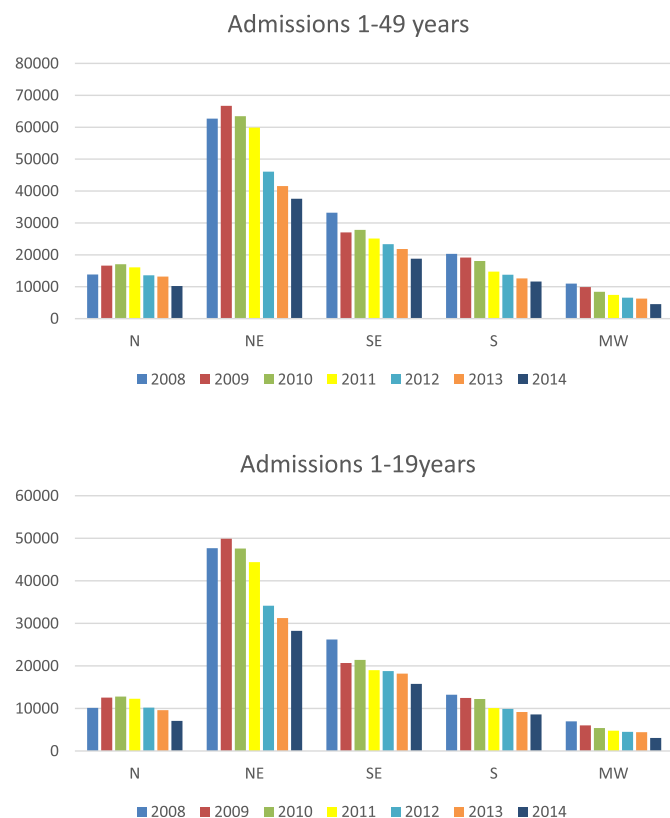


Fig. 2. Absolute number of asthma admissions from 2008 through 2014, according to geographic regions and ages 1–49 yr (top), 1–9 yr (middle) and 1–4 yr (bottom). The North (N) and Northeast (NE) regions present the major low socioeconomic index in Brazil. The provision of free medicines to the population was introduced in June 2011 (yellow bar in the figure). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

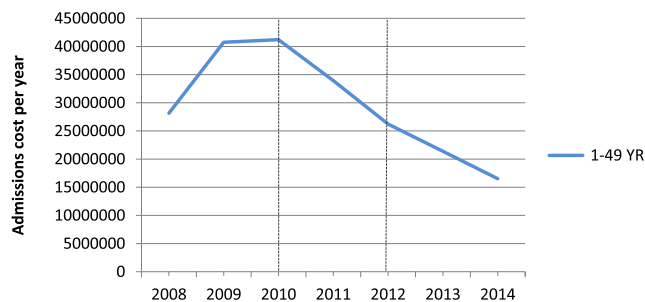
condition, can be assessed routinely in this age group [5]. Thus, the mild reduction in hospitalization rates in young children could be attributed to the lower impact of the asthma medications in this age group, with a more diverse phenotypic wheezing disorder. These results are in line with recent guidelines [6,10], which reinforce the importance of ensuring access to medications for asthma control to high-risk population [11].

Importantly, asthma also constitutes a major cause of hospitalization in several Brazilian cities, with social level and intra-urban differences playing a role on the incidence of hospitalizations [12,13]. Moreover, the impact of free medications to treat asthma could be seen as an important mechanism to prevent deaths related to disease, since the population with higher risk to die by asthma complications are hospitalized patients [14,15]. Further studies to investigate the impact of the provision of free medications to treat asthma on Brazilian mortality rates are needed.

Asthma composes an important health issue worldwide, as a result of its high mortality and morbidity rates. In this scenario, several countries developed programs aimed at more effective treatments for asthma, in order to reduce their exacerbations, thus reducing hospitalizations and also reducing costs that this disease causes to the public system [16]. In Brazil, asthma is a major and steady economic burden on the public health system, with around US\$ 208 million spent on hospitalizations from 2008 to 2014, representing 11.68% of all costs spent on hospital admissions due to respiratory diseases in the same period.

Disability adjusted life years (DALYs), a measure of burden of disease, considered the years of life prematurely lost and the years of life lived with disability, concluding that asthma was the 14th

A 1-49 yr



B Age groups 1-19 yr and 20-49 yr

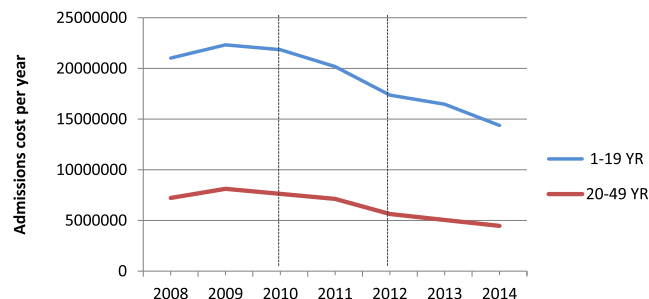


Fig. 3. Absolute financial cost (US dollars) spent on asthma admissions from 2008 to 2014, according to age group. The period from 2008 to 2010 constitutes the pre-free medicine program. The inclusion of ipratropium bromide, beclomethasone dipropionate and salbutamol free of charge to the population was introduced in June 2011.

Table 3

Financial cost of asthma admissions per year in Brazil from 2008 to 2014 (age: 1–49 years).

Admissions cost per year ^a	Year
28,154,572.30	2008
40,738,415.15	2009
41,207,551.22	2010
33,918,457.02	2011
26,216,925.61	2012
21,385,573.90	2013
16,528,033.39	2014

^a Currency in US dollars.

most important disease in terms of global years lived with disability [17]. Taking these data into account, the impact of the expansion of asthma treatment goes far beyond economic factors, although these are also important. This measure has significant impact on patients' lives, in their quality of life, reducing their disability and mortality related to the disease. But taking into account the financial savings generated to the public funds and the fact that the program benefited 513% more asthmatics, increasing from approximately 67,000 people in 2012 to 344,000 people in 2015, it is assumed that the measure was indeed in-depth and cost-effective [18]. Besides, in 2014, US\$ 16.5 million were spent on hospitalizations for asthma by SUS, while the Ministry of Health has invested US\$ 7.7 million to supply free drugs for asthma treatment. In this scenario, 60,504 admissions that have been squeezed between the years of 2008 and 2014 would have an estimated cost of US\$ 8.44 million. Therefore, our data suggests that the dispensing free medications for the treatment of asthma seems to be an effective strategy from the pharma-economics point-of-view [19].

Our study has some limitations. We have included the source of the data (DATASUS) that depended on the diagnosis by the attending physicians, which may have some accuracy limitations,

and do not shows information about compliance on uptake of medications. However, underreporting is unlikely as these data are also used for reimbursement purposes. Despite of the accounted limitations, it is difficult to assign other reasons for the strongly decrease shown in asthma hospitalizations, other than the introduction of free medication delivery. There was no educational or modified asthma treatment program applied in this period by Brazilian government. Moreover, besides the clear different trend of admission rates between the periods analyzed, the consistency of the results across the country and in all age groups studied reinforce the hypothesis that the simple and easy access to asthma medications reduced the incidence of hospitalizations.

In conclusion, asthma hospitalization rates decreased significantly in the three year period after the provision of free medications to treat asthma. Conversely, rates of non respiratory admissions remained stable. These data describes the potential beneficial impact of provision of free medications in the reduction of hospitalization due to asthma in developing countries and the great impact that this measure may result in the economy of public health systems.

Author contributions

Talitha Comaru participated in conception and design of the study, acquisition, analysis and interpretation of data; drafting the article and revising it critically. Paulo Márcio Pitrez and Leonardo A. Pinto participated in conception and design of the study, analysis and interpretation of data; drafting the article and revising it critically. Frederico Orlando Friedrich and Victória D. Silveira participated in acquisition, analysis and interpretation of data; drafting the article or revising it critically.

All the authors approved the final version to be published.

Conflict of interest

None of the authors have conflicts of interest.

References

- [1] C.K. Lai, R. Beasley, J. Crane, S. Foliaki, J. Shah, S. Weiland, International study of asthma and allergies in childhood phase three study group. Global variation in the prevalence and severity of asthma symptoms: phase three of the international study of asthma and allergies in childhood (ISAAC), *Thorax* 64 (6) (2009 Jun) 476–483.
- [2] S. Cohen, N. Berkman, A. Avital, C. Springer, L. Kordoba, Z. Haklai, et al., Decline in asthma prevalence and severity in Israel over a 10-year period, *Respiration* 89 (1) (2015) 27–32, <http://dx.doi.org/10.1159/000368613>.
- [3] I.B. Mikalsen, L. Skeiseid, L.M. Tveit, D.H. Engelsvold, K. Øymar, Decline in admissions for childhood asthma, a 26-year period population-based study, *Pediatr. Allerg. Immunol.* (2015 Mar 18), <http://dx.doi.org/10.1111/pai.12372>.
- [4] Centers for Disease Control and Prevention (CDC), Vital signs: asthma prevalence, disease characteristics, and self-management education: United States, 2001–2009, *MMWR Morb. Mortal. Wkly. Rep.* 60 (17) (2011 May 6) 547–552.
- [5] S.E. Pedersen, S.S. Hurd, R.F. Lemanske Jr., A. Becker, H.J. Zar, P.D. Sly, et al., Global initiative for asthma. Global strategy for the diagnosis and management of asthma in children 5 years and younger, *Pediatr. Pulmonol.* 46 (1) (2011 Jan) 1–17, <http://dx.doi.org/10.1002/ppul.21321>.
- [6] WHO Guidelines Approved by the Guidelines Review Committee, Prevention and Control of Noncommunicable Diseases: Guidelines for Primary Health Care in Low Resource Settings, World Health Organization, Geneva, 2012.
- [7] S. Suissa, P. Ernst, A. Kezouh, Regular use of inhaled corticosteroids and the long term prevention of hospitalisation for asthma, *Thorax* 57 (2002 Oct) 880–884.
- [8] R. Gupta, et al., International trends in admissions and drug sales for asthma, *Int. J. Tuberc. Lung Dis.* 10 (2) (2006 Feb) 138–145.
- [9] K. Hasegawa, Y. Tsugawa, D.F. Brown, C.A. Camargo Jr., Childhood asthma hospitalizations in the United States, 2000–2009, *J. Pediatr.* 163 (4) (2013 Oct) 1127–1133 e3, <http://dx.doi.org/10.1016/j.jpeds.2013.05.002>.
- [10] National Asthma Education and Prevention Program, Expert panel report 3 (EPR-3): guidelines for the diagnosis and management of asthma-summary report 2007, *J. Allerg. Clin. Immunol.* 120 (5 Suppl) (2007 Nov) S94–S138.
- [11] C.Y. Chiang, N. Ait-Khaled, K. Bissell, D.A. Enarson, Management of asthma in resource-limited settings: role of low-cost corticosteroid/ β -agonist combination inhaler, *Int. J. Tuberc. Lung Dis.* 19 (2) (2015 Feb) 129–136, <http://dx.doi.org/10.5588/ijtld.14.0363>.
- [12] C. Roncada, S.G. de Oliveira, S.F. Cidade, E.E. Sarria, R. Mattiello, B.S. Ojeda, et al., Burden of asthma among inner-city children from Southern Brazil, *J. Asthma* (2016 Jan 20) 1–7 [Epub ahead of print].
- [13] F.P. Antunes, C. Costa Mda, J.S. Paim, A. Cruz, L.M. da Silva, M. Barreto, Social determinants of intra-urban differentials of admissions by respiratory diseases in Salvador (BA), Brazil, *Rev. Bras. Epidemiol.* 17 (Suppl 2) (2014) 29–38.
- [14] E. Prescott, N. Godtfredsen, J. Vestbo, M. Osler, Social position and mortality from respiratory diseases in males and females, *Eur. Respir. J.* 21 (5) (2003 May) 821–826.
- [15] L.J. Akinbami, J.E. Moorman, X. Liu, Asthma prevalence, health care use and mortality: United States, 2005–2009, *Natl. Health Stat. Rep.* 12 (32) (2011 Jan) 1–14.
- [16] O. Selroos, M. Kupczyk, P. Kuna, P. Łacwik, J. Bousquet, D. Brennan, et al., National and regional asthma programmes in Europe, *Eur. Respir. Rev.* 24 (137) (2015 Sep) 474–483, <http://dx.doi.org/10.1183/16000617.00008114>.
- [17] The Global Asthma Report [homepage on internet]. What is the impact of asthma on rates of disability and premature death? [access in 16 sep 2015]. Available at: <http://www.globalasthmareport.org/>.
- [18] Casa Civil [homepage on internet]. Mais de 31 milhões de pessoas beneficiadas pelo Farmácia Popular em quatro anos. [access in 16 sep 2015]. Available at: <http://www.casacivil.gov.br/>.
- [19] T.A. Lee, K.B. Weiss, An update on the health economics of asthma and allergy, *Curr. Opin. Allergy Clin. Immunol.* 2 (3) (2002 Jun) 195–200.