

ORIGINAL PAPER

Skin test results and self-reported symptom severity in allergic rhinitis: the role of psychological factors

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Clinical and Experimental Allergy

Summary

Background In allergic conditions, the degree of skin test reactivity does not always correlate with the severity of clinical symptoms. Additional factors may contribute to the reported symptom severity.

Objectives To investigate the association between the magnitude of the skin prick test (SPT) response and the reported symptom severity in patients with allergic rhinitis and the possible modifying role of psychological factors.

Methods One hundred four patients with allergic rhinitis and 23 with non-allergic rhinitis, classified according to their SPT response to 19 aeroallergens, were asked to rate the severity of five symptoms and to indicate whether their symptoms intensified on exposure to five common aeroallergens. They also completed a psychological questionnaire.

Results Reported symptom severity of allergic rhinitis did not correlate with weal size for any of the aeroallergens tested or with the number of positive responses on SPT. It was not related to patient age, sex, or education. The reported symptoms severity correlated positively (0.29, $P < 0.01$) with reported symptom intensification on exposure to allergens. Moreover, both outcomes were positively associated with the psychological factors of hypochondriasis (0.20, $P < 0.05$ and 0.18, $P < 0.05$, respectively), and somatic awareness (0.24, $P < 0.05$ and 0.33, $P < 0.01$, respectively), but not with neuroticism.

Conclusions The severity of symptoms experienced by patients with allergic rhinitis is apparently not related to the magnitude of SPT response, but rather to psychological factors of hypochondriasis and somatic awareness. Physicians should be aware of the contribution of psychological factors to patient perceptions of the intensity of symptoms and of the intensification of symptoms on their exposure to allergens.

Keywords aeroallergens, allergic rhinitis, psychological factors, skin prick test, symptoms severity

Submitted 24 January 2006; revised 24 July 2006; accepted 21 August 2006

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Introduction

Skin prick tests (SPT) are used to establish the clinical diagnosis of allergic rhinitis. However, clinical experience and research findings suggest that the objective *in vivo* or *in vitro* results may have no relation to the clinical expression of the allergy [1]. Studies of airway allergies have reported that skin tests do not accurately predict the airway response to an allergen [2, 3]. Only strong skin-test positivity to house dust mite was closely associated with increased nasal reactivity on nasal provocation test [2], and skin test sensitivity to allergens did not accurately

predict airway response to allergens on provocation test [3]. In children, with asthma, an increase in the number and size of the positive skin tests was found to be related to an increasing severity of the disease [4]. Some studies of food allergy suggested a cut-off size (weal diameter) for the SPT above which open oral food challenges were positive [5,6]. However, in an investigation of 1000 patients with a typical allergic reaction, there was no correlation between weal size and graded severity of worst reaction for nuts and peanuts [7].

These findings indicate that additional factors may contribute to the severity of allergy symptoms. We

hypothesized that the patients's psychological make-up may play a role. This is in accordance with the biopsychosocial model of health and illness, which was developed by Engel [8, 9], which emphasizes, among other factors, the psychological aspects of health and illness in terms of cognitions, emotions, and behaviours. Our review of the literature on the subjective perception of symptoms of allergic rhinitis indicated that the relevant psychological factors may be neuroticism, hypochondriasis, and somatic awareness. Neuroticism is the life-long tendency to experience negative emotions and to be highly self-conscious and somatically concerned [10,11]. Individuals with high neuroticism are likely to present an exaggerated symptom profile to their physicians. They tend to report more symptoms, more severe symptoms, and more general affective distress than individuals with low neuroticism [11–13]. Although high-neuroticism individuals may indeed suffer more illnesses [14], it is generally agreed that neuroticism per se leads to a tendency to inflate health complaints [11,12].

Similar trends were uncovered in studies that used more direct measures of somatic awareness or body sensations, such as the Minnesota Multiphasic Personality Inventory (MMPI)-II Hypochondriasis (Hs) scale [15], which measures the number and type of reported somatic complaints. The studies, conducted predominantly in individuals with chronic pain, found that the patient group had elevated MMPI-Hs scores compared with controls [16]. Furthermore, within this patient population, those who scored higher tended to be more concerned with their health, complained more about the suffering, reported higher pain intensity, and were more likely to emit pain behaviours than their counterparts [17,18]. Similar findings were noted with the use of the Modified Somatic Perception Questionnaire (MSPQ), which measures heightened somatic and autonomic awareness [19]. Patients with physical illness tended to have higher scores on the MSPQ than controls [20]. The MSPQ, moreover, could also successfully predict exaggerated pain symptoms and illness behaviour in patients with abdominal disorders [21].

The aim of the present study was twofold: (1) to examine the correlation between weal size on the SPT and the severity of symptoms reported by patients with allergic rhinitis; and (2) to determine whether self-reported severity of symptoms and intensification of symptoms on exposure to allergens are associated with psychological factors of neuroticism, hypochondriasis, and somatic awareness.

Material and methods

Patients

The study sample included 127 consecutive patients referred for evaluation to the allergy clinic for suspected

allergic rhinitis. There were 86 women of mean ($\pm$ SD) age 33.3 ± 12.9 years and 41 men of mean ($\pm$ SD) 31.2 ± 12.1 years. Seventy-eight patients (61%) reported having perennial rhinitis, 76 (61%) seasonal rhinitis, 45 (35%) recurrent conjunctivitis, and 22 (17%) asthma. The patients presented physical findings suggestive of allergic rhinitis. All signed an informed consent form before enrollment in the study; one additional patient refused to participate. The study protocol was approved by the hospital's ethics committee.

Skin prick test

SPT for 19 common aeroallergens (Center Laboratories, Port Washington, NY, USA) were performed as part of the evaluation, with histamine phosphate (histamine base concentration 1 mg/ml) and glycerinated phenol saline as controls. All tests were performed by a standard technique (single-headed lancet; Heinz, Herenz, Germany) and were read by a single experienced nurse who was blinded to the clinical symptoms. The aeroallergens included house dust mite (mix), mixed feathers, cockroach, cat, dog, moulds (*Aspergillus*, *Alternaria* and *Penicillium*), and pollens common to the country (tree pollens – Olive, Cypress, and Pecan; grass pollens – Bermuda, Ryegrass, Orchard, and Timothy; and weeds – Mugwort, Parietaria, Pigweed, and English plantain).

For each allergen, we measured the largest diameter of the weal and the diameter orthogonal to it, and then calculated the mean. A positive reaction was defined as a mean weal diameter of ≥ 3 mm. All the saline controls were negative. Patients were considered allergic, if they had at least one positive SPT to any of the allergens tested.

Symptom questionnaire

We used a symptom questionnaire based on a previously published format [22]. The questionnaire included a list of five symptoms that were generally characteristic of allergic rhinitis or rhinoconjunctivitis: runny nose, sneezing, itchy nose and throat, itchy eyes, and tearing.

Symptom severity. The patients were asked to rate the symptoms by severity on a four-point scale from zero (absent) to three (severe). The reported symptom severity score was calculated as the total rating across the five symptoms and ranged from 0 to 15. Cronbach's α for this measure was 0.74.

Symptom intensification. The patients also rated the degree to which their symptoms intensified when they were exposed to each of five common allergens (house dust, cat, dog, grass pollens, tree pollens), on a four-point scale: 0 – not intensified at all, 1 – intensified to a small extent, 2 – intensified to a moderate extent, and 3 – intensified to

a large extent. The score for each allergen and the total score for the five items were calculated. The ratings of symptoms intensification for a given allergen ranged from 0 to 3, the total rating that ranged from 0 to 15 Cronbach's α for this measure was 0.76.

Other items in the questionnaire included use of medications (present and past), history of past visits to allergy clinics, and self-referrals to complementary medicine practitioners. The symptoms questionnaire was administered to the patients before the performance of the SPT.

Psychological instruments

Neuroticism was assessed with the 23-item *N*-scale of the Eysenck Personality Questionnaire (EPQ) [23], which has a score range of 0 to 23. Cronbach's α for this scale was 0.88.

Hypochondriasis was assessed with the 32-item MMPI-Hs [13]. Raw scores were converted to *T* scores, based on a normative sample of Israeli men and women [24]. Cronbach's α for this scale was 0.80.

Somatic awareness was assessed with the 14-item MSPQ [17], which has a score range of 14–56. Cronbach's α for this scale was 0.86.

Statistical analysis

Associations between continuous variables were analysed with Spearman's correlation coefficients. The significance of differences between means was analysed with Student's *t*-test or one-way ANOVA, followed by Scheffe post hoc comparisons. The significance level was set at < 0.05 .

Results

Skin prick test results and reported symptom severity

Of the 127 patients included in the study, 104 (82%) had a positive SPT for at least one aeroallergen and were considered allergic; the rest were categorized as nonallergic. Eighty-five patients (80%) were positive for house dust mites, 51 (49%) for at least one tree pollen, 48 (46%) for at least one grass pollen, 16 (15%) for at least one weed pollen, 29 (28%) for cat, 16 (15%) for dog, nine (9%) for at least one mould, and 22 (21%) for cockroach.

There was no statistically significant correlation between the reported severity of symptoms and the weal size of the positive aeroallergen reactions ($r = -0.17$ – 0.19 ; $P > 0.05$ for each allergen, separately). This finding also held true when the SPT weal diameter was adjusted to the histamine response (by subtracting the histamine weal from each allergen weal). The reported symptom severity was also not significantly correlated with the number of

aeroallergens that yielded a positive reaction ($r = 0.07$, $P = 0.45$).

Skin prick test results and reported symptom intensification on exposure to allergens

Table 1 presents the mean rating of the reported symptom intensification on exposure to one or more of the allergens listed, according to allergic/non-allergic state and positive/negative SPT result for the allergen. For the grass, tree, and weed pollen categories, a skin test result was considered positive if there was a reaction to at least one grass, tree, or weed pollen, respectively.

This analysis yielded several interesting findings. First, patients with a positive reaction to a specific allergen had a two- to fourfold higher tendency to report an intensification of symptoms on exposure to that allergen than patients with a negative test. Second, allergic patients tended to report mild symptom intensification on exposure to specific allergen, despite a negative SPT. Scores varied by type of allergen, from 0.31 for dog to 1.09 for house dust mites. Third, the same trend was observed for the non-allergic group, with a similar rating as the allergic patients with a negative SPT for the specific allergen. The ratings were particularly high for exposure to house dust, tree pollens, and grass pollens.

Association of patients's clinical status with study variables

The correlational analysis between the patients's clinical status (i.e. non-allergic rhinitis, 0, or allergic rhinitis, 1) and the study variables, presented in Table 2, yielded a positive association (0.19) of the clinical status only with the symptom intensification score. This finding basically replicates the results presented in Table 1. No association was found with other study variables: symptom severity, personality factors, and demographic data. The absence of a significant correlation between clinical status and personality factors was also observed after a further breakdown by sex across the two patient groups ($P = 0.23$ – 0.83). Thus, in view of the apparent lack of differences between the allergic and non-allergic rhinitis patients for nearly all the study variables (as confirmed by individual *t*-tests; data not shown), we combined them into a single study group (see Table 2) to examine the second study hypothesis.

Personality factors and symptom severity/intensification

Not unexpectedly, the reported severity of symptoms correlated positively (0.29) with the reported intensification of symptoms on exposure to allergens. Both these variables also correlated positively with personality factors of hypochondriasis (0.20 and 0.18, respectively), and

Table 1. Ratings for symptom intensification on exposure to allergens and SPT results in patients with allergic and nonallergic rhinitis

	House dust mite		Cat		Dog		Grass pollen		Tree pollen	
Group	Mean rating* $P^{\dagger}$		Mean rating* $P^{\dagger}$		Mean rating* $P^{\dagger}$		Mean rating* $P^{\dagger}$		Mean rating* $P^{\dagger}$	
Allergic patients										
(1) SPT Positive	2.07	(a) < 0.0001	1.21	(a) < 0.0001	1.25	(a) < 0.0001	1.44	(a) 0.0012	1.59	(a) 0.0036
(2) SPT Negative	1.09	(b) 0.71	0.30	(b) 0.79	0.31	(b) 0.95	0.70	(b) 0.61	0.89	(b) 0.82
(3) Nonallergic patients	1.39		0.39		0.30		0.76		0.82	

SPT, skin prick test.

*The rating for specific allergen ranges from 0 to 3.

† Based on Scheffe's test of significance of difference between: (a) group 1 and group 2; (b) group 2 and group 3.

somatic awareness (0.24 and 0.33, respectively). No association was found between reported symptom severity or symptom intensification and neuroticism, age, sex, or education level.

There was no change in the positive correlations between the personality factors and reported symptom severity or symptom intensification even after adjusting for patient clinical status (by computing partial correlation coefficients; data not shown). The positive correlation between personality factors and symptom intensification on exposure to allergens also held true when the subgroup of allergic patients with positive SPT results were analysed separately. These correlations were examined separately for exposure to specific allergens. They were found to be particularly high for exposure to house dust mite (0.32 and 0.31, for hypochondriasis and somatic awareness, respectively), cats (0.22 and 0.38, respectively), grass pollen (0.15 and 0.29, respectively), and tree pollen (0.37 and 0.34, respectively).

Personality factors and illness behaviour

Patients with a long history of consultations with allergy experts (more than 5 years before the current clinic referral), irrespective of age, had a significantly higher mean ($\pm$ SD) scores for somatic awareness (23.51 ± 1.22) than patients with a consultation history of 2–5

years (19.25 ± 1.79) or 1 year (19.6 ± 0.83) ($P = .03$). Patients who had consulted several experts had a higher mean ($\pm$ SD) hypochondriasis score than those who had not (51.1 ± 1.2 vs. 50.4 ± 1.13 , $P = 0.04$). No such trend was observed with respect to complementary medicine.

Discussion

Previous studies have reported that the degree of skin test reactivity does not correlate absolutely with the severity of clinical symptoms for insect sting hypersensitivity [25], food allergy [5–7], nasal reactivity [3], and airway hyperactivity [2]. To the best of our knowledge, the present study is the first to show that the severity of symptoms reported by patients with allergic rhinitis bears no relationship with the size of the reaction to the aeroallergen on SPT. There was also no correlation with the number of allergens that tested positive. An early study that reported an increase in the number of positive SPT reaction with increasing severity of asthma was conducted entirely in children [4]. We are unaware of any study on this tendency in adults. In the total sample of the present study, the reported symptom severity was unrelated to age, sex, or education level. At the same time, the study revealed an association of perceived symptom severity with personality factors of hypochondriasis and somatic awareness, irrespective of the patients's clinical status.

Table 2. Spearman's correlations among the study variables

Variable	1	2	3	4	5	6	7	8	9
1. Clinical status †	–	.13	.19*	.00	–.06	–.00	–.07	–.06	.21*
2. Symptom severity		–	.29**	.14	.20*	.24*	.12	.07	.07
3. Symptom intensification			–	.08	.18*	.33**	–.00	–.05	.09
4. Neuroticism				–	.43**	.58**	–.17	.07	–.12
5. Hypochondriasis					–	.50**	.08	.15	–.11
6. Somatic awareness						–	–.16	.10	–.02
7. Age							–	.05	.18*
8. Sex								–	.03
9. Education									–

† 0, patients with non-allergic rhinitis; 1, patients with allergic rhinitis.

* $P < .05$, ** $P < .01$.

Both these personality factors denote a heightened awareness of somatic symptoms or body sensations, which may lead to an exaggeration in the perceived intensity of symptoms and their distressing and debilitating effects. This finding is consistent with trends reported in the literature for patients with pain and patients with different types of physical illness [17,18, 20]. In this study, perception of symptoms' severity correlated positively with reported symptom intensification on exposure to allergens. Furthermore, perception of symptom intensification on exposure to allergens was also positively associated with the same personality factors, independent of the SPT results. The later association was maintained in the subgroup of allergic patients with positive SPT results. Yet, within the allergic rhinitis group, the rate at which patients reported an intensification of symptoms on exposure to an allergen for which they tested positive was significantly higher than the rate of reportage by patients who tested negative to that allergen. In both groups, the patients reported higher symptom intensification after exposure to house dust, trees, and grasses than to dogs and cats. This finding might be attributable to the non-specific irritants in house dust or to the high public awareness of the allergic potential of house dust and pollen. Our experience has shown that people often believe that house dust, rather than their pet, is responsible for exacerbations of their indoor symptoms.

Given the above findings, it was not surprising that the psychological factors of hypochondriasis and somatic awareness were also related to illness behaviour. Patients with high scores on these scales were found to have a long history of allergic consultations and to have consulted more than one allergist. Thus, in this group of patients, the perception of symptoms as severe, disturbing and rather annoying prompted them to consult relevant experts and to do so persistently.

There was no difference in the findings for any of the personality factors examined between the allergic and non-allergic patients of either sex. Only two previous studies performed a similar comparison [26, 27], and both found that patients with allergies, particularly women, scored significantly higher for hypochondriasis than their counterparts in the non-allergic group. The paucity of studies in this area prevents us from determining whether the latter findings were a chance outcome owing to the small sample size in both studies [26, 27]. Additional investigations are needed to determine whether there is a difference in personality factors between allergic and non-allergic patients.

There are ample studies documenting the impaired quality of life in patients with allergic rhinitis [28] compared with reference groups of non-allergic patients or healthy controls. These differences were all observed at the group level. However, in light of the present findings, it is possible that individual differences in the perceived

impairment of quality of life in the allergic patient group stemmed from differences in the patients's psychological make up. Further studies of the quality-of-life perceptions of allergic patients with high hypochondriasis or somatic awareness, in relation to perceived symptom severity and illness behaviour, are warranted.

The present study has some limitations. We are aware that the evaluation of symptom severity harbours several difficulties. We chose, among several options, to present the symptom severity as the sum of the scale scores across all five symptoms. The same results were obtained when the patient-perceived symptom severity was calculated according to the number of symptoms (out of five) to which the patient assigned a score of three (data are not shown). To ensure compliance, we used a relatively short battery that did not include a measure of depression. Several studies have indicated that combining depression with scales of neuroticism, hypochondriasis, somatic awareness, and somatization increases the clinical ability to predict pain severity, disability, and reportage of general symptoms [29–31]. Thus, adding a questionnaire on depression might have contributed important information.

In summary, the present study shows that the severity of symptoms experienced by patients with allergic rhinitis is not related to the magnitude of the SPT response, but rather to psychological factors. In all patients, both allergic and non-allergic, the perceived severity of symptoms as well as the perceived intensification of symptoms on exposure to allergens was positively associated with the psychological factors of hypochondriasis and somatic awareness. Patients scoring high on these factors also displayed characteristic illness behaviour, manifested by a long history of consulting allergy experts and a tendency to consult more than one allergist. These findings suggest that the reported severity of symptoms cannot be used to validate objective measures of allergy. Furthermore, physicians should be aware of the contribution of psychological factors to the reported intensity of symptoms.

This study has also heuristic value for the treatment of allergic rhinitis, which needs to take both the objective findings and the individual perception of symptom severity into account. Further research into the association between psychological factors and the appropriate treatment is warranted.

Acknowledgement

We wish to thank Mrs Hana Nuehaus of Rabin Medical Center for performing the skin tests.

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