



Do asthma patients in general practice profit from a structured allergy evaluation and skin testing? A pilot study

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KEYWORDS

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Summary Background: Although allergy is central to the pathophysiology of asthma, little is known about the benefits of a structured approach to allergen diagnosis and management in primary care asthma patients.

Objectives: We studied effects of a structured allergen evaluation and allergen avoidance advice combined with or without additional allergy skin testing on health status, illness perception, and lung function of asthma patients treated in general practice.

Method: Fifty-four asthma patients were randomly assigned to three groups: (i) Standard asthma care with information on the stepwise treatment approach, a written action plan, and inhaler technique training; (ii) Additional structured allergen evaluation and avoidance advice; (iii) Additional structured allergen evaluation and avoidance advice based on skin prick test results. Patients were seen for one initial appointment at a primary care asthma clinic and a follow-up examination 3 months later. On both occasions, questionnaire measures of symptoms, illness perception, and the perceived control of asthma were administered. Lung function was measured by spirometry (PEF, FEV₁). Perceived allergic asthma triggers, the trigger impact, and the trigger control were assessed in both intervention groups.

Results: Following intervention, a decrease in beta-adrenergic inhaler use, an increase in the perceived control of asthma, and a decrease in the bothering from asthma symptoms were observed for all three groups. Intervention groups showed a higher awareness of animal-allergic triggers, and the perceived control of asthma triggers was increased in the group receiving no skin tests. FEV₁ showed an improvement in both intervention groups.

Conclusion: Structured allergy evaluation and avoidance advice can improve lung function and the control of asthma in primary care. Further research is needed on the additional benefits of allergy skin testing.

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Introduction

Patient education in the self-management of asthma is widely recommended.^{1,2} It is essential in building a partnership between patient and health care professionals, to increase patients' subjective and objective control of their chronic condition.³ Education programs in self-manage-

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ment have been shown to improve functional status in asthma and reduce health care utilization.⁴ Programs usually include multiple teaching elements and methods. It is now increasingly reflected that there is a need to evaluate less complex interventions in non-academic health care settings,⁵ but little research is available on the effectiveness of limited interventions. Offering patients a limited choice of intervention elements will lead to a greater flexibility by allowing to tailor interventions for the individual patient. Recent interview surveys have confirmed the need for a more individualized approach to asthma management.^{6,7}

Allergic mechanisms are now generally accepted as an important pathophysiological feature of asthma.⁸ However, in general practice a systematic approach to diagnosis and management of allergies in asthma is often missing. Comprehensive material is available to guide health care professionals,^{2,9} but the actual allergy assessment and avoidance education to patients has remained largely unstructured. Patients may be provided with information material, but the abundance of information can discourage the initiation of adequate steps for prevention.¹⁰ Measures necessary for the avoidance or control of allergens are then usually carried out in an unsystematic fashion. Ideally, critical areas and suggestions for control measures should be negotiated between the health care professional and the patient and should be included in the regular treatment plan.

The skin prick test is a commonly used procedure in secondary care for assessing a specific sensitization in allergic respiratory diseases. Up to 85% of asthma patients show positive reactions to skin tests for common aeroallergens.¹¹ Research has demonstrated the reliability and predictive validity of allergy skin testing.^{12–15} Skin testing for IgE sensitivity to common allergens provides objective information thus allowing a firmer diagnosis of possible allergies. However, this is only achieved in combination with careful subjective history taking. Failure to use this combined approach could result in deficiencies in diagnosis and asthma management.^{16–18} Tschopp et al.¹⁵ recently concluded that the skin prick test should be used as a primary tool by clinicians to assess respiratory allergic diseases, as the test is comparably economical and provides immediate educational information for patient and physician. Allergy skin testing can play an important role in reducing the amount of specific avoidance advice that nurses in general practice give to patients.¹⁹

The present pilot study was designed to determine whether a structured allergen interview for

diagnosis and avoidance advice with or without additional skin prick testing has the potential to improve lung function, symptom experience, medication usage, and perceived illness control of asthma patients.

Materials and methods

Study design

The study was carried out in a repeated measurement design with data collection at baseline and a follow-up visit during a 10-month period from November to August. The average interval between first and second appointment was approximately 89 days, with SAC 87 days, SAA 92 days, SPT 87 days. Patients were randomly assigned to three groups: (i) Standard asthma care including medication advice, inhaler technique training, spirometry, and reversibility testing (SAC), (ii) additional structured allergy assessment and advice (SAA), and (iii) additional allergy assessment and advice and skin prick testing (SPT). A specialist asthma/allergy nurse who was not blind to the patients' group allocation undertook treatments and outcome measurements. Due to the pilot character of the study, a blinded outcome assessors was not feasible.

Patients

Random samples of 290 patients from a list of 1200 adult asthma patients registered in the practice database were invited for a study on asthma and allergy. Potential participants were selected from the age range between 15 and 55 years to reduce the risk of recruiting patients with chronic obstructive pulmonary disease (COPD). Seventy-one patients responded, three were not eligible (two men had COPD, one woman had prior experience with skin testing) and eight women were randomly excluded to reach a final sample of 60 patients, which was then stratified into equal proportions of women and men and randomized into three groups ($n = 20$). Seven patients dropped out at follow-up, and one woman excluded earlier was recruited in anticipation of dropout. Further recruitment was not possible due to logistic reasons, so that a total of 54 patients were included in the final analysis. Patients had previously been treated for asthma at the health centre by one of the general practitioners, but had not been seen by the nurse practitioner in the asthma clinic. None of them had received education in the stepwise treatment

approach,¹ or in allergen avoidance measures. Participation was voluntary, and it was made clear to patients that their decision whether to take part or not would not affect their regular treatment. Informed consent was obtained from all patients. The University Hospital Lewisham ethical review committee approved the study.

Interventions

Patients were scheduled for individual 1–1½-h appointments at an asthma clinic in a primary care health centre. Short- and long-acting bronchodilators were discontinued prior to test sessions. All patients underwent a full assessment of their asthma on standard audit cards and a reversibility test with spirometry. During reversibility testing, skills at using the metered dose inhaler were checked and re-education on technique and use of reliever and preventer inhalers was given. Actual spirometry readings were shown to the patient and compared with the normal estimated range of readings in an effort to improve the patients' understanding of the procedure and to increase treatment adherence. Information on reliever medication use, inhaler technique skills, prescribed medication, current smoking, and current restrictions at daytime and nighttime, and on activity, was then entered in standard clinical audit cards (Allen & Hanbury, Glaxo, UK). Advice was then given for a stepwise approach to treatment^{1,20,21} and a personal self-management plan was agreed with the patient. Patients then filled in a set of questionnaires in a separate room. This included demographics and asthma-related information (illness history, history of health care utilization, medication use, and limitations on daily activities), a questionnaire on asthma symptom frequency and bother,²² the Perceived Control of Asthma Questionnaire,²³ and the Illness Perception Questionnaire²⁴ adapted for asthma, with subscales for illness consequences and illness time-line (degree of perceived chronicity of asthma).

Both intervention groups SAA and SPT were additionally administered the asthma trigger inventory (ATI²⁵) and the structured allergy inventory (SAI). The ATI is a checklist of perceived asthma trigger factors, including allergic, meteorological, exercise, irritant, and emotional triggers. Scores for trigger impact and control were obtained by averaging the ratings for the (up to) six triggers reported as the patient's main triggers. The SAI is a combined structured interview and self-administered questionnaire inventory on allergen history and avoidance behaviors. It explores history, type,

frequency, duration, and perennial patterns of allergic symptoms, trigger factors, and previous treatments. Features of the home environment which are potentially linked to allergens and non-specific triggers (moulds, dust mite, pollen, pets, smoking, indoor climate) are also explored.²⁶ Patients are then asked to fill in a checklist of allergen avoidance behaviors (house dust mite, pets, pollens, indoors and outdoors mildew, non-specific trigger factors) indicating which of these measures they were familiar with (from standard material provided by the British Allergy Foundation, Welling, UK, and the UCB Institute of Allergy, Watford, UK). For each problem area the portion of the measures checked by the patient to measures listed was calculated.

The SPT group then received skin prick tests, and test results were discussed with the patients in the light of their perceptions of triggers reported in the SAI and ATI. Depending on the identified problem trigger areas (assessed by self-report in SAA, or by self-report and skin test in SPT) and reported current avoidance skills, the practicality of individual avoidance behaviors in the patient's environment was discussed. Discussion of these and other issues in trigger avoidance was not provided for SAC patients.

Patients returned for a follow-up visit 3–6 months later, for asthma assessment on audit cards, spirometry testing, inhaler technique reassessment, and questionnaires on symptoms and illness perceptions. All patients filled in the ATI at this stage. Patients of SAC and SAA were now offered skin prick tests with reinforced allergen advice to positive results and SAC patients were offered additional allergen avoidance advice.

Lung function testing

Lung function (PEF, FEV₁) was measured using a MicroLab 3500 spirometer (Micro Medical Ltd, Rochester, UK). Following the initial spirometric assessment, patients took a dose of 400 µg of their regular beta-agonist inhaler (salbutamol, or terbutaline in on case), and spirometry was repeated after 20 min.

Skin testing

Skin prick tests (ALK UK Soluprick) using seven common aeroallergens were administered: six mix grass pollen (205,214,218,223,225,228), three mix tree pollen (106,108,113), house dust mite (*Dermatophagoides Pteronyssinus*), cat dander, dog dander, indoor fungus (*Aspergillus Fumigatus*), out-

door fungus (*Cladosporium Herbarum*). Histamine and saline solutions were also administered as positive and negative control for comparison. Tests were performed on the volar aspect of the forearm more than 5 cm above distal skin crease at the wrist. The test site was observed at 15 min after the test for the presence of wheal and erythema formation. A wheal size ≥ 3 mm was regarded as being positive.²⁷ All 54 patients had a positive reaction to the histamine control, and none had a reaction to the saline control. Antihistamines were discontinued 48 h prior to the test.

Analysis

Equivalence of groups in dependent variables at baseline was initially tested by one-way ANOVA with multiple *T*-test comparison, or by non-parametric Kruskal–Wallis test, Mann–Whitney *U*-test or χ^2 test where appropriate. Main outcome measures were analyzed by two-way repeated measure analysis of variance (ANOVA) with group (SAC, SAA, SPT) and time (baseline, follow-up) as variables. Changes in reliever use were calculated within each group by Wilcoxon rank-sum test. It was expected that clinical control of asthma (symptoms, lung function, and perceived control) would improve specifically in SAA and even further in SPT. A significance level of $P < 0.05$ was set for all tests. Effect sizes were calculated to allow calculation of sample sizes necessary for future large-scale evaluations.^{28,29}

Results

Baseline assessment

The three patient groups were largely equivalent in demographic and asthma-related variables (Table 1), as well as the ATI subscales (follow-up scores used for SAC group). A large percentage of patients were treated according to Step 2 or 3 of the BTS guidelines.¹ No significant group differences were found for knowledge on avoidance measures (Table 2). Knowledge was low for irritants (SAA: 26.2%, SPT: 23.7%) and other non-specific triggers factors (SAA: 14.5%, SPT: 7.9%). SAA and SPT were roughly equivalent in perception of their major triggers. One or more allergens were perceived by 63.2% of SAA and 81.3% of SPT (63.2% of SAC at follow-up) patients as major triggers, and one or more non-specific triggers by 94.7 of SAA and 93.8% of SPT (94.7 of SAC at follow-up). Only one patient in SPT perceived 'mould' as a major trigger factor. Across SAA and SPT, reported major triggers (house dust, animals, pollen) were not related to respective knowledge of avoidance measures. For SPT, there was a strong discrepancy between the number of patients who reported the respective allergen as their main trigger, and number of patients who actually tested positive for the allergen. There were no group differences for baseline values of outcome measures (Table 3).

Table 1 Demographics, asthma-related variables and lung function at baseline.

	SAC (n = 19)	SAA (n = 16)	SPT (n = 19)
Sex, women, % of group	47.4%	43.8%	52.6%
Ethnic origin, White European, % of group	84.2%	87.5%	68.4%
Education, A-levels & degree, % of group	10.5%	31.3%	26.3%
Smoking, current non-smoker, % of group	63.2%	93.8%	68.4%
Family history of asthma, positive, % of group	84.2%	68.8%	63.2%
BTS treatment step, % of group			
Step 1	15.8%	6.3%	21.1%
Step 2	31.6%	50.0%	57.9%
Step 3	42.1%	37.5%	15.8%
Step 4	10.5%	6.3%	5.3%
Age, years (SD)	40.3 (11.9)	38.3 (8.6)	31.8 (11.9)
Age at asthma onset, years (SD)	23.1 (15.8)	16.9 (15.9)	18.9 (11.5)
Asthma-related GP visits, previous year (range)	1.7 (0–8)	1.9 (0–6)	1.3 (0–5)
E&A visits, lifetime (range)	2.1 (0–15)	3.6 (0–30)	1.5 (0–10)
Days of oral steroids, previous year (range)	1.3 (0–14)	2.1 (0–14)	1.2 (0–7)
Limitation on physical activity, rating 0–3 (SD)	1.3 (0.9)	1.6 (0.8)	1.3 (0.5)
FEV ₁ % predicted (SD)	88.8 (16.1)	87.9 (15.1)	87.7 (21.6)
FEV ₁ (% predicted) post-bronchodilator (SD)	94.7 (16.8)	97.2 (15.6)	96.3 (21.1)
Bronchodilator: Δ FEV ₁ > 200 ml, % of group	47.4%	56.3%	52.6%

Table 2 Knowledge on trigger avoidance, perceived triggers, and skin test results at baseline.

	Group	Dust mite	Pets	Pollen	Indoor fungus	Outdoor fungus
Avoidance measure knowledge, % of measures recognized	SAA	28.5	10.2	13.5	13.4	12.5
	SPT	30.5	23.7	29.5	25.6	26.2
Perceived major trigger % of group	SAA	43.8	37.5	50.0		0.0
	SPT	42.1	15.8	36.8		5.3 ^a
Skin prick test, positive, % of group	SPT	73.7	73.7 ^b	84.2 ^c	42.1	63.2
Test positive & perceived major trigger, % of group	SPT	36.8	15.8	36.8	5.3 ^a	5.3 ^a

^aOnly one patient reported 'mould' as major trigger.^bTested positive for cat and/or dog dander.^cTested positive for grass and/or tree pollen.

Intervention effects

At follow-up, one patient in SAA and two patients in SPT had stopped preventer intake. BTS treatment steps remained relatively stable for SAC patients compared to the other groups: only two (10.5%) patients in SAC had reduced their medication one step, whereas four (25.0%) patients in SAA and three (15.8%) patients in SPT had reduced medication one step, and one (5.3%) patient in SPT had stepped down three steps. These changes were almost outbalanced by one (6.7%) patient in SAA and four (21.1%) patients in SPT stepping up one step. Reliever use dropped from a weekly to a monthly use in all groups. No A&E attendance occurred between baseline and follow-up.

In both intervention groups, perceived frequency of animal-allergic triggers was increased at follow up (time effect: $F(1,33) = 7.56$, $P = 0.010$), whereas frequency of pollen-allergic triggers remained stable. Trigger control increased in SAA only (Table 3). Perceived control of asthma increased, and bothering about symptoms decreased in all three groups, as did restrictions by symptoms at daytime, nighttime, and on activity, time effects $F(1,51) = 9.30$, 16.25 , and 17.07 , all $P_s < 0.001$, respectively. Spirometric lung function was improved at follow-up, mainly due to improvements in SAA and SPT as shown by the group by time interaction for FEV₁. Effect sizes of SAA and SPT interventions were moderate for FEV₁ and small for symptoms and perceived control of asthma.

Discussion

This study has demonstrated that a structured allergy and asthma education intervention in a primary care asthma clinic improves patients' asthma control and illness perception. Specific effects of the interventions were observed in measures of spirometry, most clearly in FEV₁. Both intervention groups, SAA and SPT, showed comparable improvements in lung function at follow-up, and the SAA group also showed improvements in perceived asthma trigger control. This is encouraging, particularly since the intervention constituted only a single nurse-practitioner consultation session with assessments and advice. Clinical practice often requires several repeated appointments with doctors or nurses to stabilize or improve patients.

Additional non-specific improvements in all groups are not surprising as all patients had only received traditional asthma care (without sufficient

Table 3 Means, difference scores, and effect sizes for selected outcome measures.

	Group	Baseline Mean (SD)	Follow-up Mean (SD)	Difference scores Mean (95%CI)	ANOVA effect	Effect size <i>d</i> vs. SAC
ATI trigger impact	SAC ^a		2.2 (1.0)			
	SAA	2.2 (1.0)	2.3 (0.8)	0.04 (−0.35–0.43)		N/A ^a
	SPT	2.1 (0.9)	2.1 (0.9)	0.04 (−0.25–0.33)		N/A ^a
ATI trigger control	SAC ^a		1.7 (0.9)			
	SAA	1.4 (0.98)	2.0 (1.0)	0.64 (0.18–1.10)	$G \times T^*$	N/A ^a
	SPT	1.8 (0.97)	1.7 (1.0)	−0.06 (−0.52–0.41)		N/A ^a
Reliever use	SAC	1.6 (1.1)	1.0 (1.2)	−0.6 (−1.2–0.0)		
	SAA	1.5 (0.9)	0.9 (0.3)	−0.6 (−1.2–0.1)	T^{*b}	0.00
	SPT	1.5 (1.0)	0.7 (1.9)	−0.7 (−1.4–0.1)		0.08
Symptom frequency	SAC	12.6 (7.7)	11.4 (7.8)	−1.2 (−4.6–2.3)		
	SAA	11.4 (8.2)	10.2 (5.6)	−1.2 (−5.6–3.2)		−0.03
	SPT	11.2 (6.3)	9.1 (7.7)	−2.2 (−4.9–0.6)		0.20
Symptoms 'bother'	SAC	0.9 (0.5)	0.7 (0.5)	−0.2 (−0.4–0.1)		
	SAA	1.2 (0.5)	1.0 (0.7)	−0.2 (−0.4–0.1)	T^{**}	0.10
	SPT	1.0 (0.5)	0.7 (0.5)	−0.3 (−0.5–0.1)		0.36
Perceived control	SAC	40.4 (5.4)	40.5 (4.3)	0.1 (−2.0–2.1)		
	SAA	38.4 (5.5)	40.0 (5.6)	1.7 (−0.8–3.9)	T^*	0.28
	SPT	40.1 (5.2)	42.8 (4.9)	2.7 (0.4–4.9)		0.44
FEV ₁	SAC	2.84 (0.72)	2.83 (0.77)	−0.01 (−0.12–0.10)		
	SAA	2.84 (0.79)	3.06 (0.77)	0.22 (0.10–0.35)	$T^{***}; G \times T^*$	0.63
	SPT	2.89 (0.78)	3.18 (0.86)	0.28 (0.07–0.49)		0.64
PEF	SAC	403.1 (117.4)	404.9 (113.1)	1.8 (−13.2–16.8)		
	SAA	423.6 (128.0)	462.3 (125.5)	38.7 (2.4–75.0)	T^{**}	0.46
	SPT	428.4 (133.3)	454.9 (124.6)	26.5 (−1.4–54.5)		0.38

^{*} $P < 0.05$, ^{**} $P < 0.01$, ^{***} $P < 0.001$; T , time effect, $G \times T$, group by time interaction.
^aNot applicable, as for SAC measurements were only taken at follow-up.
^bIndividual Wilcoxon–Rank–Sum test for each groups.

training in inhaler technique and the stepwise approach) from general practitioners prior to the study. Thus, the SAC control group received a minimal intervention in our study. In addition, measurements of spirometry and critical discussion of the results would have served to motivate self-management behaviors. Although non-specific effects could also be due to factors such as habituation, placebo- or expectancy effects, or the Hawthorne effect, improvements in control groups have also been observed in other asthma self-management trials^{5,30,31} and have been attributed to better asthma care.³²

Both intervention groups reported a higher frequency of animal-allergic triggers on the ATI at follow-up, suggesting that the interventions had increased their awareness of these triggers in particular. Interestingly, SPT did not profit in terms

of perceived trigger control. One could speculate whether confrontation of the SPT group with previously unperceived trigger factors by objective skin testing actually affected their feeling of control over trigger factors. However, as both groups showed stable ratings of perceived trigger impact, as well as comparable improvements in symptoms, perceived control of asthma, and lung function, it is likely that the SPT intervention failed to affect this aspect of trigger perception selectively.

It is conceivable that longer monitoring periods across 1 year would reveal a greater impact of SPT testing on patients' perceived trigger control. The impact of avoidance measures (such as removal of a pet from the household) on allergen levels may need 12 months to materialize.³³ Also, a reduction in preventative medication might only show

considerable changes during longer monitoring periods. Seasonal variations in pollen triggers could have lead to a reduced immediate trigger experience of some patients throughout the assessment period. For a number of patients (37.7% of the sample, no significant difference between groups) the follow-up assessment took place before the peak pollen season between June and August. Thus, although a high percentage of pollen allergies had been detected in the SPT group, a number of patients might not have been confronted with this type of trigger within the observation period.

The level of education in allergen avoidance measures was rather low in our sample. There was also a considerable gap between the perceived major allergic triggers and actual positive skin tests in SPT. This is consistent with earlier studies.^{34,35} Ideally, skin testing could play an educational role by clarifying patients' allergic status and thus enabling them to make an informed choice using the correct avoidance measures.¹⁸ Skin testing can be a valuable aid to nurses to highlight actual allergens to patients. The procedure can fit into their existing work routine and is well accepted by patients.¹⁹ Including the test in primary care could improve the financial burden of prevention measures on patients. Our findings point out the need for a greater emphasis on allergen education in primary care. This could help to reduce asthma morbidity and mortality, and to avoid unnecessary referrals to specialist services, which are limited in number in the UK.³⁶ Introduction of an allergy nurse practitioner service can significantly reduce general practitioner consultations and prescribed medication.³⁷

One potential limitation of this study could be seen in the lack of a blinded outcome assessor. Involvement of an additional researcher was not possible due to limited resources and practice logistics. However, a contribution through assessor biases was probably small if any at all, as questionnaires were filled in by patients in a separate room from the experimenter, and results in outcome measures of lung function did not match the original expectancies of the researchers (of a superiority of the SPT group) closely. Nevertheless, blind assessors should be a mandatory feature of a future large-scale study. Due to the small group size, this small pilot study could also have lacked power for variables such as perceived control of asthma and PEF. Based on the effect sizes it can be calculated that a study of 15 nurses seeing 15 patients each (total of $N = 225$ patients) over the course of 1 year would have sufficient power to achieve significance in these variables at a power of 0.90.²⁹ These numbers compare with larger trials

that have demonstrated significant effects of asthma education interventions (e.g. ^{31,38,39}). In terms of practicalities, health care personnel conducting such a study would need to have additional training in asthma and allergy management including skin prick testing from accredited institutions (such as the National Respiratory Training Center in the UK). The individual primary care practice would have to provide basic facilities for nurse-led asthma clinic⁴⁰ with equipment, spirometer, skin testing kit, and a professional environment.

In conclusion, our preliminary results demonstrate the potential of a structured allergen education in primary care. Even a limited intervention such as evaluation of allergic triggers and avoidance advice can lead not only to improvements in perceived control of triggers but also to actual improvements lung function in patients suffering from asthma. The structured allergy evaluation and advice could be included as one extra 20-min appointment following the initial assessment. Although no additional effects of skin testing were observed, further research is warranted as the sample size was small, the observation period was relatively short, and only a limited number of potentially beneficial aspects of skin testing were evaluated in this pilot study.

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