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The management of childhood asthma in the community

W. Maziak*, E. von Mutius#, C. Beimfohr*, T. Hirsch¶, W. Leupold¶, U. Keil*, S.K. Weiland+

The management of childhood asthma in the community. W. Maziak, E. von Mutius, C. Beimfohr, T. Hirsch, W. Leupold, U. Keil, S.K. Weiland. ©ERS Journals Ltd 2002.

ABSTRACT: The aim of the present study was to assess the management of children with asthma in the community.

Community-based random samples of children aged 5–7 and 9–11 yrs in Dresden and Munich, Germany, were studied in 1995–1996 using the phase II protocol of the International Study of Asthma and Allergies in Childhood. Detailed information on the use of antiasthma drugs and accessory treatment in the past year was collected by parental questionnaire. A total of 11,094 (response rate 83%) children participated.

Among children with wheeze in the last year, 36% had used bronchodilators and 19% were on regular anti-inflammatory treatment. The strongest determinant of treatment was a physician's diagnosis of asthma. Forty-seven per cent of the children with current wheeze had not been diagnosed as asthmatics and received hardly any treatment (9% bronchodilators and 2% anti-inflammatory drugs), despite an increased prevalence of severe asthma symptoms, bronchial hyperresponsiveness and atopic sensitisation compared with children without asthma symptoms. The proportion of children regularly using inhaled steroids was small (6%) among current wheezers and reached only 21% among children with diagnosed asthma and >12 wheezing attacks in the last year. Inhaled steroid use was lower in Munich than in Dresden and inversely related to the use of alternative remedies.

Further efforts to improve the diagnosis and treatment of childhood asthma are needed. These should aim to increase awareness of the chronic nature of asthma and the need for treatment according to current guidelines.

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*Institute of Epidemiology and Social Medicine, University of Münster, Münster, #University Children's Hospital, Munich, ¶Children's Clinic, Technical University of Dresden, Dresden, and +Dept of Epidemiology, University of Ulm, Ulm, Germany.

Correspondence: S. Weiland, Dept of Epidemiology, University of Ulm, Helmholzstr. 22, 89081 Ulm, Germany.
Fax: 49 731 5031069
E-mail: stephan.weiland@medizin.uni-ulm.de

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Childhood asthma is an important health problem causing substantial morbidity in children and costs for society [1, 2]. Treatment of children with asthma has been standardised in many countries through national and international guidelines [3]. Most of these guidelines stress the importance of early introduction of anti-inflammatory treatment for patients with persistent asthma symptoms, and promote patients' involvement in the control of their condition. Recent studies, however, suggest that a substantial proportion of asthmatic children are still inadequately treated [4–11].

Most studies assessing the quality of care of asthmatic children have utilised data from physicians [7, 8], or information from prescription records [9, 10]. Although these studies are important for the assessment of physicians' understanding and treatment of asthma, they do not always correlate with general practice [11], nor do they necessarily convey the real situation regarding what medications have been used by children for asthma control, and how they have been used. Information from population-based surveys about the use of pharmaceutical and other means of asthma control in children has been scarce. Studies on the treatment of unselected children with asthma in the community are of major importance for the proper assessment of the management of asthma in the general population and for directing future efforts to improve its outcome.

A large population-based survey was conducted within the framework of the International Study of Asthma and Allergies in Childhood (ISAAC). Detailed information was collected on the use of drugs and other treatment tools for asthma by children in two major German cities [12, 13]. The aim of the current analysis was to assess the status and determining factors of the management of childhood asthma in these two communities.

Methods

Study population

The study methods have been described in detail elsewhere [13]. Briefly, cross-sectional surveys were conducted in two German cities: Dresden (480,000 inhabitants) in South-East Germany and Munich (1.3 million) in South-West Germany. In 1995–1996, community-based random samples of fourth graders (n=3,017 in Dresden; n=2,612 in Munich) and school beginners (n=3,299 in Dresden; n=2,165 in Munich)

were surveyed using the ISAAC phase II protocol. The questionnaires were completed for 83.0 and 87.6% of the older children, and 85.7 and 78.6% of the younger children, in Dresden and Munich, respectively. The sociodemographic characteristics of the study population are given in table 1. Children were divided approximately equally by sex, age group and socioeconomic status (SES). Most (>95%) school beginners were aged 5–7 yrs and most (>95%) fourth graders were aged 9–11 yrs at the time the survey was conducted.

Health outcome measures

The parental questionnaire included ISAAC phase II core questions on the occurrence and severity of wheezing episodes in the 12 months prior to the survey [12, 14]. Current wheezing was defined as a positive response to the question: "Has your child had wheezing or whistling in the chest in the last 12 months?". Severity of asthma was assessed using the ISAAC core questions on the number of wheezing episodes, the occurrence of speech-limiting wheeze and exercise-induced wheeze in the 12 months prior to the survey [12, 14]. Parents were also asked: "Did a doctor ever diagnose any of the following diseases in your child? a) asthma; b) asthmatic, spastic or obstructive bronchitis; c) bronchitis?". Children were classified as having a diagnosis of asthma if their parents reported that a doctor had diagnosed "asthma" at least once or "asthmatic, spastic or obstructive bronchitis" more than once [13]. Finally, the parents were also asked whether their children had visited an emergency department or been hospitalised due to asthma. In addition, a bronchial challenge with hypertonic (4.5%) saline to assess bronchial hyperresponsiveness (BHR), defined as a drop in forced expiratory volume in one second of $\geqslant$15% from baseline, was conducted in a random subsample (n=1,042 in Dresden; n=904 in Munich) of the older age group in both cities [13]. Skin-prick tests were performed in all children (participation ~60%) using six common aeroallergens: *Dermatophagoides pteronyssinus*, *D. farinae*, cat, *Alternaria tenuis*, mixed tree pollen, and mixed grass pollen. A positive skin reaction was defined as a weal of $\geqslant$3 mm in diameter after subtraction of the negative control [13]. Additional information on triggers of the wheezing episodes was collected as part of a subsequent nested case/control study. All children who had reported wheeze during the last year and, in addition, at least one wheezing attack or waking up at night due to wheeze were defined as cases (participation 259 of 327 (79.2%)). Control children were a random sample of all other children (participation 340 of 455 (74.7%)). Parents were asked to tick from a list of possible triggers which included infections, allergens, exercise and physical stimuli. Two categories were created for the purpose of this analysis: 1) wheezing triggered by infections alone; and 2) wheezing due to other triggers.

Table 1. – Characteristics of the study population

	Dresden	Munich
Subjects	6317	4777
Males	3289 (52.1)	2390 (50.0)
Females	3026 (47.9)	2386 (50.0)
Age group		
5–7 yrs	3300 (52.2)	2165 (45.3)
9–11 yrs	3017 (47.8)	2612 (54.7)
SES		
High	2782 (46.0)	2440 (52.8)
Low	3263 (54.0)	2183 (47.2)
Current wheeze	456 (7.4)	412 (8.8)

Data are presented as n (%). It should be noted that, for certain variables, some values are missing. SES: socioeconomic status.

Asthma management

All parents who reported that their child had ever had "wheezing or whistling in the chest", "shortness of breath" or a doctor's diagnosis of asthma or wheezy bronchitis were asked to respond to the following question: "In the past 12 months, did your child use any medication (liquids, tablets or sprays) against these respiratory problems? (yes/no)". Those responding with "yes" were asked to list the brand names of drugs that had been used, and to specify whether their use was on demand or regular. Regular use was defined for the parents as daily intake for $\geqslant$2 successive months.

The pharmacologically active substances of all reported medications were coded using the *Rote Liste 1996* [15], the annually updated official list of the German pharmaceutical industry, and the *European Drug Index* [16]. The international classification system (anatomical therapeutic chemical (ATC)) was used to further classify the pharmacologically active substances into categories allowing international comparison [17]. In the ATC system, a code is assigned to each active substance of a drug according to its chemical characteristics and treatment indications. For 95% of all recorded prescriptions, the active substances could be coded accordingly. Only substance classes and/or active substances used in the treatment of asthma (ATC codes R03, R06 and H02) were considered for the purposes of the present report. Antiasthma medications were further classified into bronchodilators, *i.e.* inhaled and oral β_2-agonists, theophylline, anticholinergics, and anti-inflammatory drugs, *i.e.* inhaled steroids and cromolyns (sodium cromoglycate and nedocromil).

Parents of the older age group were also asked about the use of alternative remedies such as herbal, homeopathic and similar agents. Additional questions ascertained whether the parents had a written asthma management plan and a peak flow meter.

Statistical analysis

Because the proportion of children without German nationality differed substantially between Dresden (1%) and Munich (22%) [13], and because the prevalence of asthma and atopy differs substantially

by nationality among children in Germany [18], the analysis was restricted to children of German nationality (n=11,094) in order to allow unbiased comparisons between the two cities. The SES was considered high if at least one of the parents had an education consisting of $\geqslant$13 yrs of formal school education. The Chi-squared test was used for comparison of dichotomous variables, with a p-value of <0.05 considered significant. Logistical regression analysis was performed to assess the independent effect of potential determinants in multivariate models. Variables that were considered relevant (sex, age, SES, study area, frequency of symptoms, episodes of speech-limiting wheeze, hospital admissions, atopic sensitisation, parental asthma, use of systemic steroids, and the presence of a written plan or peak flow meter) were entered into the models, and were backward selected using the likelihood ratio method.

Results

The prevalence of current wheeze in the present study population was 7.8% (table 1). Of these children (n=868), 36% reported use of bronchodilators and 28% use of anti-inflammatory drugs during the past year (table 2). Thirty-three per cent of parents of current wheezers had a written asthma management plan and 17% reported having a peak flow meter. Use of these accessory management means increased with symptom severity ($p<0.01$ for both).

The pattern of use (regular *versus* on demand) of bronchodilators and anti-inflammatory drugs according to asthma severity is shown in table 2. Nineteen per cent of all current wheezers reported regular use of anti-inflammatory drugs during the past year. The prevalence of regular anti-inflammatory therapy increased with frequency and severity of symptoms. Fourteen per cent of children who had had 1–3 attacks had used anti-inflammatory drugs regularly and this figure rose to 44% among children who had had >12 wheezing attacks ($p<0.01$). Regular use of anti-inflammatory treatment was found in 28% of children with emergency department visits or hospitalisations during the past year. There were no reports of regular use of systemic steroids.

The strongest determinant of treatment was a physician′s diagnosis of asthma. Table 2 shows that almost one-half (47%) of the children with current wheeze did not report a doctor′s diagnosis of asthma and these children received hardly any treatment (9% bronchodilators and 2% anti-inflammatory drugs). Comparisons were performed for the prevalence of severe asthma symptoms, BHR and atopic sensitisation according to current wheeze and asthma diagnosis (table 3). The group of children with wheeze and no diagnosis had a lower prevalence of severe symptoms than wheezy children with a diagnosis of asthma, but showed a significantly ($p<0.05$) higher prevalence of severe asthma symptoms, BHR and atopic sensitisation than children without current wheeze. Determinants of an asthma diagnosis among children with current wheeze are reported in table 4. Male sex, low SES, a parental history of asthma and severity of symptoms independently increased the likelihood that a child was diagnosed as asthmatic.

Most children receiving anti-inflammatory treatment were using sodium cromoglycate. Inhaled steroid use was reported by only 9.4% of current wheezers, but their use increased with symptom severity (table 5). However, among children with diagnosed asthma and >12 wheezing attacks in the last year, only 42% reported use of inhaled steroids. Regular use of inhaled steroids was even lower: 6% among current wheezers and 21% in the children with diagnosed asthma and >12 wheezing attacks. Regardless of

Table 2. – Proportion of children with current wheeze using antiasthmatic drugs and accessory treatment means during the past year by symptom severity, asthma diagnosis and presence of bronchial hyperresponsiveness (BHR)

	Subjects n	Bronchodilators			Anti-inflammatory drugs			Peak flow meter	Written plan
		Regular	On demand	Total	Regular	On demand	Total		
Number of wheezing attacks									
0	132	4	11	16	7	5	11	9	18
1–3	518	8	25	34	14	11	23	14	32
4–12	140	24	45	59	35	28	53	30	40
>12	54	28	43	61	44	30	56	35	46
Speech-limiting wheeze									
Yes	197	16	39	52	29	25	47	27	43
No	657	10	24	32	15	10	22	14	29
Asthma diagnosis									
Yes	454	20	46	62	32	23	48	26	41
No	409	2	6	9	3	2	6	4	21
Emergency/hospital admission									
Yes	94	19	31	44	28	15	40	20	49
No	639	12	32	43	21	16	31	17	30
BHR									
Yes	61	20	53	64	31	28	49	37	35
No	87	7	25	32	10	12	20	15	29
Total	868	11	27	36	19	13	28	17	33

Data are presented as percentage (n=868).

Table 3. – Symptom severity, bronchial hyperresponsiveness (BHR) and atopic sensitisation in all of the children by current wheeze and diagnosis of asthma

	Current wheeze and asthma diagnosis	Current wheeze without asthma diagnosis	No current wheeze
Frequent ($\geq$4) wheezing attacks[#]	142/443 (32)*	51/396 (13)*	0/9983 (0)
Speech-limiting wheeze[#]	136/449 (30)*	58/400 (15)*	13/9983 (0.1)
BHR[¶]	44/86 (51)*	17/62 (27)*	277/1763 (16)
Atopic sensitisation[+]	134/239 (56)*	92/239 (38)*	987/5569 (18)

Data are presented as n (%) (n=11,094). [#]: during the past year; [¶]: defined as a decrease in forced expiratory volume in one second of $\geq$15% following inhalation of hypertonic (4.5%) saline; [+]: defined as a positive skin-prick test (weal diameter $\geq$3 mm greater than control) to at least one of six common aeroallergens. *: $p<0.05$ *versus* children without current wheeze (Chi-squared test).

Table 4. – Determinants of a doctor's diagnosis of asthma among children with current wheeze

	Adjusted odds ratio[#]	95% CI	p-value
Sex (male *versus* female)	1.6	1.2–2.2	0.005
SES (high *versus* low)	0.7	0.5–1.0	0.07
Parental asthma (yes *versus* no)	2.3	1.5–3.3	<0.001
Number of wheezing attacks[¶] ($\geq$4 *versus* <4)	3.0	2.0–4.5	<0.001
Speech-limiting wheeze[¶] (yes *versus* no)	2.3	1.6–3.5	<0.001

n=868. [#]: adjusted for observed effect of all variables presented in table using logistic regression analysis; [¶]: during the past year. CI: confidence interval; SES: socioeconomic status.

symptom severity, any or regular use of inhaled steroids was reported more frequently in Dresden than in Munich (table 5). The results of the multivariate analysis show that, among children with current wheeze in the study area, an asthma diagnosis, the number of wheezing attacks in the previous 12 months, and the presence of a written plan or a peak flow meter were significant determinants of treatment with inhaled steroids (table 6).

Furthermore, the type of wheezing illness determined use of anti-inflammatory medication. Within the nested case/control study, children reporting only infections as triggers of their exacerbations (54 of 234 (23.1%)) used anti-inflammatory drugs infrequently: 9% on a regular basis and 17% on demand. Regular use of inhaled steroids even dropped to 2%. These figures were lower than those for children who also had other triggers (180 of 234 (76.9%)), such as exercise and allergies. Thirty-three per cent of these subjects used anti-inflammatory drugs on a regular basis, 27% on demand. Wheezy children with infectious triggers only experienced a milder course of disease with less frequent wheezing attacks (>4 attacks: 11 *versus* 37%) or speech-limiting wheeze (22 *versus* 38%) than children with all types of exacerbations.

The occurrence of exercise-induced wheeze (403 of 837 (48.1%)) may be considered an indicator of interval symptoms. These children used regular anti-inflammatory treatment (31%), including inhaled steroids (11%), more frequently than children without exercise-induced symptoms (8 and 3%, respectively).

Alternative remedies (not shown in tables) were reported by 31% of parents of children aged 9–11 yrs with current wheeze and were used more often ($p<0.05$) in Munich (44%) than in Dresden (19%). Multivariate analyses involving only current wheezers in this age group, *i.e.* those with information on the use of alternative remedies, found an inverse relationship between use of alternative remedies and use of inhaled steroids, even after adjustment for the above-mentioned factors (odds ratio 0.4, 95% confidence interval 0.2–0.9, $p<0.05$). Forty per cent of current

Table 5. – Use of inhaled steroids among children with current wheeze by symptom severity, asthma diagnosis and study area

	Dresden		Munich	
	Current wheeze and asthma diagnosis	Current wheeze without asthma diagnosis	Current wheeze and asthma diagnosis	Current wheeze without asthma diagnosis
Number of wheezing attacks				
0	2/20 (10)	1/58 (2)	2/22 (9)	0/32(0)
1–3	20/128 (16)	5/149 (3)	9/131 (7)	1/106 (1)
4–12	18/55 (33)	1/15 (7)	7/49 (14)	0/21 (0)
>12	8/15 (53)	0/2 (0)	8/23 (35)	0/13 (0)
Speech-limiting attacks				
Yes	17/60 (28)	1/31 (3)	11/76 (14)	0/27 (0)
No	31/157 (20)	6/197 (3)	15/156 (10)	1/145 (1)
Total	48/221 (22)	7/235 (3)	26/232 (11)	1/179 (1)

Data are presented as n (%) (n=868).

Table 6. – Determinants of inhaled steroid use among children with current wheeze

	Adjusted odds ratio[#]	95% CI	p-value
Asthma diagnosis (yes *versus* no)	4.3	1.8–9.8	0.001
Number of wheezing attacks[¶] ($\geq$4 *versus* <4)	2.7	1.6–4.6	<0.001
Written plan (yes *versus* no)	3.5	2.0–6.1	<0.001
Peak flow meter (yes *versus* no)	2.3	1.3–4.0	0.003
Study area (Dresden *versus* Munich)	2.0	1.1–3.4	0.02

n=868. [#]: adjusted for observed effect of all variables presented in table using logistic regression analysis; [¶]: during the past year. CI: confidence interval.

wheezers who reported using alternative remedies did not use bronchodilators or inhaled anti-inflammatory drugs.

Discussion

The present data suggest substantial undertreatment of asthma among children in these communities and indicate determinants of undertreatment, which should be addressed by future efforts to improve asthma management. Before interpreting these findings, however, methodological issues should be discussed. The strength of the present study is that it provides information on large samples which are representative of the children in the general population. Detailed information on symptoms and diagnoses of asthma, as well as measurements of bronchial responsiveness and atopic sensitisation, has been collected. In addition, the study provides data on real use of antiasthma drugs and accessory treatment means. A limitation is that recall bias, particularly underreporting of drug use, may have occurred. The duration of the study (12 months), individual differences in recall of drug intake and severity of asthma symptoms may have been sources of differential recall of drug use. However, the extent of underreporting is unlikely to be high since 92% of eligible parents responded to the introductory question on drug use by ticking either yes or no. Of those responding with yes, 98% also listed the brand names of the drugs that had been used, and specified whether their use was on demand or regular. In addition, the questionnaires were completed at home so that parents could check which drugs the children were using.

The analysis was restricted to children of German nationality because of the large difference in the proportion of children not of German nationality between the two cities. Stratified analyses within Munich showed that treatment among children not of German nationality was even worse than that of German children. For example, among current wheezers not of German nationality, 15% had used β-mimetics, 15% had received anti-inflammatory treatment and only 2% had used inhaled steroids during the previous year. The study was conducted in 1995–1996 and it may be argued that asthma management, particularly medical treatment, may have changed since then. However, data from national sources suggest only modest changes in the sale and consumption of asthma drugs in Germany in the years 1995–2000. For example, the cost of prescriptions of β-mimetics dropped from €383 million to €345 million, whereas the cost of prescriptions of inhaled corticosteroids increased from €108 million to €110 million [19]. The cost of cromoglycate use dropped from €7.3 million to €6 million [20]. Unfortunately, these data do not permit discrimination between adults and children. However, since, at the national level, the reductions in the prescription of β-agonists and cromoglycates were more pronounced than the increase in the use of inhaled steroids, it seems unlikely that the medical treatment of childhood asthma in the two communities has improved significantly since these data were collected.

The analyses concentrated on asthma management among current wheezers, which might have included a small proportion of children with a diagnosis other than asthma. However, transient wheezing or other wheezing-associated respiratory disorders are not common in the studied age groups, which minimises such bias. The categories of asthma severity were based on the annual number of wheezing attacks and the occurrence of speech-limiting wheeze and are, therefore, not directly comparable to the severity criteria used by asthma management guidelines [21, 22], which limits the extent to which conclusions can be drawn about the adequacy of management of children with asthma. However, it is likely that the majority of children with >12 wheezing attacks in the previous year belong to the moderate persistent category of the treatment guidelines.

The present study showed that <50% of the children with current wheeze had used antiasthma drugs in the year prior to the survey. Treatment with bronchodilators, primarily in the form of β_2-agonists, was most frequent, whereas anti-inflammatory therapy was reported by 28% of children with current wheeze, mostly in the form of sodium cromoglycate. However, not all children on anti-inflammatory therapy were using it regularly (*i.e.* effectively); only 19% reported regular intake. The frequency of treatment increased with severity, but, even among children with >12 wheezing attacks in the last year, only 44% were on regular anti-inflammatory treatment. These findings are in line with previous reports by others. The Asthma Insights and Reality in Europe (AIRE) study, involving samples from seven European countries, found that among children with mild persistent or more severe symptoms, ~80% used β_2-agonists and ~41% had used anti-inflammatory treatment [23]. A large US survey observed that only 18% of children with asthma had used anti-inflammatory drugs in the previous 4 weeks [24].

A physician's diagnosis of asthma was a very important determinant of treatment. Lack of a reported diagnosis could be due to underdiagnosis by physicians, less severe or typical clinical course, insufficient communication between physicians and parents, and erroneous

reporting of wheezing in children without asthma. The increased prevalence of severe symptoms, BHR and atopic sensitisation in this group of symptomatic children without diagnosis argues against the latter possibility and indicates that many asthmatic children in the community are left undiagnosed and, consequently, untreated. Underdiagnosis of asthma has been reported before in children [25, 26] and adults [27]. The present study is the first investigation that presents measurements of bronchial responsiveness and atopic sensitisation in a large community-based sample of children to support this notion.

Male sex and parental asthma were determinants of a doctor′s diagnosis, even after adjustment for symptom severity. This indicates that knowledge about the disease in the family and characteristics which are known to be associated with the condition influence the likelihood of diagnosis. SES was also associated with the disease. Interestingly, those with a higher status were less likely to be diagnosed. This contrasts with findings from New Zealand [28], and may reflect a reluctance of doctors to use the label in these patients.

Most of the anti-inflammatory therapy used by the children was in the form of inhaled sodium cromoglycate; only 9% of current wheezers reported use of inhaled steroids. These results contrast with data reported from other Western countries [9, 10, 24], where most anti-inflammatory treatment was in the form of inhaled steroids. Prescription of inhaled steroids to children with persistent asthma symptoms is considered an important indicator of good adherence to asthma treatment guidelines [5, 8, 29]. It might be argued that the low proportion of inhaled steroid use in the present survey is due to the fact that most of these children show mild asthma symptoms (table 2). However, even among children with diagnosed asthma and >12 wheezing attacks in the last year, only 42% had used inhaled steroids (regularly or on demand). The proportion of children in this group with parental reports of regular use of inhaled steroids was only 21% (40% in Dresden and 9% in Munich). This suggests substantial underutilisation of inhaled steroids in children with moderate-to-severe asthma symptoms, particularly in Munich. These findings are in line with recent data from the AIRE study, which was conducted in seven European countries [23]. The investigators in this study also reported poor utilisation of inhaled steroids among children and adults with asthma regardless of severity of symptoms. They stressed an immediate need to improve communication and awareness of the reasons underlying recommendations to use anti-inflammatory medication in patients with asthma.

Children with a diagnosis of asthma, more frequent symptoms, written plans and peak flow meters and those living in Dresden were more likely to have received inhaled steroids in the previous year than were other current wheezers. The use of alternative remedies, in turn, was associated with less use of inhaled steroids. Age and SES were not related to use of inhaled steroids among current wheezers in the present study, whereas studies looking at predictors of inadequate treatment with inhaled anti-inflammatory drugs in the USA found low SES, young age and belonging to an ethnic minority to be associated with use of inhaled steroids [30–32]. Most of these studies, however, involved younger children in a healthcare setting differing from the German system. From these findings, it would seem that the apparent reluctance to use inhaled steroids comprises two factors. The first appears to be related to the parents′ perception of asthma and the role of modern treatment, as judged by the inverse association between use of alternative remedies and inhaled steroids. The second seems to relate to physicians′ practices, as assessed by the fact that physicians who provide their patients with a written asthma management plan or peak flow meters, and hence are probably more knowledgeable about current treatment concepts, are more likely to prescribe their patients inhaled steroids. Both factors are in line with the recent observations of others [33–35].

There seem to be unaddressed concerns about the long-term use of inhaled steroids among parents, particularly in Munich, since the use of other anti-inflammatory drugs, *i.e.* inhaled sodium cromoglycate, did not differ significantly between the two cities. The opposite was noticed for use of alternative remedies, which was much higher among children aged 9–11 yrs in Munich than in Dresden. For example, among children with speech-limiting episodes, use of alternative therapies was almost doubled in Munich compared to Dresden (51 *versus* 27%). These results emphasise the importance of patients′ education and cooperation in achieving good asthma control [36], and also the importance of addressing parents′ as well as physicians′ concerns about the efficacy and safety of inhaled steroids [37].

The use of accessory management means, such as a written management plan or peak flow meter, is recommended by guidelines for improving asthma control and decreasing the need for emergency visits to healthcare facilities [21, 38, 39]. The present analyses show that the frequency of utilisation of these means by physicians rose according to severity and with an asthma diagnosis (table 2). However, the data suggest that these means were generally underutilised since only ~50% of the children with severe asthma symptoms (>12 attacks), with or without an asthma diagnosis, had a written management plan.

In conclusion, the present study presents a detailed picture regarding the reality of childhood asthma management within the community. It highlights several areas of concern, mainly continuing underuse of anti-inflammatory drugs, particularly inhaled steroids, and underutilisation of written management plans and peak flow meters in children with frequent and severe asthma symptoms in Germany. In addition, a substantial proportion of children with asthma symptoms were not recognised as asthmatics, and, as a consequence, were undertreated with antiasthma medications. Future efforts to improve the treatment of childhood asthma should aim at better educating patients and physicians about the chronic nature of asthma and current therapeutic concepts, and enhancing provider/patient communication and cooperation.

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