Anti-asthmatics prescriptions in the paediatric population in the Lazio Region of Italy: association with socio-demographic children's and physician's characteristics

Francesco Chini[1], Letizia Orzella[1], Patrizio Pezzotti[1], Marco Nardelli[2], Gabriella Guasticchi[1]

ABSTRACT

BACKGROUND: Asthma is the most common chronic disease in childhood; in Italy its prevalence is estimated to be 9% in children (0-14 years old).
Objective: estimate the use of anti-asthmatics prescriptions in the paediatric population and to evaluate its association with children's and physician's characteristics.
METHODS: The study was conducted in 728,830 children 1-14 years old residing in the Lazio region, Central Italy. Individual data on AA (ATC R03) prescriptions during 2009 were used. Prevalence was calculated according to children's gender, age and area of residence.
The association, in terms of rate ratio (RR), between AA prescription with children's and physicians' characteristics was estimated by multi level Poisson models.
RESULTS: Overall, 404,239 AA prescriptions were given to 178,850 (25%) children with the highest frequency in the 1-2 age group (39%). Boys were more likely to receive a prescription than girls. Beclomethasone was the most prescribed active ingredient (34%), followed by salbutamol (24%); 44% of children ≥ 6 years old had only 1 box prescription in the year, 48.9% of these subjects were treated with inhaled corticosteroids alone.
Children's gender, age and area of residence were the major determinants in drug prescription while, as far as physicians' level, gender and number of patients in charge were associated to a greater probability of getting an AA prescription.
CONCLUSIONS: Prescription data provide useful information to measure prevalence use and consumption of AA drugs. Variability between age groups as well as differences in physicians' characteristics suggests that specific strategies to optimise resource use of AA are needed.

Key words: Pharmacoepidemiology, Prevalence, Drug utilisation, Multilevel models, General Practice

(1) Laziosanità - Agency of Public Health, Lazio Region; Rome, Italy
(2) Local Health Authority RMC, Lazio Region, Rome, Italy

CORRESPONDING AUTHOR: *Francesco Chini, Laziosanità - Agency for Public Health, Via di S. Costanza 53, 00198 - Rome, Italy. E-mail: chini@asplazio.it*

DOI: ***10.2427/8887***
Published as Online First on June 3, 2014

INTRODUCTION

Asthma is a chronic disease characterized by recurrent attacks of breathlessness and wheezing, which vary in severity and frequency from one person to another. Symptoms, in affected individuals, may occur several times in day or week, and for some people they become worse during physical activity or at night. Asthma has a relatively low fatality rate compared with other chronic diseases. All over the world, WHO estimated that 235 million people were suffering from asthma in 2010 and in Italy has been estimated a prevalence equal to 9% [1, 2]. Particularly, prevalence data for children have not varied significantly throughout the last 20 years (from 9.1 to 9.5%) [1, 3, 4], however this pathology still represents a serious public health problem and, when uncontrolled, it can place severe limits on daily life and sometimes can be fatal. Although asthma cannot be cured, appropriate treatment could control the disease and enable people to enjoy a good quality of life [5].

Studies on the organisation of care for adult asthma patients suggested that integrated care, based on primary care supported by specialised health care, provides equivalent outcomes and lower cost compared with usual outpatient care [5]. Similar studies are needed on the management of asthma in children as well as the identification of the population of asthmatic children. Pharmacoepidemiology, as well as pharmacoutilisation studies, might represent useful tools to assess appropriateness in drug prescription and to estimate therapeutic needs [6].

To our knowledge, there are few studies evaluating physicians' and patients' characteristics that might affect anti-asthmatics (AA) prescriptions in terms of prevalence and consumption. Administrative health databases allow us to analyze the association between physicians' behaviour in prescribing activity, their socio-demographic factors (age, gender, how long they have practiced medicine, number of patients in an individual GP's practice, type of practice) and their patients' characteristics.

The objective of this study was then to estimate the prevalence of AA prescriptions in the paediatric population in 2009 and to evaluate its association with children's and physician's characteristics.

METHODS

Study setting

The study was conducted in the Lazio region, in Central Italy, which includes the city of Rome.

In the region, territory is divided into local health authorities (LHAs), geographically-based organizations responsible for assessing needs and providing comprehensive care for a defined population [7]. There are overall 12 LHAs in Lazio (five in the municipality of Rome, three in the province of Rome but not in the municipality and four in the remaining provinces of Lazio). Regional health authorities provide citizens with universal coverage for health care, in Lazio, as well as all over Italy.

General practitioners (GP) and paediatricians initially assess patient's needs and are expected to provide most primary care [8]. People may choose any GP they prefer, provided that the number of patients treated by a single doctor does not exceed the maximum number allowed (1,500 for GP and 800 for paediatricians). Patients are allowed to change providers at any time. Children are assigned to a paediatrician until they are 14 years old; afterwards, parents can choose to register the child with a general practitioner [8].

Population and study design

Study population consisted in 728,830 children and adolescents 1-14 years old (male/female ratio=1.06), representing 13% of the regional population [9].

Children <1 year of age were not included in the analysis in order to assure, among total population, at least one year of exposure to drug utilization.

An observational cross-sectional study was carried out in the primary care setting on AA drug utilization in the period 1st January - 31st December 2009. AA were classified as drugs belonging to the R03 (Drugs for obstructive airway diseases) main therapeutic group of the Anatomical Therapeutic Chemical classification system (ATC) [10].

Data source

Regional Informative System on Drugs [11] collects all relevant data about the drugs

prescribed (such as drug code, dose, formula, number of packages and LHA of the child, regional code of the medical doctor prescribing the drug). The term 'prescription' refers to drug claims that have been written by physician. Data were analysed using an anonymous patient code.

Regional Informative System on general practitioner [12] collects information about all GPs' variables [i.e., age, gender, type (i.e., family paediatrician and GP), how long they have practiced medicine, number of patients in their practice].

Databases were linked through deterministic record linkage using the regional code of the physicians as the key.

Statistical Analysis

Prevalence estimates according to sex and age were calculated by dividing the number of drug users (i.e., children having at least one prescription of AA in 2009) by the total number of resident male and female in each age group. For the ten most prescribed AA drugs the number of prescriptions was shown by age groups.

Prevalence estimates standardized by age, using the Italian population estimated at the 1st of January 2009 by the Italian National Bureau of Census (www.demo.istat.it), were mapped by area of residence of children. The following areas were mapped: city of Rome (including five LHAs), province of Rome but not the municipality (including three LHAs) and four areas for each remaining province of the region (Viterbo, Rieti, Latina and Frosinone) [13].

A specific focus was performed for children in school-age (≥ 6 years old) because in 0-5 age group asthma has basically viral causes while for children older than six years old the diagnosis of asthma can be due to allergic factors and it is possible to better identify asthma and establish a certain diagnosis [14].

According to other studies [14, 15], we categorized children aged ≥6 years in groups based on number of boxes prescribed in the year, in order to estimate drug consumption level: 1) occasional users: children having only one box prescription; 2) low users: subjects having two or three boxes prescriptions; 3) high users: those having four or more boxes prescriptions. Four boxes threshold was set because it represented the 90th percentile in our distribution of frequency of treated children by number of boxes. Physicians' attitude in prescribing was analysed by these three subject groups.

The association, in terms of rate ratio (RR), between the number of AA prescriptions with childrens' and physicians' characteristics was estimated by multi-level Poisson models. The multi-level modelling, also known as hierarchical regression, generalizes ordinary regression modelling to distinguish multiple levels of information in a model. This approach allows to take into account the hierarchical structure of the data and to calculate the variance at the physician level on the total variability observed; the ratio (i.e., the intra-cluster correlation) between the variance at the physician level and the total variability provides the proportion of variability due to this level. According to this model it was possible to estimate the effect on the outcome associated to physicians' characteristics [16]. Further models (focusing on children ≥6 years old) were also performed categorizing the quantity of boxes prescribed as described above and thus considering as outcome: 1) occasional users vs. no users; 2) low users vs. occasional or no users; 3) high users vs. low or occasional or no users. Statistical analysis was performed using Stata software, version 11.0.

RESULTS

Prescription profile in total children population (in 0-14 years old)

AA were the second most prescribed drug class in children after the antibiotics. During the year 2009, 404,239 AA prescriptions were given to 178,850 children highlighting a marked increase (+9%) compared to 2007 values (data on 2008 were not available).

In 86% of cases, the prescription was provided by a paediatrician. A total of 453,278 boxes (corresponding to 26 anti-asthmatic drugs) were prescribed; on average, each treated child received two boxes.

Overall, 25% of children had at least one AA prescription in the year with a dramatic peak in the 1-2 age group (39%) and a progressive decrease in the remaining classes (16% in 11-14 group) (Figure 1). Figure 2

FIGURE 1

PREVALENCE RATE BY AGE GROUP AND GENDER FOR ALL DRUGS AND ANTI ASTHMATIC DRUGS

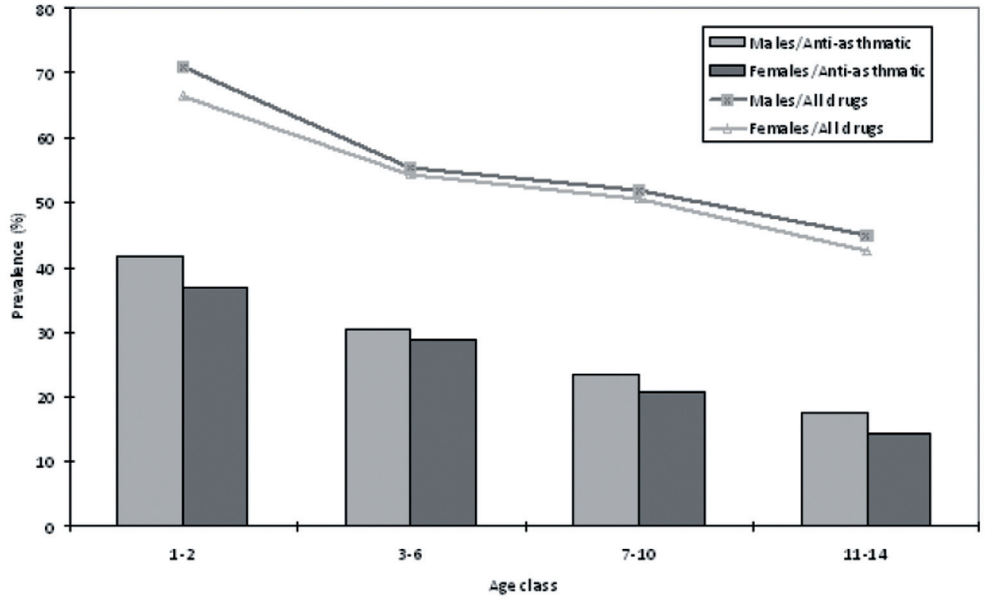
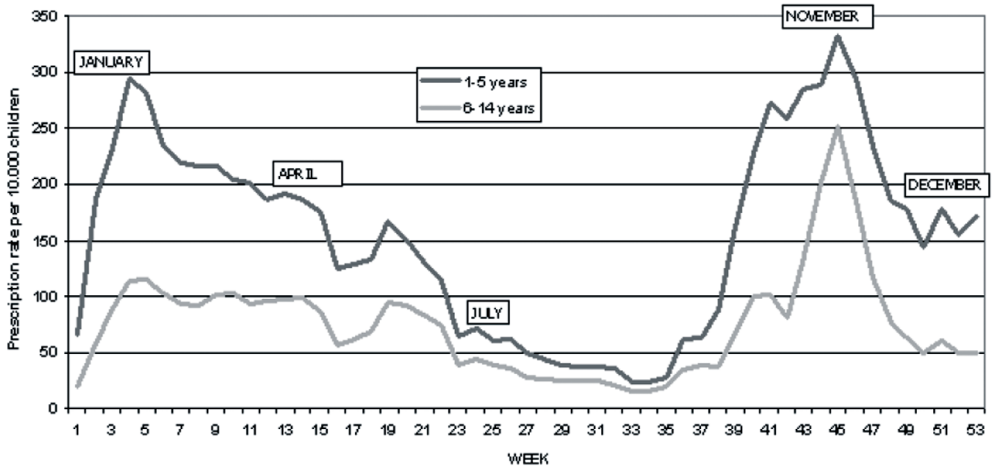


FIGURE 2

SEASONAL TREND OF PRESCRIPTION RATES (10000) BY AGE GROUPS



shows the seasonal trend of the prescription rates with higher values during the autumn and the winter seasons both for age group 0-5 6-14 years old. Prescription rates for inhaled corticosteroids (ICS) alone were higher during winter for 0-5 age group while an higher utilization of long acting beta agonists (LABA) was found in spring period for children 6-14 years old (data not shown).

Overall, boys were more likely to have a prescription than girls (rate ratio=1.04 for all drugs and 1.12 specifically for AA, p<0.001). Differences were also found in prevalence rates by area of residence, with higher values in southern provinces (particularly in the provinces of Latina and Frosinone in which consumption levels, in terms of prescribed boxes, were also relevant, data not shown). A statistically significant correlation between rank distributions at LHA level was found for AA prevalences with antibiotics prevalences (ρ= 0.87, p<0.001) (data not shown).

TABLE 1

TEN MOST PRESCRIBED ANTI-ASTHMATIC ACTIVE INGREDIENTS BY AGE GROUP, LAZIO REGION, ITALY

ACTIVE INGREDIENTS	AGE GROUP				
	1-14	1-2	3-5	6-10	11-14
	%	RANK			
BECLOMETHASONE DIPROPIONATE	34.0	1	1	1	1
SALBUTAMOL	24.4	2	2	2	2
BUDESONIDE	12.7	3	3	3	3
FLUNISOLIDE	6.5	5	5	6	6
FLUTICASONE	6.4	6	4	4	5
MONTELUKAST	5.9	7	7	5	4
IPRATROPIUM BROMIDE + SULBUTAMOL	5.9	4	6	7	8
SALMETEROLUM + FLUTICASONUM	1.5	10	9	8	7
IPRATROPIUM BROMIDE	1.1	8	8	9	10
NEDOCROMIL	0.7	9	10	10	9
TOTAL NUMBER OF PRESCRIPTIONS	**404,239**	**102,066**	**120,443**	**120,204**	**61,526**
TOTAL NUMBER OF PRESCRIBED DRUGS	**26**	**22**	**24**	**24**	**24**

There was no correlation in rank distribution at LHAs level among paediatric and adult prescription, moreover, no correlation was found in rank distribution at LHA level of the prevalence rates in children and hospitalization for asthma during 2009 (data not shown).

In terms of number of prescriptions, the first 10 AA represent 99% of the total of dispensed boxes; ICS were the most frequently prescribed drug (88%), particularly beclomethasone was the most prescribed one (34%), followed by salbutamol (24%), and budesonide (13%). In rank classification there was no variability in first positions (beclomethasone, salbutamol and budesonide) among age groups while differences were found for montelukast for which prescriptions increased with age (Table 1). Differences found for montelukast were probably due to the fact that, before 2006, this active ingredient was indicated specifically for children older than 6 years old. Since 2006, montelukast use was allowed also for children older than 6 months old.

Prescription profiles in school-age children population (≥6 years old)

Overall, 44% of children 6-14 years old were occasional users (received only one prescription package), while only 16.5% resulted high users (Table 2); 43.3% of subjects were treated with short-acting beta-2-agonists (SABA) (12.8% of them received SABA exclusively), 48.9% with ICS alone, 40.4% with ICS in association with other anti-asthmatic (30.3% with ICS and SABA). The percentages of subjects with prescriptions both of ICS with leukotriene receptor antagonists (LTRA) and of ICS with SABA were quite relevant among high users (respectively 20.2% and 51.0%).

As expected, occasional users were mainly treated with ICS alone. Beclomethasone was the main drug received by occasional users (53.9%) following by budesonide (13.7%) and salbutamol (10.4%); 8.6% received systemic steroids, with difference between groups, in particular high users were likely to receive steroids more than three times compared to occasional users ($p<0.001$) (Table 2).

Moreover, 29 children received only one prescription of LABA without any other anti-asthmatic drug (data not shown).

Multivariate regression analysis

Table 3 reports multilevel Poisson regression results when considering the number of prescribed boxes as outcome. Gender, age and residence of the children were significantly associated in all models (including or not

TABLE 2

PRESCRIPTION PROFILE OF CHILDREN ≥6 YEARS OLD BY CONSUMPTION LEVEL

DRUG TYPES	OCCASIONAL USERS N=39,053		LOW USERS N=34,994		HIGH USERS N=14,628		TOTAL N=88,675	
RESCUE MEDICATION								
	N	%	N	%	N	%	N	%
SABA	5,495	14.1	21,451	61.3	11,490	78.5	38,436	43.3
SABA ALONE*	4,050	10.4	797	2.3	73	0.5	4,920	5.5
NOT RECEIVING SABA	33,558	85.9	13,543	38.7	3,138	21.5	50,239	56.7
SYSTEMIC STEROIDS	2,016	5.2	2,860	8.2	2,769	18.9	7,645	8.6
CONTROLLER MEDICATION								
ICS	32,621	83.5	32,687	93.4	13,861	94.8	79,169	89.3
ICS ALONE*	31,743	81.3	10,496	30.0	1,102	7.5	43,341	48.9
ICS+LABA	878	2.2	1,269	3.6	1,344	9.2	3,491	3.9
ICS+LTRA	0	0.0	722	2.1	2,961	20.2	3,683	4.2
ICS+LABA+LTRA	0	0.0	23	0.1	748	5.1	771	0.9
ICS+SABA	0	0.0	19,411	55.5	7,455	51.0	26,866	30.3
ICS+OTHERS**	0	0.0	766	2.2	251	1.7	1,017	1.1
NO ICS	6,432	16.5	2,307	6.6	767	5.2	9,506	10.7

**without other anti-asthmatic prescriptions*

***not ICS alone, not SABA, not LABA, not LTRA*

SABA (salbutamol, fenoterol); ICS (beclomethasone, fluticasone, flunisolide, budesonide); LABA (formeterol, salmeterol, fixed association budesonide/formoterol, fixed association fluticasone/salmeterol); Chromones (comolyn Sodium, ndocromil Sodium); Anticholinergics (ipratropium bromide, oxitropium bromide); LTRA (montelukast, zaphirlukast), not as exclusive therapy; Steroids, not as exclusive therapy

the physician characteristics). Particularly, the probability of AA prescription decreases with increasing age (RR 0.37, 95% CI 0.37-0.38 for 11-14 compared to 1-2 age group); the probability increases for children living outside the city of Rome (RR=1.25 for Rome province but not the municipality), and in the south area of the region (RR=1.24 for the province of Latina and RR=1.23 for the province of Frosinone). Regarding the characteristics of the prescribing physician, gender and number of patients in charge represented factors associated with the probability of AA prescription: children having a female doctor or a physician with high number of patients (>900) had a slight higher probability of receiving an AA prescription. It is of note that the physician level explains around 12% of the total variability.

Table 4 shows multilevel Poisson regression results when considering different categories of users. Results are overall consistent with those reported in Table 3. However, at the children level, gender and age effects were stronger when comparing high users with the other categories; on the other side, the effect of the area of residence of the children decreased when comparing high users to the other categories. Considering the physician level, prescriber effect changed for different level of users: paediatricians had lower probability of having occasional users whereas they had higher probability of having low and high users compared to general practitioners.

Similar results were obtained for model performed only in school-age children (data not shown in tables).

DISCUSSION

We investigated AA prescriptions in children in the Lazio region of Italy and their association with characteristics of prescribing physicians and their patients in charge.

TABLE 3

ADJUSTED RATE RATIOS (RR) OF NUMBER OF ANTI-ASTHMATIC PRESCRIPTIONS IN 2009 FOR CHILDRENS' AND PHYSICIANS' CHARACTERISTICS; LAZIO REGION, ITALY. MULTILEVEL POISSON REGRESSION ANALYSIS AT CHILDREN AND PHYSICIANS LEVEL

			MODEL 1 (CHILDREN VARIABLES)			MODEL 2 (FULL MODEL, DOCTORS AND CHILDREN VARIABLES)		
VARIABLES			RR	95% CI		RR	95% CI	
CHILDREN	GENDER	Males (reference)	1.00			1.00		
		Females	0.83	0.83	0.84	0.83	0.83	0.84
	AGE CLASS (YEARS)	1-2 (reference)	1.00			1.00		
		3-5	0.80	0.79	0.81	0.80	0.79	0.81
		6-10	0.52	0.52	0.53	0.52	0.52	0.53
		11-14	0.37	0.37	0.38	0.37	0.37	0.38
	AREA OF RESIDENCE	Municipality of Rome (reference)	1.00			1.00		
		Rome, province (not municipality)	1.27	1.21	1.34	1.25	1.19	1.32
		Viterbo	1.02	0.93	1.13	1.03	0.94	1.14
		Rieti	1.20	1.06	1.36	1.20	1.05	1.35
		Latina	1.23	1.14	1.32	1.24	1.15	1.33
		Frosinone	1.22	1.13	1.31	1.23	1.14	1.33
PHYSICIANS	TYPE	General practitioner (reference)				1.00		
		Paediatrician				1.21	1.12	1.29
	GENDER	Males (reference)				1.00		
		Females				1.07	1.02	1.12
	AGE (YEARS)	≤52 (median age) (reference)				1.00		
		>52				0.87	0.83	0.91
	NUMBER OF PATIENTS	<700 (reference)				1.00		
		700-900				1.02	0.94	1.10
		>900				1.12	1.06	1.19
VARIANCE BETWEEN PHYSICIANS			0.46	0.44	0.49	0.46	0.44	0.49
INTRA CLUSTER CORRELATION (%)			12.4	11.8	12.9	12.3	11.7	12.9

Prescription patterns for AA drugs in this study appear to be consistent with previous Italian reports [3, 14-15, 17-19] and even though the prevalence rate is higher than in other Italian contexts, the trend by age was similar, with the highest values in preschool age. National data on asthma prevalence reported a value of 9% (without any dramatic increase over the past 20 years) [1] while prescription prevalence rate in the present paper appeared definitely higher. Twenty five per cent of subjects received at least one AA drug during the year 2009, with lower prevalence rates as age increased and higher percentages of prescriptions for boys.

Prevalences rates were also higher in the southern part of the region (particularly in the provinces of Latina and Frosinone). Geographical differences might be due to a different attitude in prescribing (explained also by the multivariate model) as well as possible environmental factors. A statistically significant correlation between rank distributions at LHA level was found for anti-asthmatics as well as antibiotics prevalence. These findings are coherent with other studies previously conducted in Italy [14, 15].

As far as the focus on prescription for children in school age, 44% were occasional users and 49% of prescriptions is related to ICS alone. Particularly, occasional users were mainly treated with ICS alone suggesting that a

TABLE 4

ADJUSTED RATE RATIOS (RR) OF ANTI-ASTHMATIC PRESCRIPTIONS IN 2009 FOR CHILDRENS' AND PHYSICIANS' CHARACTERISTICS; LAZIO REGION, ITALY. MULTILEVEL POISSON REGRESSION ANALYSIS AT CHILDREN AND PHYSICIANS LEVEL

			OCCASIONAL USERS VS. NO USERS			LOW USERS VS OCCASIONAL + NO USERS			HIGH USERS VS. LOW + OCCASIONAL + NO USERS		
VARIABLES			RR	95% CI		RR	95% CI		RR	95% CI	
CHILDREN	GENDER	males	1.00			1.00			1.00		
		females	0.95	0.94	0.96	0.86	0.85	0.88	0.75	0.74	0.77
	AGE CLASS (YEARS)	1-2	1.00								
		3-5	0.70	0.68	0.71	0.74	0.73	0.76	0.83	0.81	0.86
		6-10	0.53	0.52	0.54	0.51	0.50	0.52	0.47	0.46	0.49
		11-14	0.41	0.40	0.42	0.36	0.35	0.37	0.30	0.29	0.32
	AREA OF RESIDENCE	city of Rome	1.00			1.00			1.00		
		district of Rome	1.33	1.27	1.40	1.20	1.14	1.27	1.13	1.04	1.22
		Viterbo	1.22	1.11	1.34	0.99	0.89	1.10	0.80	0.69	0.93
		Rieti	1.40	1.24	1.58	1.12	0.98	1.29	0.90	0.74	1.10
		Latina	1.29	1.20	1.39	1.14	1.05	1.24	1.24	1.11	1.39
		Frosinone	1.33	1.24	1.43	1.13	1.04	1.23	1.25	1.12	1.40
PHYSICIANS	PRESCRIBER	general practitioner	1.00			1.00			1.00		
		paediatrician	0.92	0.86	0.98	1.12	1.04	1.20	1.17	1.06	1.29
	PRESCRIBER GENDER	males	1.00			1.00			1.00		
		females	1.07	1.02	1.12	1.06	1.01	1.12	1.08	1.01	1.16
	PRESCRIBER AGE (YEARS)	<=52 (median age)	1.00			1.00			1.00		
		> 52	0.89	0.85	0.93	0.87	0.83	0.92	0.87	0.81	0.93
	NUMBER OF PATIENTS	<700	1.00			1.00			1.00		
		700-900	0.97	0.90	1.05	0.96	0.88	1.05	1.03	0.92	1.15
		>900	1.01	0.95	1.08	1.02	0.95	1.09	1.16	1.04	1.28
VARIANCE BETWEEN PRESCRIBER			0.46	0.44	0.49	0.33	0.31	0.36	0.47	0.43	0.52
INTRACLUSTER CORRELATION (%)			12.3	11.7	12.9	9.2	8.6	9.8	12.6	0.11	0.14

relevant part of those children received AA for other diseases different from asthma [14] and this might create possible overestimates of prevalence data. Beclomethasone dipropionate is the most commonly active ingredient prescribed for respiratory airways infections also in the absence of bronchospasm because in Italy this drug is also licensed for the treatment of rhinopharyngitis. It is also relevant pointing out questions on appropriateness of therapeutic choices: almost 57% of children has not received SABA, more than 10% has not received ICS and almost 6% received SABA alone. However, we can just assume that a potential inappropriateness is present because, using only an administrative database of drug prescriptions (without any record linkage with hospital admission database and with databases of GPs) we do not have specific information about the reason of the prescription. Therefore, this lack of information did not allow us to identify the real number of asthmatic patients and to validate the appropriateness of AA utilisation.

Multivariate regression analysis findings highlight that males subjects were more exposed to AA. Two hypotheses might explain this difference: 1) a higher prevalence of symptoms related to asthma disease in males; 2) a gender issue in the access to drugs in terms of prescriptions.

As far as physicians' characteristics,

paediatricians represented the main prescribers (86%) even though there was also a quite relevant part of children population followed by GPs. Physician's gender was also highlighted as a determinant in prescribing, as female doctors were more likely to prescribe AA drugs. However, it is important to take into consideration that female paediatricians represent 66% of the total physicians. Younger physicians appeared to have a greater attitude in prescribing AA drugs and this could mean that the numbers of years of practice might be seen as a proxy of prescribing behaviour. Besides, a recent study on inter-country variations in AA drug prescriptions [19] highlighted that a great variability in prescription might be attributable also to differences prescribing attitude more that differences in prevalence of asthma. Moreover, this attitude seems to be not only quantitatively but also qualitatively different. This means that the presence of international guidelines for asthma treatment can help the prescriber but they are not sufficient to ensure an appropriate use of AA, because physicians' adherence and compliance to guidelines are not obvious or common [19]. Finally, a very recent Italian study [20] pointed out how educational programmes and better communication can improve awareness and compliance with medical prescriptions and adherence to guidelines.

Limitations

This study presents some limitations that should be mentioned. Firstly, the study type does not allow us to carry out possible comparisons with data on AA prescriptions in previous years. Secondly, using only information about drugs reported in administrative databases, we were not able to assess the patients' adherence to therapy. Thirdly, administrative databases did not allow us to address issues of over-treatment, under-treatment or lack of treatment; as already mentioned, there is a lack of information about an underlying diagnosis. Fourthly, in our analysis we considered the whole ATC class R03 and this can be misleading because this category includes several drugs not necessarily prescribed only for asthma. Finally, there are many other variables that can affect prescribing behaviour, such as physicians' knowledge, role perception and patients' expectations of obtaining a prescription and for which no information was available. However, despite such limitations, data presented in this paper are likely to be an accurate representation of the prescriptions in Lazio region, Italy, for children with asthma.

CONCLUSION

Our study showed that pharmacy data can provide interesting information of AA prescriptions in the general population as a quick and priceless alternative to survey data.

Variability between age groups in terms of prevalence and consumption as well as differences in physicians' characteristics suggests qualitative and quantitative differences exist in the profile of AA prescription and therefore strategies and interventions able to optimize resource use are needed. Future studies, gathering more specific information in order to ensure adequate monitoring of prescribing practice, could involve a focus on a more specific use of LABA, SABA and LTRA alone or in association with ICS stratifying the children population on the duration of the therapy and not only on number of boxes.

COMPETING INTERESTS: *The authors declare that they have no competing interests.*

AUTHORS' CONTRIBUTION: *FC developed the concept, collected the data, participated in the analysis, and drafted an revised the manuscript. LO participated in the analysis, and substantially revised the manuscript drafts. PP provided substantial methodological comments on the drafts, and revised the final version of the manuscript. MN and GG contributed to the conception of the research question, assisted in revising the manuscript. All authors reviewed and approved the final manuscript.*

ACKNOWLEDGEMENTS: *We would like to thank: Professor Marisa Maurelli for the English editing.*

References

[1] SIDRIA (Italian Studies on Respiratory Disorders in Childhood The Environment) Collaborative Group. Asthma respiratory symptoms in 6-7 years old Italian Children: gender, latitude, urbanization and socioeconomic factors. Eur Respir J 1997; 10: 1780-6.

[2] WHO, World Health Organisation. Available from http://www.who.int/features/factfiles/asthma/en/index.html [Last accessed November 2011].

[3] Galassi C, De Sario M, Biggeri A, et al. Changes in prevalence of asthma and allergies among children and adolescents in Italy:1994-2002. Pediatrics 2006; 117: 34-42.

[4] GINA Report 2010, Global Initiative for Asthma, Global Strategy for Asthma Management and Prevention, Updated 2010. Available from http://www.ginasthma.org [Last accessed, December 2011].

[5] Bodenheimer T, Wagner E, Grumbach K. Improving primary care for patients with chronic illness. JAMA 2002; 288(14):1775-9.

[6] MacLeod SM. Pharmacoepidemiology: a health imperative. J Clin Epidemiol 1991; 44(12):1285-6.

[7] Orzella L, Chini F, Giorgirossi P, Borgia P. Physician and patient characteristics associated with prescriptions and costs of drugs in the Lazio region of Italy. Health Policy 2010;95(2-3):236-44.

[8] Donatini A, Lo Scalzo A, Orzella L, et al. Health Care Systems in Transition: Italy, European Observatory on Health Care Systems. Available from http://www.euro.who.int/en/who-we-are/partners/observatory/health-systems-in-transition-hit-series/countries-and-subregions/italy-hit-2009 [Last accessed June 2013].

[9] Da Cas R, Desiderio V, Lombardozzi L, Orzella L, Pasquale L, Raschetti R. Prescrizione farmaceutica nella Regione Lazio. Analisi dei dati relativi al 2009. Rapporto ISTISAN 11/11. Available from http://www.iss.it [Last accessed February 2012].

[10] WHO, World Health Organisation. Available from www.who.int/patientsafety/activities/technical/drug_safety/en/ [Last accessed November 2012].

[11] Consorzio ISED. Available form http://www.ised.it.

[12] Lait SpA. Available from http://www.laitspa.it [Last accessed June 2011].

[13] Chini F, Pezzotti P, Orzella L, Borgia P, Guasticchi G. Can we use the pharmacy data to estimate the prevalence of chronic conditions? A comparison of multiple data sources. BMC Public Health 2011;11:688.

[14] Bianchi M, Clavenna A, Labate L, et al. Anti-asthmatic drug prescription to an Italian paediatric population. Pediatr Allergy Immunol 2009; 20:585-91.

[15] Bianchi M, Clavenna A, Sequi M, et al. Anti-asthma medication prescribing to children in the Lombardy region of Italy: chronic versus new users. BMC Pulmonary Medicine 2011;11:48.

[16] Hox J. Multilevel Analysis. Mahwah, NJ: Lawrence Erlbaum Associates, 2002.

[17] Osservatorio Nazionale sull'impiego dei medicinali (OSMED), Italian Medicine Agency (AIFA), L'uso dei farmaci in Italia, Rapporto Nazionale, Rome, 2009. Available from http://www.agenziafarmaco.gov.it/sites/default/files/Rapporto_OSMED_2009_finale_13072010_0.pdf [Last accessed June 2013].

[18] Clavenna A, Rossi E, Berti A. Inappropriate use of anti-asthmatic drugs in the Italian population. Eur J Clin Pharmacology 2003; 59:565-9.

[19] Bianchi M, Clavenna A, Bonati M. Inter-country variations in anti-asthmatic drug prescriptions for children. Systematic review of studies published during the 2000–2009 period. Eur J Clin Pharmacol 2010; 66:929–36.

[20] Calamelli E, Ricci G, Pession A. Recent advances in diagnosis and therapy of allergic rhinitis and asthma in childhood. Eur Ann Allergy Clin Immunol 2012; 44 (6): 215-24.