
Quality of care in patients with asthma and rhinitis treated by respiratory specialists and primary care physicians: a 3-year randomized and prospective follow-up study

Vibeke Backer, MD, DMSci; Steen Nepper-Christensen, MD; and Hendrik Nolte, MD, DMSci

Background: Previous studies evaluating asthma care provided by primary care providers and respiratory specialists (RSs) are limited by short observation periods and nonrandomized designs.

Objective: To evaluate long-term outcomes in patients with asthma and rhinitis randomly selected to be cared for by RSs or primary care specialists.

Methods: In a randomized, 3-year, longitudinal study, 472 patients with asthma and allergic rhinitis were cared for by RSs or primary care physicians. Outcome measures, including disease severity, lung function, medication use, compliance, and self-management knowledge, were compared between groups.

Results: Compared with patients followed up by primary care providers, those in the RS group had reduced asthma severity ($P = .046$), significantly fewer days with asthma symptoms ($P < .01$), and improved asthma self-management knowledge ($P < .01$). At baseline, most patients were undertreated. This value was significantly reduced from 74% to 37% in the RS group and from 71% to 57% in the primary care physician group. We found odds ratios of 8.5 (95% confidence interval, 2–43; $P < .01$) for worsening of asthma and 0.3 (95% confidence interval, 0.1–0.9; $P = .04$) for asthma improvement when followed up by primary care physicians, which indicates that primary care follow-up increases the risk of worsening of asthma and decreases the chance of improving. Similar results were observed in patients with allergic rhinitis, although the findings were less pronounced.

Conclusion: Treatment and follow-up by an RS ensured better quality of care in patients with asthma and rhinitis.

Ann Allergy Asthma Immunol. 2006;97:490–496.

INTRODUCTION

Asthma and rhinitis are chronic disorders and major public health problems.^{1–4} Optimum therapy requires regular evaluation of disease severity, and patients should be taught to take control of factors that contribute to severity. Pharmacologic therapy is then modified according to symptoms, lung function, and quality-of-life variables.^{5,6} The severity of disease will alter owing to different factors, and even when the disease is controlled, monitoring and treatment will still be needed to maintain permanent control.⁶ There is growing discussion about the quality of care provided to patients with chronic disorders. Several studies^{7–12} have indicated that asthma outcomes may be improved when patients receive their care from allergy and respiratory specialists (RSs) compared with primary care physicians. In addition, many studies^{13–16} document undertreatment of asthma, which has been associated with increased morbidity. Such studies have prompted increased focus on public awareness campaigns,

treatment guidelines, and continued medical education to support efforts to improve asthma management by asthma specialists and primary care physicians.^{5,6,8}

Asthma and allergy guidelines recommend regular follow-up care by primary and secondary care providers for patients with chronic respiratory disorders. These guidelines have been available for several years, and resources have been provided to implement the guidelines in primary and secondary care settings through seminars, conferences, and the teaching of health professionals. The main purpose of this study is to evaluate the long-term outcome when primary care providers (general practitioners [GPs]) and RSs treat patients with mild-to-severe asthma and rhinitis.

METHODS

Study Population

Patients were recruited from an asthma and rhinitis screening study described in detail in a previous article.¹⁵ A total of 726 individuals (314 males and 412 females) from the general population aged 14 to 44 years with asthma, allergic rhinitis, or both were enrolled. They were then randomized to treatment by 11 RSs in the same clinic or 22 different GPs. All the patients were offered a baseline visit and a final visit after 3 years of follow-up.

Patients randomized to GP care were referred to their primary care physician immediately after enrollment with a

Respiratory and Allergy Research Unit, Department of Internal Medicine, University Hospital of Copenhagen, H:S Bispebjerg Hospital, Copenhagen, Denmark.

This study was supported by an unrestricted grant from AstraZeneca and ALK-Abello Inc. There were no competing interests between the research group and the supporters.

Received for publication February 22, 2006.

Accepted for publication in revised form May 16, 2006.

letter detailing the medical examination, diagnosis, and test results. The letter advised whether pharmacologic therapy or allergen immunotherapy was recommended. Before referral, all 22 local GPs were informed by letter about the objective of the study, were given the recommended schedule of follow-up in chronic disease management, and were advised to use international treatment guidelines (Global Initiative for Asthma [GINA] and Allergic Rhinitis and Its Impact on Asthma [ARIA]), including measurement of lung function preferably by means of spirometry or peak flow meter. In addition, the local health authority distributed a circular about asthma with a color copy of the GINA guidelines.

All patients cared for by RSs were offered standard practice care and regular follow-up every 6 months (8 visits). At each visit, information about asthma self-management was provided verbally and in writing using action cards and peak flow meter recordings. Disease severity was evaluated, and treatment was adjusted (including the administration of allergen immunotherapy) in accordance with guidelines.^{5,6} The GPs who did not administer immunotherapy had the option of referring study patients to the hospital's immunotherapy clinic free of charge.

Questionnaires and Clinical Examination

At the baseline and following visits, all the participants completed questionnaires assessing baseline variables, symptoms, smoking habits, education, income, and asthma- and rhinitis-related medical resource use. The questionnaire about asthma symptoms was adapted from the American Thoracic Society.¹⁶ Number of pack-years of cigarette smoking and body mass index were calculated. All the patients were, at each visit, evaluated in accordance with GINA and ARIA guidelines, including classification of disease severity.^{5,6} A nonblinded physician evaluation based on a review of symptoms, pulmonary function test results, and medication use was used to compare disease severity at screening and at the final visit. Then the changes were classified as improved, unchanged, or worsened.

Diagnostic Tests

Spirometry was performed as recommended by the American Thoracic Society,¹⁷ and percentages of predicted values for forced expiratory volume in 1 second and forced vital capacity were calculated at all visits. Airway responsiveness to inhaled methacholine was measured,¹⁸ and the dose-response slope was calculated¹⁹ at the first and last visits only. Last, all the participants underwent allergen skin prick testing with 10 inhalant allergens in accordance with the European Academy of Allergology and Clinical Immunology guidelines.^{20,21}

Treatment Compliance

Patients were asked how often they took their medication during the preceding 4 weeks (always, often, sometimes, rarely, never, or no medication). Compliance was confirmed by history only and then was assigned to 1 of 3 categories: reasonable compliance (always, often, or sometimes), poor compliance (rarely or never), and no treatment.

Statistical Analysis

Data were analyzed using a statistical software package (SPSS version 12.0; SPSS Inc, Chicago, IL). Differences in mean $\pm$ SD or, when appropriate, median (range) were calculated. For the continuous variables, data were analyzed using analysis of variance, followed by the 2-sample *t* test, paired *t* test, or, when appropriate, Kruskal-Wallis and Mann-Whitney tests. The χ^2 test was used for unpaired data, and the McNemar test was used for paired data. Number needed to treat (NNT), ie, the proportion that benefited from treatment by RSs vs GPs, was calculated according to the method of Guyatt et al.²² Linear and logistic regression analysis was used to evaluate factors related to change in asthma control, and nonsignificant variables were deleted by means of backward elimination. The odds ratio (95% confidence interval) was calculated for the observed improvement between groups. $P < .05$ was considered statistically significant. All the patients and their guardians received information verbally and in writing and gave their informed consent in writing before enrollment. The study was approved by the local ethics committee of Copenhagen, Denmark (Den Videnskabs- etiske Kommite Frederiksberg).

RESULTS

Patients

A total of 726 patients entered the study, and no statistically significant differences were found in the baseline characteristics between the 2 groups. Of these patients, 254 dropped out of the study and did not return for the final visit. The number of dropouts was equally distributed between the groups, ie, 124 in the RS group and 130 in the GP group, and their baseline characteristics, including disease severity, were similar. The main reason for dropout was the long duration of the study and lack of incentive to stay in the study. A total of 472 patients were evaluable for the full duration of the study. At study entry, the demographic characteristics and clinical profile of the 2 groups were comparable with respect to age (29.5 vs 29.7 years), sex (40% vs 49% male), history of smoking (7.9 vs 7.4 pack-years), atopy status (77% vs 74%), asthma severity (GINA group 4: 54 vs 50 patients), and rhinitis severity (ARIA group 4: 55 vs 61 patients) (Table 1).

Severity and Treatment of Asthma

At screening, only 23% of asthmatic patients in both groups had been asymptomatic in the preceding 4 weeks (Table 2). After 3 years of follow-up, significantly more patients cared for by RSs were free of symptoms (a change from 26% to 40%; $P < .001$) compared with patients followed up by GPs (a change from 20% to 26%). After 3 years, patients who received care from RSs showed significantly less severe asthma (patients with severe asthma symptoms were reduced by 54%; $P < .001$) and fewer days with asthma (from 1.4 to 0.5 days; $P = .04$) compared with patients followed up by GPs (increase from 0.9 to 1.6 days; $P = .045$). At the first visit, 62% of the patients were untreated (Table 3). After 3 years, the use of inhaled glucocorticosteroids and β_2 -agonists

Table 1. Baseline Values of the 2 Study Groups at the Time of Enrollment and at the Last Visit

	Baseline visit				Final visit			
	GP group	RS group	All	P value	GP group	RS group	All	P value
Patients, No.								
Asthma	233	260	493		147	170	317	
Rhinitis	275	296	571		170	197	367	
All	349	377	726	.46	219	253	472	.64
Asthma, mean (SD)								
FEV ₁ , L	3.46 (0.8)	3.59 (0.8)	3.52 (0.8)	.06	3.39 (0.8)	3.56 (0.8)	3.48 (0.8)	.06
FEV ₁ , % predicted	93 (16)	94 (15)	93 (16)	.43	93 (16)	93 (14)	93 (15)	.43
FEV ₁ /FVC	81 (9)	82 (8)	82 (9)	.28	81 (8)	82 (6)	82 (8)	.28
%ΔFEV ₁ /μmol	0.97 (0.4)	1.02 (0.5)	1.00 (0.4)	.26	0.96 (0.4)	0.99 (0.4)	0.97 (0.4)	.26
Nonasthma, mean (SD)								
FEV ₁ , L	4.03 (0.8)	3.94 (0.8)	3.98 (0.8)	.44	4.06 (0.8)	4.03 (0.8)	4.04 (0.8)	.44
FEV ₁ , % predicted	100 (12)	98 (13)	100 (13)	.62	100 (13)	100 (13)	101 (13)	.62
FEV ₁ /FVC	85 (6)	85 (6)	85 (6)	.67	85 (6)	86 (6)	85 (6)	.67
%ΔFEV ₁ /μmol	0.69 (0.1)	0.69 (0.1)	0.69 (0.1)	.76	0.68 (0.1)	0.69 (0.1)	0.69 (0.1)	.76

Abbreviations: FEV₁, forced expiratory volume in 1 second; FVC, forced vital capacity; GP, general practitioner; RS, respiratory specialist.

Table 2. Asthma Symptoms Based on Severity by Group at Baseline and the Last Visit

GINA class	GP group, %		RS group, %	
	Baseline	Last visit	Baseline	Last visit
Asymptomatic	20	26	26	40
Mild persistent	24	37	25	37
Moderate persistent	27	14	23	11
Severe persistent	29	23	26	12

Abbreviations: GINA, Global Initiative for Asthma; GP, general practitioner; RS, respiratory specialist.

Table 3. Patient Treatment by Group at Baseline and the Last Visit.

Asthma treatment	GP group, %		RS group, %	
	Baseline	Last visit	Baseline	Last visit
Untreated	62	20	62	3
SABA alone	12	47	15	27
LABA alone	1	2	3	2
ICS alone	13	1	9	9
ICS/LABA/SABA	12	30	11	59

Abbreviations: GP, general practitioner; ICS, inhaled corticosteroid; LABA, long-acting β_2 -agonist; RS, respiratory specialist; SABA, short-acting β_2 -agonist.

had increased, and the frequency of untreated patients was reduced in both groups ($P < .001$) (Table 3). At baseline, as defined by the GINA guidelines, most patients in the RS and GP groups (74% and 71%, respectively; $P = .10$) were undertreated based on asthma severity and recommended treatment. The reduction in undertreatment was sizable for patients followed up by RSs (reduced from 74% to 37%; $P < .001$) compared with patients treated by GPs (reduced from 71% to 57%; $P < .001$). In patients with inhalant allergies, RSs initiated immunotherapy in 20 (61%) of 33 possible

treatable patients, whereas GPs initiated similar treatment in 1 (3%) of 39 patients ($P < .01$).

Asthma Treatment Compliance, Self-care Education, and Health Care Use

At the final visit, the frequency of reasonable compliance had increased in the GP group (from 18% to 39%; $P < .001$) and in the RS group (from 12% to 47%; $P < .001$), resulting in better compliance among patients followed up by RSs ($P = .05$). In all self-management variables, except for having written asthma management plans, an improvement was noted in both groups, although more in the RS group (Table 4). At baseline, more than 82% of the patients reported at least 1 GP visit within 12 months before inclusion in the study. During follow-up, the frequency of asthma-related visits by patients followed up by GPs was not noted. However, most GP patients reported that they visited their GP for an asthma-related issue within 6 (64%) and 12 (84%) months before the last study visit. In the RS group, 60% of the patients participated in at least 4 of 8 follow-up visits.

Change in Asthma Symptoms and Risk Factors

After 3 years, patients followed up by an RS exhibited fewer asthma and rhinitis symptoms, and, furthermore, a reduction in asthma and rhinitis medication use was possible (Table 5). Asthmatic patients in the GP group had an 8.5 times higher risk of symptom deterioration and a lower chance of improvement. Patients with multiple allergies or airway hyperreactivity were most at risk (Table 6). Finally, we estimated the effectiveness of the treatment by RSs and GPs by calculating the NNT. The NNT for the RS vs the GP group was 3.7, which indicates that for every GP-treated patient showing an improvement, 4 patients showed significant improvement when treated by RSs.

Rhinitis Treatment and Disease Severity

Reduction in the severity of rhinitis and change in treatment regimens showed the same pattern as that observed in asth-

Table 4. Patients' Asthma Self-management Knowledge

Question	GP group, %			RS group, %			
	Baseline visit	Final visit	<i>P</i> value (1 vs 2)	Baseline visit	Final visit	<i>P</i> value (3 vs 4)	<i>P</i> value (2 vs 4)
	Row 1	Row 2		Row 3	Row 4		
Have you been told enough about your asthma treatment?	18	24	<.05	16	38	<.001	<.05
Have you been told how to use your asthma inhaler or device?	49	60	<.01	53	82	<.001	<.01
Have you been told how to use a peak flow meter?	33	49	<.01	27	68	<.001	<.01
Have you been told about triggers of asthma and rhinitis and how to avoid them?	44	45	.10	41	80	<.001	<.001
Have you been told how to adjust your asthma medication if you are exposed to asthma triggers?	23	28	<.01	20	55	<.001	<.001
Have you been told how to adjust your medication when your asthma worsens or when you have an attack?	26	31	<.01	24	52	<.01	<.01
Have you been given a written asthma management plan?	1	4	.08	1	5	<.05	.90

Abbreviations: GP, general practitioner; RS, respiratory specialist.

Table 5. Final Respiratory Evaluation Based on Symptoms and Pulmonary Function Test Results in 472 Patients

	GP group, % (n = 219)	RS group, % (n = 253)	<i>P</i> value (GP vs RS)
Asthma symptoms			<.01
Improved	33	55	
Unchanged	40	34	
Worse	27	11	
Asthma treatment			<.01
Reduced/stopped	6	18	
Unchanged	57	64	
Increased	7	6	
Adding new drug	30	12	
Rhinitis symptoms			.09
Improved	32	42	
Unchanged	50	49	
Worse	18	9	
Rhinitis treatment			<.05
No treatment	54	40	
Reduced/stopped	2	14	
Unchanged	20	29	
Increased/new drug	24	17	

Abbreviations: GP, general practitioner; RS, respiratory specialist.

matic patients, although the differences were less pronounced (Table 5). The reduction in severity was substantial in the GP and RS groups. At baseline in the GP group, the patient distribution based on ARIA severity class 1 to 4 was 35%, 19%, 10%, and 36% respectively, and at the final visit was 58%, 18%, 8%, and 16% ($P = .03$). At baseline in the RS group, the ARIA class 1 to 4 distribution was 40%, 17%, 15%, and 28%, respectively, and at the final visit was 66%, 21%, 1%, and 12% ($P = .03$). Furthermore, the frequency of moderate intermittent and persistent rhinitis was significantly

different at the final visit in the GP group vs the RS group (8% and 16% vs 1% and 12%, respectively; $P < .01$). Most patients were untreated at baseline and follow-up, with no seasonal differences (data not shown). Patients with allergic rhinitis were significantly more likely to be treated with immunotherapy when followed up by RSs (3 vs 28; $P < .001$).

Rhinitis Treatment Compliance

The compliance rate was low before and after the study (17% and 25%), with no difference between the 2 groups. Patients with moderate-to-severe rhinitis tended to be more compliant than those with mild rhinitis ($P = .07$).

DISCUSSION

This study examined differences in the treatment outcomes of patients with all severities of asthma and allergic rhinitis who received their care from RSs or GPs. During 3 years of follow-up, we noted a sizable reduction in asthma and allergic rhinitis severity with considerably less undertreatment when patients were followed up by RSs. Interpretation of the present findings may be affected by the voluntary nature in which patients should contact their GP after the first visit to the RS and by the high dropout rate. The dropout rate among young adults with chronic disorders is known to be high in long-term studies in clinical settings similar to this study. However, the dropout rate and patient characteristics were similar in both groups, indicating that the data are comparable.

Regular preventive care visits in patients with diabetes mellitus are already standard in primary care, and in asthmatic patients, the same is encouraged and mandated by health authorities. Patients cared for by GPs in the present study were, therefore, in principle, given the same opportu-

Table 6. Odds Ratios for Change in Asthma Control During 3 Years of Follow-up, Estimated at the Last Evaluation Based on Symptoms, Lung Function, Airway Responsiveness, and Treatment*

	Improvement		Deterioration	
	Odds ratio (95% CI)	P value	Odds ratio (95% CI)	P value
Classification at screening				
GINA 1	0.23 (0.4–1.5)	.12	1.7 (0.2–9.7)	.57
GINA 2	2.84 (0.6–12.6)	.17	1.3 (0.1–15.2)	.83
GINA 3	2.14 (0.6–8.3)	.27	1.5 (0.4–6.3)	.56
GINA 4†	0.00 (0.0–0.0)	.90	NA	NA
General characteristics				
BMI	0.99 (0.8–1.1)	.90	1.00 (0.9–1.2)	.73
Sex (male)	1.86 (0.6–6.0)	.29	0.60 (0.1–2.4)	.42
Age	1.02 (1.0–1.1)	.52	0.93 (0.9–1.0)	.09
Pack-years	0.94 (0.9–1.0)	.15	1.07 (1.0–1.2)	.14
FEV ₁ , % predicted	1.00 (1.0–1.1)	.86	1.04 (1.0–1.1)	.21
%ΔFEV ₁ /μmol	1.03 (0.2–3.5)	.97	3.92 (0.9–17)	.07
GP follow-up	0.28 (0.1–0.9)	.04	8.52 (1.7–43)	.01
Atopy status (prick test)				
Negative result	0.41 (0.1–3.0)	.38	7.54 (0.6–100)	.13
1 positive result	0.22 (0.0–2.4)	.21	9.26 (0.5–175)	.14
2 positive results	0.77 (0.1–7.4)	.82	24.04 (1.2–493)	.04
3 positive results	0.63 (0.0–5.1)	.45	57.07 (2–1,450)	.02

Abbreviations: BMI, body mass index; CI, confidence interval; FEV₁, forced expiratory volume in 1 second; GINA, Global Initiative for Asthma; GP, general practitioner; NA, not applicable.

* Unchanged asthma was used as the reference value in the multivariate logistic analysis.

† Deterioration was not possible because the most severe degree of asthma is GINA 4 (follow-up values).

nity for regular preventive checkups, and most of them (82%) also confirmed that they saw their GP for an asthma checkup before study entry and at least once during the last study year. Therefore, unwillingness to seek medical help or lack of patient-physician contact does not explain the poor study results in the GP group.

Although the RS group was at one clinic location and the GP group was at various locations, this should not give any specific advantage to the RS group as far as any specific administrative support because there was no specifically assigned asthma educator or study coordinator (except for the administrative assistant for scheduling visits), and each patient follow-up visit was scheduled for 15 minutes with the physician (excluding pulmonary function testing). The RS group followed the standard practice format throughout the study. The GP practices had no other incentives to comply with the study other than the initial letters and following guideline treatment provided to them and recommended by the national health authorities. We aimed to mimic current practice in both settings. One may consider that by informing GPs about the study and the nonblinded design it may have introduced a treatment bias. However, it can be argued that this bias may have confounded the data in both groups.

The most striking difference between the 2 groups was the reduction in the number of patients with severe asthma when followed up by RSs. In accordance with previous studies,^{9,22} this was paralleled with increased use of combined β_2 -agonist and corticosteroid inhalation drugs. Proper evaluation by an RS, regular adjustment of the treatment, and improved patient

self-management knowledge may, thus, account for the observed improvement in asthma.^{23–25} It is known that patients and physicians in general practice may have difficulty recognizing asthma symptoms or evaluating disease severity.^{14,26} This finding is supported by the observations that more than 50% of patients with severe persistent asthma feel that their asthma is well or completely controlled.²⁷ Therefore, the patients in the present study might have had a low perception of symptoms, and GPs may have had difficulty evaluating disease severity, because 40% of patients with moderate-to-severe asthma were not receiving anti-inflammatory treatment. The relatively low rate of corticosteroid use is in line with earlier findings that reported suboptimal use of inhaled corticosteroids by patients with severe persistent asthma.²⁸ In contrast, in the RS group, undertreatment was greatly diminished, whereas only a small reduction was observed in patients followed up by GPs. Furthermore, patients followed up by GPs less often used inhaled asthma combination (long-acting β_2 -agonist and glucocorticoids) medications and had more days with symptoms of asthma. One reason may be that combination products were relatively new when the study started. However, this finding is similar to a previous study²⁹ also indicating that GPs are less likely to prescribe controller medication. Furthermore, compliance and asthma self-management knowledge showed a slight improvement in the RS group, which may be explained by patients experiencing better disease control, induced by the higher rate of inhaled corticosteroid use. The present findings are consistent with a growing body of literature supporting the concept that treat-

ment and follow-up by RSs reduce asthma and rhinitis health care costs and morbidity by improving disease control and reducing the need for acute care.^{5,6,9,12,22,30}

It is generally accepted that most asthma and rhinitis care should be provided at the primary care level, but for patients who may benefit from consulting, an RS should be identified and referred accordingly. The discrepancy in the present study between the improvement in asthma symptoms with unchanged lung function and almost unchanged bronchial responsiveness is well known in patients with less severe asthma.^{22,28} This suggests that there is a need for easier and more accurate tools to evaluate asthma control by physicians and patients.

Low use of long-acting and high use of short-acting β_2 -agonists was inappropriately balanced to the use of inhaled corticosteroids, and severity of asthma symptoms in the GP group is in accordance with European studies of randomly selected populations.^{27,31,32} Furthermore, patients with allergy showed a greater risk of asthma deterioration compared with others. This justifies specific attention to a patient's allergy and perhaps more frequent use of allergen specific immunotherapy when indicated.^{33,34}

Similar to asthma management, allergic rhinitis should be managed in accordance with the guidelines, including avoidance of allergens, medication, and allergen immunotherapy. Considering that earlier studies have shown that the appropriate management of rhinitis may improve coexisting asthma, it is disappointing to note that 38% of the patients with asthma and concomitant rhinitis were untreated.³⁵ Although immunotherapy may prevent the occurrence of asthma in patients with moderate-to-severe rhinitis,³⁴ few patients receiving immunotherapy were found in the GP-treated group, indicating that patients were not referred to an RS, and little attention is given to this type of treatment.

At the final study visit, the evaluation of whether the patients were improved, unchanged, or worse was nonblinded and performed by different RSs. Although an evaluation bias cannot be excluded, note that the RS prescribed new medications in 30% of the GP-treated patients and only in 12% of RS-treated patients. The RS followed the guidelines strictly, and this supports that treatment by GPs was suboptimal. In addition, the 8-fold higher risk of asthma deterioration and the NNT of 4 in favor of asthma specialist care further indicate that the guidelines for the management of asthma are not being adequately observed by GPs and that RSs are more likely to apply current prescribing guidelines, leading to better outcomes.

In summary, this study showed that patients treated by RSs improved patient outcomes compared with those cared for by GPs. The conclusion in the present study is not that all patients should be treated by RSs but rather that asthma and rhinitis treatment must improve in the general care setting and that the current patient outcomes are suboptimal. Despite guidelines and multiple efforts to improve asthma and rhinitis treatment by specialists and GPs, asthma and allergic rhinitis care is still far from perfect. The results also suggest that

many patients with these disorders benefit from specialist evaluation.

ACKNOWLEDGMENTS

We thank the research assistants and the local patients with asthma and rhinitis who were helpful in the data collection process.

REFERENCES

1. Strachan D, Sibbald B, Weiland S. Worldwide variations in the prevalence of symptoms of allergic rhinoconjunctivitis in children: the International Study of Asthma and Allergies in Childhood (ISAAC). *Pediatr Allergy Immunol*. 1997;8:161–176.
2. Linneberg A, Jorgensen T, Nielsen NH, et al. The prevalence of skin test positive allergic rhinitis in Danish adults: two cross-sectional surveys 8 years apart: the Copenhagen Atopy Study. *Allergy*. 2000;55:767–772.
3. Ulrik CS, von Linstow ML, Backer V. Prevalence and predictors of rhinitis in Danish children and adolescents. *Allergy*. 2000;55:1019–1024.
4. International Study of Asthma and Allergies in Childhood (ISAAC) Steering Committee. Worldwide variation in prevalence of symptoms of asthma, allergic rhinoconjunctivitis, and atopic eczema: ISAAC. *Lancet*. 1998;351:1225–1232.
5. Bousquet J, Van Cauwenberge P, Khaltaev N; Aria Workshop Group; World Health Organization. Allergic rhinitis and its impact on asthma. *J Allergy Clin Immunol*. 2001;108:S147–S334.
6. Global Initiative for Asthma (GINA), National Heart, Lung, and Blood Institute (NHLBI). *Global Strategy for Asthma Management and Prevention*. Bethesda, MD: National Institutes of Health; 1995. NIH publication 95–3659.
7. Laforest L, Van Ganse E, Devouassoux G, et al. Management of asthma in patients supervised by primary care physicians or by specialists. *Eur Respir J*. 2006;27:42–50.
8. Keeley D. How to achieve better outcome in treatment of asthma in general practice. *BMJ*. 1993;307:1261–1263.
9. Vollmer WM, O'Hollaren M, Ettinger KM, et al. Specialty differences in the management of asthma: a cross-sectional assessment of allergists' patients and generalists' patients in a large HMO. *Arch Intern Med*. 1997;157:1201–1208.
10. Schatz M, Zeiger RS, Mosen D, et al. Improved asthma outcomes from allergy specialist care: a population-based cross-sectional analysis. *J Allergy Clin Immunol*. 2005;116:1307–1313.
11. Harrold LR, Field TS, Gurwitz JH. Knowledge, patterns of care, and outcomes of care for generalists and specialists. *J Gen Intern Med*. 1999;14:499–511.
12. Donohoe M. Comparing generalist and specialty care, discrepancies, deficiencies, and excesses. *Arch Intern Med*. 1998;158:1596–1608.
13. Piccoro LT, Potoski M, Talbert JC, et al. Asthma prevalence, cost, and adherence with expert guidelines on the utilization of health care services and costs in a state Medicaid population. *Health Serv Res*. 2001;36:357–371.
14. Anis AH, Lynd LD, Wang XH. Double trouble: impact of inappropriate use of asthma medication on the use of health care resources. *CMAJ*. 2001;164:625–631.
15. Rabe KF, Vermeire PA, Soriano JB, et al. Clinical management

-
- of asthma in 1999: the Asthma Insights Reality in Europe (AIRE) study. *Eur Respir J*. 2000;16:802–807.
16. Nolte H, Nepper-Christensen S, Backer V. Unawareness and undertreatment of asthma and rhinitis in a general population. *Respir Med*. 2006;100:354–362.
17. US Department of Health, Education, and Welfare. *Proceedings of the First NHLBI Epidemiology Workshop*. Washington, DC: US Government Printing Office; 1971.
18. Quanjer PH, Tammeling GJ. Summary of recommendations: standardized lung function testing: report of the Working Party, European Community for Coal and Steel. *Bull Eur Physiopathol Respir*. 1983;19(suppl 5):7–10.
19. Yan K, Salome C, Woolcock AJ. A rapid method for measurement of bronchial responsiveness. *Thorax*. 1983;38:760–765.
20. O'Connor G, Sparrow D, Taylor D, et al. Analysis of dose-response curves to methacholine: an approach suitable for population studies. *Am Rev Respir Dis*. 1987;136:1412–1417.
21. Dreborg S. Skin tests used in type 1 allergy testing (position paper). *Allergy*. 1989;44(suppl 10):22–30.
22. Guyatt GH, Juniper EF, Walter SD, et al. Interpreting treatment effects in randomized trials. *BMJ*. 1998;316:690–693.
23. Wu AW, Young Y, Skinner EA, et al. Quality of care and outcomes of adults with asthma treated by specialists and generalists in managed care. *Arch Intern Med*. 2001;161:2554–2560.
24. Gibson PG, Coughlan J, Wilson AJ, et al. Self-management education and regular practitioner review for adults with asthma [Cochrane Review on CD-ROM]. Oxford, England: Cochrane Library, Update Software; 2001;issue 2.
25. Bateman ED, Boushey HA, Bousquet J, et al. Can guideline-defined asthma control be achieved? the Gaining Optimal Asthma Control study. *Am J Respir Crit Care Med*. 2004;170:836–844.
26. Caress AL, Beaver K, Luker K, Campbell M, Woodcock A. Involvement in treatment decision: what do adults with asthma want and what do they get? results of a cross sectional survey. *Thorax*. 2005;60:199–205.
27. Osborne ML, Vollmer WM, Pedula KL, et al. Lack of correlation of symptoms with specialist-assessed long-term asthma severity. *Chest*. 1999;115:85–91.
28. Vermeire PA, Rabe KF, Soriano JB, et al. Asthma control and differences in management practices across seven European countries. *Respir Med*. 2002;96:142–149.
29. Williams LK, Pladevall M, Xi H, et al. Relationship between adherence to inhaled corticosteroids and poor outcomes among adults with asthma. *J Allergy Clin Immunol*. 2004;114:1288–1293.
30. Legoretta AP, Christian-Herman J, O'Connor RD, et al. Compliance with national asthma management guidelines and specialty care: a health maintenance organization experience. *Arch Intern Med*. 1998;158:457–464.
31. Van den Boom G, Rutten-van Molken MPMH, Tirimanna PRS, et al. Association between health-related quality of life and consultation for respiratory symptoms: results from the DIMCA programme. *Eur Respir J*. 1998;11:67–72.
32. Vermeire P. Differences in asthma management around the world. *Eur Respir Rev*. 1994;21:279–281.
33. Jepson G, Butler T, Gregory D, et al. Prescribing patterns for asthma by general practitioners in six European countries. *Respir Med*. 2000;94:578–583.
34. Creticos PS. The consideration of immunotherapy in the treatment of allergic asthma. *J Allergy Clin Immunol*. 2000;105:S559–S574.
35. Möller C, Dreborg S, Ferdousi A, et al. Pollen immunotherapy reduces the development of asthma in children with seasonal rhinoconjunctivitis (the PAT-study). *J Allergy Clin Immunol*. 2002;109:251–256.
- Requests for reprints should be addressed to:*
Vibeke Backer, MD, DMSci
Respiratory and Allergy Research Unit
Department of Internal Medicine
Bispebjerg Hospital
Bispebjerg Bakke 23
2400 Copenhagen NV, Denmark
E-mail: backer@dadlnet.dk
-