

Original article

Symptoms of persistent allergic rhinitis during a full calendar year in house dust mite-sensitive subjects

Background: Little is known about the natural course of persistent rhinitis symptoms over a prolonged period.

Objective: To describe the frequency and severity of nasal symptoms and quality of life (QoL) in house dust mite-sensitive persistent rhinitic subjects and to determine if medication use was related to symptoms.

Methods: Rhinitics and controls were telephoned fortnightly for 1 year to monitor symptoms. QoL was measured every 3 months.

Results: Thirty-seven rhinitics and 19 controls completed the study. Total nasal symptom scores (TNSS) were 'high' for 65% (95% CI $\pm$ 6%) of the year in rhinitic subjects. When TNSS increased by 1, the likelihood of nasal medication use increased by 25% (95% CI: 7–46%). General and specific QoL were worse in rhinitic subjects than controls ($P < 0.04$ and < 0.0001). Rhinitics with pollen allergy ($n = 21$) had seasonal variation in the frequency of high nasal symptom scores ($P = 0.02$).

Conclusion: Nasal symptom scores were consistently high in rhinitics, and their QoL was worse than controls, even in general QoL. An increase in nasal symptom score increased the likelihood of nasal medication use. These findings help to characterize the course of persistent rhinitis over a previously unstudied period of 1 year.

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Key words: house dust mite; nasal symptoms; persistent rhinitis; pollen; quality of life.

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Accepted for publication 10 September 2003

Allergic rhinitis is characterized by acute nasal and eye symptoms following exposure to environmental allergens. Perennial allergic rhinitis and seasonal allergic rhinitis are now respectively referred to as 'persistent' and 'intermittent' allergic rhinitis (1, 2). The association between exposure to environmental allergens and symptoms is relatively easily established in intermittent allergic rhinitis, where there is a marked contrast in symptom severity in and out of the pollen season. In persistent allergic rhinitis, however, the predominant allergen is house dust mite (HDM), which has little or no seasonal variation. The lack of a distinct contrast between symptomatic and asymptomatic periods makes it difficult to clearly recognize the relation to allergy. Constant symptoms due to

constant exposure to HDM may mean that rhinitic subjects become adapted, or insensitive to their condition, possibly leading to an underrating of symptoms and a lack of recognition of the impact of their symptoms on quality of life (QoL). Indeed, rhinitis with persistent symptoms is significantly less likely to be labelled as rhinitis by general practitioners than rhinitis with intermittent symptoms (3).

In the indoor environment, HDM is frequently encountered, particularly in beds and carpets. It has been suggested that concentrations of HDM allergen above 10 $\mu\text{g/g}$ of dust (4) are likely to be clinically relevant, and may represent a threshold for rhinitic or asthmatic symptoms. It has been shown that subjects with rhinitis are more at risk of developing asthma (5). The mean concentration of Der p 1 allergen in Sydney homes has been measured at 38.9 $\mu\text{g/g}$ (CI: 31.8, 47.5) fine dust (6), and did not change significantly during the year. In an environment of constant high exposure to HDM allergen,

Abbreviations: HDM, house dust mite; FEV_1 , forced expiratory volume in one second; QoL, quality of life; RQLQ, rhinoconjunctivitis quality of life questionnaire; SF-36, short-form 36 questionnaire; TNSS, total nasal symptom score.

we do not know whether rhinitics experience variation in symptom intensity or whether there are any consistent patterns of the symptoms.

As the concentration of HDM allergen in Sydney, Australia, is high compared with other countries, with little seasonal variation (6), we had an opportunity to study a cohort living in an environment with continuously high allergen exposure.

The aim of this study was to measure whether HDM allergic subjects with persistent rhinitis, living in an environment of continual high allergen exposure, experience a significant variability in symptom severity over the prolonged period of 1 year. To do this we compared their nasal symptom scores with the normal range obtained from nonrhinitic control subjects living in the same environment. The second aim was to assess QoL and nasal medication use over the year, and whether the additional allergen load of pollen had an effect on the nasal symptom scores and QoL in a subgroup of persistent rhinitic subjects who were also sensitive to pollen.

Methods

Subjects

We conducted a parallel prospective study of HDM-sensitive subjects with persistent rhinitis and healthy nonallergic controls, where each individual was followed for a full calendar year. Subjects were recruited by advertisements seeking subjects with nasal symptoms who thought they were allergic to HDM. These advertisements were displayed throughout the University of Sydney campus and in local newspapers. Written consent was obtained from all subjects and the study was approved by the Central Sydney Area Health Service Ethics Review Committee.

Inclusion criteria for rhinitic subjects was on the basis of a positive (≥ 4 mm) skin test to the HDMs *Dermatophagoides farinae* or *Dermatophagoides pteronyssinus*, and rhinitis symptoms for most of the year, for at least the previous 2 years. Subjects were not excluded if they had intermittent exacerbations of rhinitis symptoms in addition to their underlying persistent symptoms. Skin prick tests for common aeroallergens were performed at the initial visit. Exclusion criteria were current smoking, rhinitis symptoms only at one time of year, regular chest medication use, nasal polyps, major septal deviation, or any other chronic disease, including asthma. We did not modify treatment in any of the subjects.

Exclusion criteria for the controls were a recent history of rhinitis symptoms, chronic disease, regular medication or current smoking, and a wheal size larger or equal to 4 mm to any of the allergens on the skin prick test panel.

Study design

This was a prospective cohort study in a real life setting. The study protocol did not inflict any modifications in treatment on any of the subjects. Medication management was left entirely up to the subject and their regular health care professionals for the duration of the study. Subjects were screened by a skin prick test, thorough nose and throat examination by a respiratory doctor and symptom history at the initial visit to our laboratory. Every second week for the duration of 1 year, every subject from the control and rhinitic groups was telephoned and asked a standard set of questions about

nasal, throat and chest symptoms and medication use from the previous 1 week.

Quality of life was assessed by both the SF-36 and the rhinoconjunctivitis quality of life questionnaire (RQLQ) at the initial visit and every 3 months for the following 1 year.

Data were collected from the control group to establish the normal range for nasal symptom scores, and these were compared with the rhinitic group. We also compared nasal symptom scores from pollen-sensitive rhinitic subjects to the scores from nonpollen-sensitive rhinitic subjects.

Skin prick test

At the initial visit, a skin prick test was performed by the methods of Pepys (7) to a standard set of aeroallergens, including a positive and negative control, cockroach, house dust, two HDMs – *D. farinae* and *D. pteronyssinus* – cat dander, dog dander, horse hair, feathers, ragweed, plantain, timothy grass, ryegrass, *Aspergillus* and *Alternaria*. Subjects were advised to withhold antihistamines for 48 h prior to the skin prick test. Wheal sizes of ≥ 4 mm were regarded as positive after subtracting the size of the negative control.

Telephone interview/questionnaire

The questionnaire was developed specifically for our study and answers were recorded immediately over the telephone and transferred to a computerized database. The questionnaire was administered over the telephone every 2 weeks for 1 year, except for a 4-week break over the Christmas and New Year period. This resulted in a total of 24 questionnaires for each subject, over a 1-year period.

The rhinitis symptoms of nasal obstruction, itching/sneezing and secretion/runny nose were each scored separately on a severity scale between 0 and 3 (0 = absent, 1 = mild, 2 = moderate and 3 = severe). These three symptom scores were combined to produce total nasal symptom score (TNSS) with a maximum score of 9. This TNSS was used in our analysis. The 'Normal Range' of the TNSS was calculated from the control group, as two standard deviations above the mean score for the control group over the year. 'High' nasal symptom scores were defined as those above the normal range (Fig. 1).

The questions asked by phone that made up the TNSS were as follows:

Rate the following symptom for the last week:

Nasal obstruction. Was it

0 = no symptom;

1 = mild – awareness but not troubled;

2 = moderate – troublesome but not interfering with normal daily activities or sleep;

3 = severe – interfering with normal daily activities or sleep.

The same format of questions was also asked for 'itching or sneezing' and 'secretion (runny nose)'.

Each subject was specifically asked at each telephone interview if they had experienced any health-related problems not related to their allergy, such as a respiratory tract infection within the last 2 weeks. If the subject had experienced a respiratory tract infection within the last 2 weeks, then all the data from that questionnaire was excluded from our analyses.

Questions on medication use related to how many days per week nasal and chest medications had been taken. Nasal medications were categorized as either antihistamines, decongestants (oral or nasal), saline spray, topical steroids, antibiotics, alternative medicine or others. In Australia, nasal topical steroids do not receive any

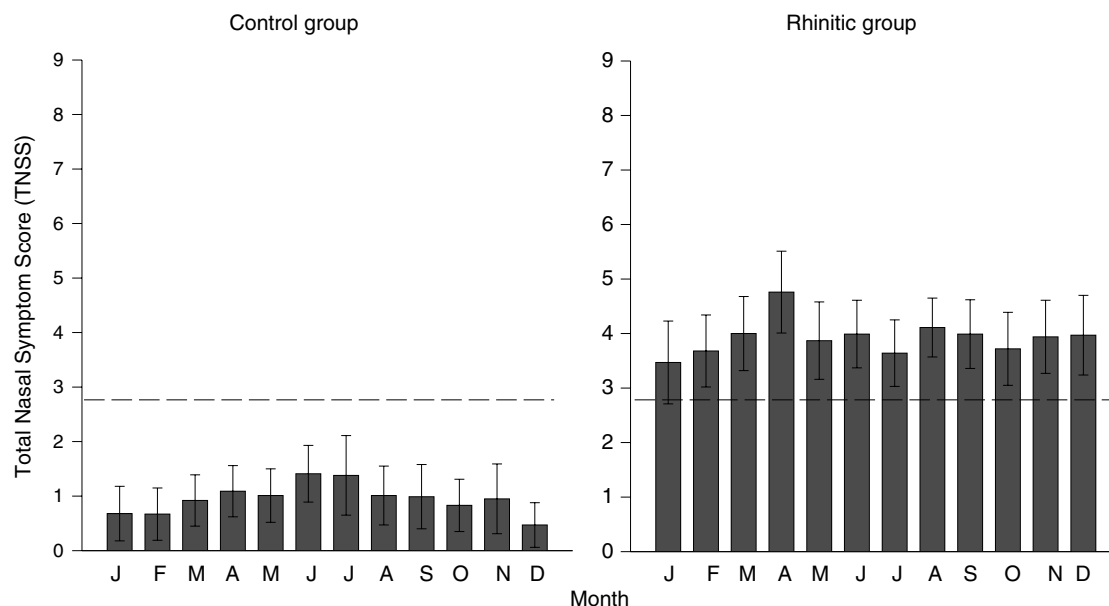


Figure 1. Calculation of the 'normal range' of nasal symptom scores. The dotted line (---) represents the cut-off for the normal range of symptom scores (mean nasal symptom score of control group + 2SD). Scores below the dotted line are in the normal range. Error bars are 95% CI. The maximum possible symptom score is 9.

Government subsidy to reduce the cost of the medication to the patient. The subject's reason for taking nasal medication and their perceived effectiveness of the medication were recorded. Specifically, subjects were asked 'Why did you take your medication?', and they could answer either:

1. To prevent symptoms;
2. A need because of present symptoms;
3. Doctor's orders;
4. A habit;
5. Other reason.

Subjects were then asked 'Is it your opinion that the medication relieved your symptoms?', and they could answer either:

1. Not at all;
2. Yes, but questionable, to some extent;
3. Yes, mostly;
4. Yes, totally.

Subjects were asked to only choose one appropriate answer for each of these questions.

Chest medications were categorized as either inhaled bronchodilators, inhaled glucocorticosteroids, oral bronchodilators, antibiotics, alternative medicine or others.

Both nasal and chest medication use were classified as either regular, intermittent or never. If the subject reported medication use in every questionnaire, they were classified as 'regular' users, if they reported medication use in one or more questionnaires they were 'intermittent' users, and if they never reported medication use they were classified as 'never' users of medication.

QoL questionnaires

Quality of life data were collected at each quarterly visit from two questionnaires. One questionnaire was rhinitis specific (8) and the other was a general health SF-36 (9) questionnaire. The

rhinitis-specific questionnaire (RQLQ) related to symptoms from the previous 1 week and the questions were divided into components including sleep, nasal symptoms, eye symptoms and emotions. The SF-36 was a general health questionnaire related to symptoms from the previous 4 weeks, and included the components of general health, physical functioning, mental health, vitality, social functioning, role-physical, role-emotional and bodily pain.

Pollen counts

In order to confirm the pollen season in Sydney, pollen counts were monitored throughout periods of the study. Pollen count data were obtained from the Department of Clinical Immunology and Allergy and the Westmead Millennium Institute, Westmead Hospital, Sydney. Burkard 7-day volumetric spore traps were used between May and November to capture spore particles at a site in Homebush, a central point in the Sydney region. Details of the pollen count methods used are fully described elsewhere (10).

Statistical analysis

Statistical analysis was performed using Analyse-it for Microsoft Excel (Analyse-it Software Ltd, Leeds, UK), and SAS (SAS Institute, Inc., Cary, NC, USA). Data reported were mean and 95% confidence intervals unless otherwise stated. Normality was tested using the Shapiro-Wilk test. The nonparametric Mann-Whitney test was used to assess the differences between rhinitic subjects and controls in their QoL scores and nasal symptom scores. One-way analysis of variance (ANOVA) was used to determine if there was a seasonal difference in nasal symptom scores. Generalized estimating equations (GEE) were used to examine whether there was a relationship between medication use, defined as a binary variable, and nasal symptom scores, taking into account the serial correlation among repeated measurements

within individual subjects. The seasonal variation in nasal medication use and its association with pollen sensitization were also evaluated by GEE method. Analysis of the data from the SF-36 Quality of Life questionnaire was undertaken using the methods described in the 1993 manual (11).

Results

We recruited 40 HDM-sensitized persistent rhinitic subjects and 23 controls. Three of the rhinitic subjects and four controls withdrew from the study because they moved out of the Sydney region ($n = 3$), moved without leaving a forwarding address ($n = 2$), or chose to withdraw due to lack of time to participate in the study ($n = 2$). A total of 37 rhinitic subjects and 19 controls completed the study. Of these, 18% of telephone interviews in rhinitics and 16% in controls were excluded from analyses because the subjects reported a respiratory tract infection in the last 2 weeks. The proportion of questionnaires completed was 93.8% (95% CI $\pm$ 5.5%) in the control group and 91.2% (95% CI $\pm$ 3.5%) in the rhinitic subjects. All 37 persistent rhinitic subjects were sensitized to either *D. farinae* or *D. pteronyssinus*. Of these, 21 (57%) were also sensitized to one or more of the pollens of ragweed, plantain, timothy grass or ryegrass. The characteristics of the subjects are shown in Table 1. Persistent rhinitic subjects are divided into two groups according to the presence or absence of pollen allergy. The three groups of subjects were similar in baseline data regarding age and percentage of predicted FEV_1 . Skin prick test sensitizations are shown in Table 2.

Nasal symptoms

The mean TNSS over 1 year for the control group was 0.7 (95% CI $\pm$ 0.2, range: 0–3.5) and for the rhinitic subjects was 3.7 (95% CI $\pm$ 0.3, range: 0.5–9, $P < 0.0001$). The limit of the normal range of nasal symptom scores was 2.8, defined as the mean plus 2SD for controls (Fig. 1). Rhinitic subjects reported high nasal symptom scores in 65% (95% CI $\pm$ 6%, range: 5–100%)

of the telephone questionnaires. In rhinitic subjects the frequency of high nasal symptom scores was consistent through the year, with no seasonal variation ($P = 0.15$).

There was no difference in the incidence of upper respiratory tract infections reported between the control and rhinitic groups ($P = 0.66$).

Medication use

Nasal medication was used intermittently by 81.1% of the rhinitic subjects, while 13.5% were regular users and 5.4% never used nasal medications during the year of the study. Of all rhinitic subjects, 68.6% used more than one type of medication for treating their nasal symptoms over the year. Medication use is summarized by category in Table 3. Nasal symptom scores were a significant predictor for nasal medication use, with an odds ratio of 1.25 (95% CI: 1.1–1.5). Adjustment for season had no effect on the odds ratio.

When asked the question 'Why did you take your medication?', the majority of persistent rhinitic subjects answered that it was 'a need because of present symptoms' [mean 75% (95% CI $\pm$ 8%)]. The frequencies of other answers to this question were 19% (95% CI $\pm$ 8%) for 'to prevent symptoms', 4% (95% CI $\pm$ 3%) for 'Doctor's orders' and 2% (95% CI $\pm$ 3%) because of 'a habit'.

When asked the question 'Is it your opinion that the medication relieved your symptoms?', 49% (95% CI $\pm$ 9%) of the persistent rhinitic subjects answered 'Yes, mostly', 30% (95% CI $\pm$ 9%) answered 'Yes, but questionable, to some extent', 10% (95% CI $\pm$ 6%) answered 'Yes, totally', and 10% (95% CI $\pm$ 8%) answered 'Not at all'.

Quality of life

Information collected using the rhinitis-specific (RQLQ) questionnaire showed that persistent rhinitic subjects were significantly more troubled by nose and eye symptoms than controls ($P < 0.0001$ for all nose symptoms

Table 1. Subject characteristics and nasal medication use

	Controls	Rhinitics		P value*
		HDM	HDM + pollen	
Subject characteristics				
<i>n</i>	19	16	21	
Mean age (range)	36.8 (18–60)	33.4 (18–51)	33.9 (18–64)	0.65
Mean percentage of predicted FEV_1 (SD)	104.7 (14.8)	106.2 (12.1)	102.5 (15.6)	0.74
Nasal medications used† (%)				
Never (95% CI)	78.9 (60.6–97.3)	6.3 (0.3–32.3)	4.8 (0.2–25.9)	
Intermittent (95% CI)	21.1 (2.75–39.5)	74.9 (53.7–96.1)	85.7 (62.6–96.2)	
Regular (95% CI)	0	18.8 (0.3–37.9)	9.5 (1.7–31.8)	

* From one-way analysis of variance (anova) between the three groups.

† Included antihistamines, decongestants (oral or nasal), saline spray, topical steroids, antibiotics, alternative medicine or others.

Table 2. Number and percentage of subjects positive to allergens from the skin prick test, and mean wheal size of the allergens in positive subjects

Allergen	n (of 37)	Atopic (%)	Mean wheal size (mm)
Cockroach	2	5.4	4
House dust	4	10.8	4.3
<i>D. farinae</i>	29	78.4	5.6
<i>D. pteronyssinus</i>	36	97.3	6.5
Cat	10	27.0	4.6
Dog	0	0	0
Horse	1	2.7	6.5
Feathers	2	5.4	4
Ragweed	2	5.4	4
Plantain	6	16.2	4.6
Timothy	16	43.2	5.9
Ryegrass	18	48.7	6.5
<i>Aspergillus</i>	3	8.1	4.2
<i>Alternaria</i>	3	8.1	4.2

Table 3. Descriptive of nasal medications used by category

Type of medication	Percentage of subjects who used this medication		
	Never	Intermittently	Regularly
Antihistamines	57.1	85	15
Decongestants (oral, nasal)	54.3	84.2	15.8
Topical steroids	48.6	82.4	17.6
Others*	34.3	75	25
Saline spray	14.3	80	20
Alternative medicine	5.7	50	50
Antibiotics	2.9	100	—

* Others included paracetamol, Intal eye drops, Atrovent nasal, pseudoephedrine, lemsip and antibiotic cream.

and $P \leq 0.002$ for all eye symptoms). Compared with healthy controls, persistent rhinitic subjects were also significantly more troubled by non-nasal, noneye problems such as fatigue, thirst, reduced productivity, tiredness, poor concentration, headache and feeling worn-out (Fig. 2).

There were no significant changes in the RQLQ over the year in either the persistent rhinitic subjects or controls ($P > 0.13$ and > 0.06 , respectively) except in the eye-symptom component in the rhinitics. The eye-symptom component was significantly higher ($P = 0.01$) in persistent rhinitics in spring than in other seasons.

The general health and vitality components of the SF-36 questionnaire were significantly lower in persistent rhinitic subjects than controls in autumn (Fig. 3). Other components that were significantly lower in persistent rhinitic subjects in the other seasons were role-physical and role-emotional. Table 4 shows the mean QoL scores over the year from our study, in addition to the results from other studies.

There were no significant changes in the SF-36 questionnaire during the year in either the persistent rhinitic subjects or controls ($P > 0.16$ and > 0.22 , respectively).

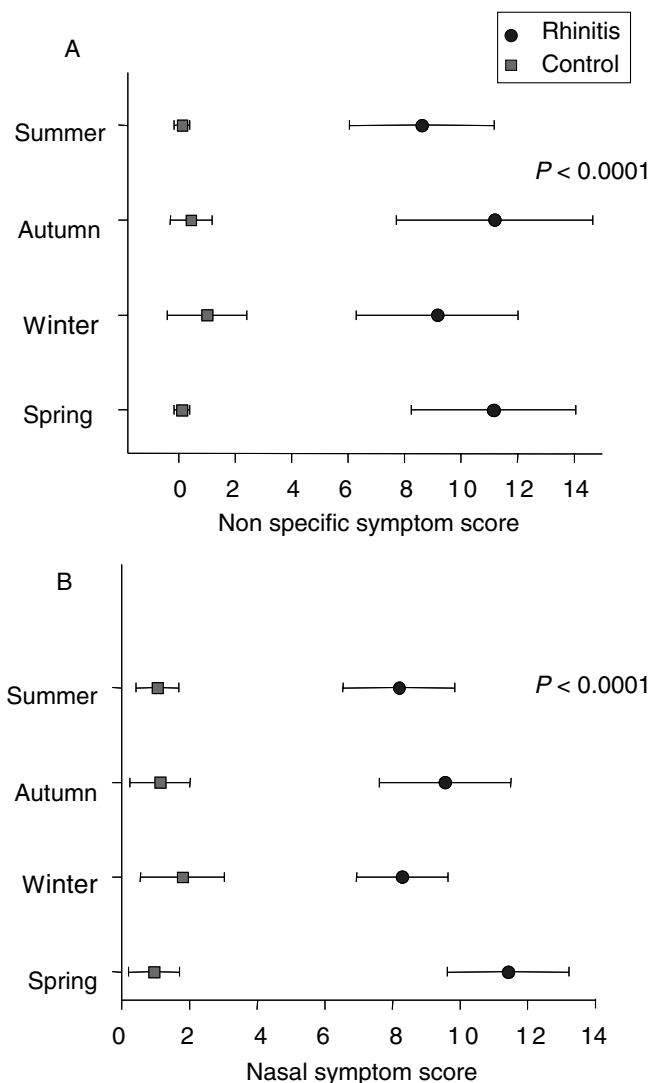


Figure 2. (A) Mean nonspecific QoL components (fatigue, thirst, reduced productivity, tiredness, poor concentration, headache and worn-out) were significantly worse in rhinitic subjects than controls in all seasons. Error bars are 95% CI. (B) Mean specific QoL (nasal symptom scores) were also significantly worse in rhinitic subjects. Error bars are 95% CI.

Pollen counts and the effect of pollen sensitivity

Pollen counts recorded between May and November were averaged over 1998, 1999 and 2000. The peak pollen periods were September and October, with a mean weekly count of 207 grains/m³ and the lowest counts were in May and June, with a mean weekly count of 10 grains/m³.

In subjects sensitized to both HDM and pollen, there was no difference in nasal symptom scores between the defined peak and low pollen periods ($P = 0.10$). The mean symptom score in the peak pollen period was 3.6 (95% CI ± 0.5) and in the low pollen period was 3.0 (95% CI ± 0.5). However, when we used data from the whole year of follow-up to examine the relationship between

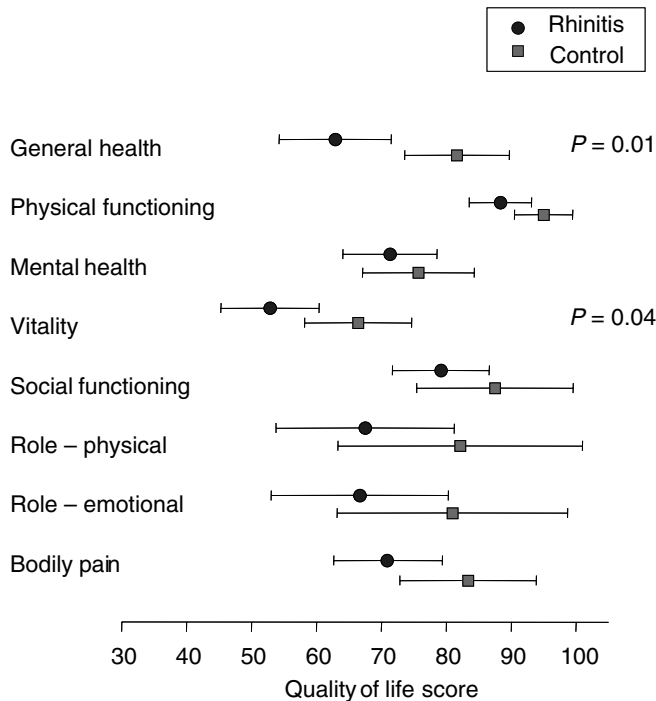


Figure 3. Components of the SF-36 questionnaire in autumn. The QoL components of general health and vitality were significantly lower ($P = 0.01$ and 0.04 , respectively) in rhinitic subjects than controls in autumn. Mean values and error bars (95% CI) are shown. P values are from nonparametric Mann–Whitney tests.

pollen sensitization and season, we found that subjects with both HDM and pollen sensitization had a significant increase in the frequency of abnormally high symptom scores in spring ($P = 0.02$, Fig. 4). The mean TNSS over the year for rhinitic subjects with pollen sensitivity was 3.5 (95% CI ± 0.4) and for rhinitic subjects without pollen sensitivity was 3.9 (95% CI ± 0.4), which was not significantly different ($P = 0.18$).

Quality of life scores were not significantly different between persistent rhinitic subjects sensitized to pollen, and not sensitized to pollen ($P > 0.1$ for all parameters).

There was also no seasonal variation in QoL scores in subjects with or without pollen sensitivity ($P > 0.1$ for all parameters).

Discussion

In this study of the natural course of persistent rhinitis we monitored key elements of persistent rhinitis through a full calendar year. Most knowledge of allergic rhinitis comes from short-term studies of intermittent rhinitis. It is presumed that persistent rhinitis is characterized by constant symptoms throughout the year, but there are no reported data of the intensity and frequency of symptoms, medication use, or QoL for a full year in persistent rhinitic subjects. This longitudinal study design, without an intervention, enabled us to study the natural variation of nasal symptoms in HDM-sensitive subjects with persistent rhinitis and to evaluate the assessments in relation to a control group of healthy subjects living in the same environment. Sydney is an environment in Australia that sustains high HDM populations all year due to consistently high relative humidity. This contrasts markedly from many parts of Europe and the US where there are more pronounced differences in climate between seasons, and therefore more variation in HDM populations (12–15). We found that HDM-allergic subjects with persistent rhinitis, living in an environment where allergen levels are known to be continually high, experience some variation on the individual level, in nasal symptom intensity throughout the year. The clinical relevance of this variation is demonstrated by the fact that an increase in nasal symptom scores predicted the use of nasal medication. Symptom scores were higher and rhinitis-specific QoL was worse than in nonrhinitic controls. Importantly, even the nonspecific measures of QoL, such as reduced productivity and fatigue were also significantly worse in the persistent rhinitic group, evidence that this disease has a wider spectrum of morbidity than once previously thought. Mean nasal symptom scores did not show a

Table 4. Comparison of mean (and SD) SF-36 QoL component scores between studies. Results from our study are mean over the year

Reference	General health	Physical function	Mental health	Vitality	Social function	Role-physical	Role-emotional	Bodily pain
This study								
R ($n = 30$)	65.8 (23.7)	90.3 (13.0)	73.0 (18.0)	56.2 (19.5)	82.0 (21.2)	74.2 (34.9)	72.8 (37.4)	74.1 (21.7)
C ($n = 19$)	80.7 (16.0)	95.1 (9.3)	79.0 (15.7)	67.6 (17.3)	88.1 (19.4)	83.7 (35.2)	85.4 (29.9)	82.1 (20.0)
(19) Leynaert et al. (2000)*								
R ($n = 132$)	72 (19)	88 (13)	61 (17)	60 (18)	85 (19)	83 (29)	71 (34)	77 (25)
C ($n = 370$)	81 (15)	93 (12)	71 (15)	69 (16)	92 (13)	92 (21)	85 (27)	83 (23)
(20) Bousquet et al. (1994)†								
R ($n = 111$)	62.4 (20.6)	88.6 (13.6)	64.8 (20.4)	54.6 (24.4)	73.1 (23.6)	60.6 (37.8)	64.2 (38.8)	76.9 (26.0)
C ($n = 116$)	81.7 (11.9)	95.9 (6.2)	73.4 (16.2)	71.9 (14.7)	91.3 (13.3)	92.0 (17.6)	86.7 (22.9)	90.3 (16.7)

* Subjects in this study had a symptom history of intermittent and persistent rhinitis.

† Subjects in this study were defined as having persistent rhinitis on the basis of a positive RAST to HDM and/or animal dander.

R = rhinitic subjects; C = controls.

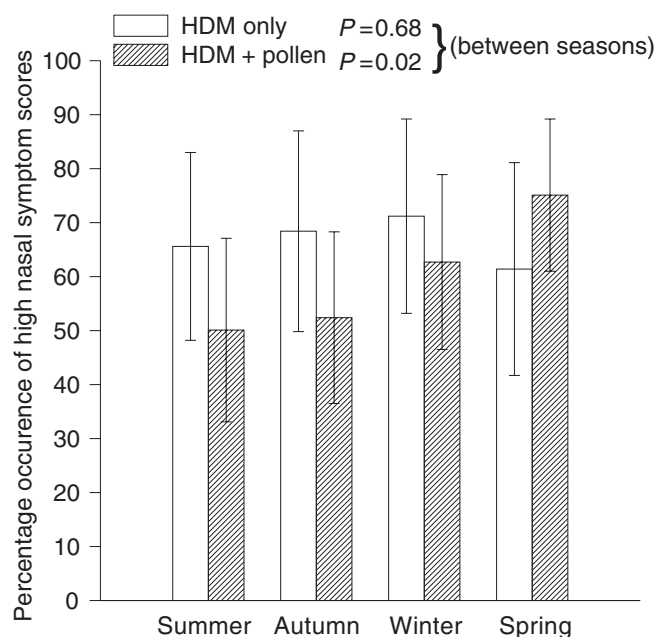


Figure 4. Mean Percentage occurrence of high nasal symptom scores in pollen vs nonpollen sensitive rhinitics with error bars as 95% CI. There was no seasonal variation in the reporting of high nasal symptom scores in HDM subjects not sensitized to pollen ($P = 0.68$), but there was a seasonal variation in those HDM subjects who were sensitized to pollen ($P = 0.02$).

seasonal trend in persistent rhinitic subjects or controls, and persistent rhinitic subjects reported high nasal symptom scores on average for 65% of the time assessed in the study. However, in subjects with both HDM and pollen allergy, the additional allergen load in spring was associated with some effect on nasal symptoms, but had no substantial effect on QoL or medication use.

An important outcome was that we were able to establish normative TNSS for healthy adults. The control group were nonallergic subjects with no previous nasal or respiratory symptoms who were also exposed to allergen in their environment. The size of the control group was relatively small, but we consider the result reliable and values were reasonably consistent. The limit for elevated TNSS, high nasal symptom scores, was defined as scores 2SD above the mean nasal symptom score from the control group. Hence, a mean TNSS of 1 was considered normal, while a score of 3 or more was considered indicative of rhinitis. In practice, this score would mean that one severe symptom, or one moderate and one mild, or three mild symptoms would be the limit for a pathological situation. This seems rational from a clinical perspective.

The second important finding was that HDM-sensitive subjects with persistent rhinitis have symptoms for the majority of the year in a high allergen environment. Mean TNSS values for the group were consistently above the upper limit of the normal range throughout the year. As a group, rhinitic subjects reported high nasal symptom scores for 65% of the time. For individual subjects,

however, this also means that TNSS were within the normal range for approximately one-third of the duration of the study. As the nasal symptom scores were not pathologically high for the whole study period, we were able to assess whether individual rhinitic subjects could detect this natural variation in symptom intensity. Of clinical relevance is the observation that increasing symptom scores increased the likelihood that rhinitic subjects would take nasal medication. It is possible that an increase in symptoms may be underestimated, due to a masking effect through the use of medications. However, the additional allergen load of pollen in the spring was associated with a further increase in the frequency of high TNSS reported in pollen-sensitive subjects.

There were no differences in the incidence of upper respiratory tract infections reported between the control and rhinitic groups. Our findings are supported by a similar study that monitored controls and rhinitics for 11 months (16), and found no differences in the incidence of upper respiratory tract infections between controls and rhinitics.

Most persistent rhinitic subjects tend to take their medications intermittently, despite having persistent symptoms and being constantly exposed to HDM. This suggests that they can tolerate a baseline level of symptoms and only commence treatment when there is an increase in symptom intensity. However, there are no published data to show how much of an increase in symptoms is needed to commence medication use. In this study, an increase in the nasal symptom score by 1 increased the likelihood of a subject taking nasal medication by 25%, implying that an increase in the nasal symptom score by 4 would double the likelihood of that person taking nasal medication. An increase in nasal symptom score can therefore be a useful indicator of how likely persistent rhinitic subjects are to take nasal medications. There are no comparable data among intermittent allergic rhinitics, but it would be useful to know if the stimulus for nasal medication use in intermittent rhinitics is similar. Only 10% of rhinitic subjects thought that their medication totally relieved their symptoms. This may be an indication that there is still much to be learnt about classifying persistent rhinitis symptoms and hence, the most appropriate treatments for them.

Subjects with persistent rhinitis have a significant impairment on certain aspects of their QoL. Interestingly, in our study the RQLQ indicated that persistent rhinitis affects not only specific measures including nose and eye symptoms, but also the nonspecific measures of QoL such as fatigue, poor concentration, headache and reduced productivity. Medications could have interfered with the QoL assessments. Tiredness could be a sign of sedation due to antihistamine intake, or be a direct result of the allergic condition itself (17).

In subjects with both HDM and pollen sensitivity neither QoL nor medication use were significantly different in the spring. In the subgroup analysis, the statistical power was less due to small numbers of subjects.

However, the QoL scores obtained in our study were similar to those obtained in larger studies. In a study including subjects with intermittent or persistent rhinitis or sinusitis (18), there were differences in both the SF-36 and the RQLQ questionnaire between the diseased and control groups. In other studies (19, 20) reductions in the vitality component of SF-36 QoL scores in rhinitics were comparable with those in our study (Table 4). SF-36 scores of healthy controls in these studies are also comparable with our control group.

It is possible that the additional effect of pollen exposure on persistent rhinitis may have been underestimated, or the additional pollen load may not have been a sufficiently strong stimulus. Over the period of our study the mean pollen count in the peak pollen season in Sydney was 207 grains/m³/week. These pollen counts are considerably lower than found in other parts of the world, such as, for example the almost 20-fold higher 546 grains/m³/day of pollen grains reported in Spain (21). Therefore, the effect of pollen sensitivity on HDM-allergic rhinitic subjects might have been different if pollen exposure had been higher. It is also possible that subjects with a chronic HDM-dependent rhinitis already have such a high allergic response that the addition of another allergen would not significantly contribute to their existing symptoms.

The strength of our study was in the longitudinal design and the use of GEE equations to assess within-subject associations or variations, not just absolute differences between groups. When we divided our persistent rhinitis group into those with and without pollen sensitivity, it is likely that we lost some statistical power to detect a difference, due to the smaller numbers.

The pattern of symptoms in persistent allergic rhinitis in Australia is likely to be very different to patterns seen in other parts of the world. In Europe and the US, there are large fluctuations in HDM allergen levels (12–15), in response to the significant climatic changes between the seasons, and more specifically, in response to changes in temperature and humidity. HDM populations are best sustained at a relative humidity of between 55 and 75% and at temperatures between 15 and 35°C. (22). In contrast to Europe and the US, Sydney has a temperate climate, with little seasonal variation in relative humidity, (63–77% throughout the year) (23), helping to sustain HDM populations. The temperature in Sydney is also moderate throughout the year. This study raises questions

about why, in a setting of consistently high HDM exposure, individual subjects experience substantial variation in symptoms and why some highly atopic HDM-sensitive subjects remain completely asymptomatic. Studies elsewhere in the world suggest that HDM allergen levels above 10 µg/g fine dust are likely to be associated with allergic symptoms (4). However, it is not known what level of exposure to HDM is required to result in rhinitic symptoms in Sydney, or whether this differs from other parts of the world.

In summary, we have shown persistent nasal symptoms over a previously unstudied period of 12 months in persistent rhinitic subjects, with pathologically high nasal symptom scores for 65% of the time. The majority of persistent rhinitic subjects used nasal medication intermittently, and increasing nasal symptom scores were a predictor for the use of nasal medications. These findings suggest that, despite continued high allergen exposure, subjects with persistent rhinitis experience some variation in symptom intensity and are able to respond to these changes by taking medication. The impaired QoL experienced in our persistent rhinitic subjects was consistent all year round, not only in the specific, but also more importantly, the nonspecific measures of QoL. The additional impact on frequency of high nasal symptom scores was seen in a subgroup of pollen-sensitive persistent rhinitic subjects during pollen periods. Still, the additional allergen load of pollen had only a marginal impact on the disease in the setting of high exposure to HDMs. Our improved understanding of the longitudinal aspects and the natural course of persistent rhinitis resulting from this study could lead to improved medical care and diagnostic accuracy.

Acknowledgments

We would like to thank Dr Tim O'Meara, Alyson Roberts and Leanne Poulos for their help with fortnightly telephone questionnaires, and Dr Greg King and Dr Conceição Maria da Costa Santos e Fonseca for their help with clinical examination of subjects. Thanks also to Dr Connie Katelaris and Therese Burke from the Department of Clinical Immunology and the Westmead Millennium Institute, Westmead Hospital, Sydney, for their assistance in providing us with information on pollen counts. We acknowledge the support from the Lady Askin Trust Sydney, AstraZeneca Research and Development Sweden, Swiss National Science Foundation and the Novartis-Foundation, Switzerland.

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