

The accuracy of features in the clinical history for predicting atopic sensitization to airborne allergens in children

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Background: The clinical history is given considerable weight when one decides which allergens are responsible for a patient's symptoms, and in research studies the clinical history has been used as the "gold standard" with which different tests for allergy are compared.

Objectives: To determine whether standardized questions accurately predict replies to detailed questions asked by an experienced allergist, and to assess the utility of certain standardized questions for predicting sensitization to individual allergen groups.

Methods: Trained interviewers put standardized questions to parents of 1160 children, aged 1 to 17 years, who had respiratory symptoms and had been newly referred to the allergy clinic of a children's hospital. For the first 151 of the subjects the answers were compared with those elicited by questions asked by a pediatric allergist. Skin prick tests and pollen counts were performed by a technologist.

Results: The standardized questions had an accuracy for predicting the allergist's history of 93% to 97% for all questions except one. The standardized questions with the highest accuracy for predicting the skin test results to the appropriate allergens were the following: for mite, improvement in symptoms when outdoors (66.8%) and when in dry areas (69.4%), and aggravation during house cleaning (65.9%) and when bed making (70.6%); for dog, symptoms when with dogs (80.6%); for cat, symptoms when with cats (77.3%); for tree pollen, symptoms worse in April (70.8%) and when among trees in March and April (80.8%); and for grass pollen, exacerbation in June (69.2%) and during lawn mowing (71.2%). Although specificity was generally above 80%, sensitivity was variable, ranging from 11% to 56%.

Conclusions: The standardized questions accurately predicted a detailed history obtained by an experienced allergist. Because standardized questions are reproducible they are the preferred method of history taking for research projects. Because several of the standardized questions have a high specificity they are useful for excluding sensitization to individual allergen groups, but because they have only a modest sensitivity, they are less helpful for detecting those who are sensitized to individual allergen groups. (*J ALLERGY CLIN IMMUNOL* 1995;96:588-96.)

Key words: Hypersensitivity diagnosis, interviews, clinical history, skin tests, allergens, children

When deciding which allergens affect their patients, most allergists consider that the clinical history provides important information. Clinicians

rely on the allergy history when deciding whether skin tests should be performed and, if so, which tests should be done,¹⁻⁴ how the results should be interpreted,²⁻⁴ and which allergens should be avoided.^{5,6} If immunotherapy is decided on, the history is used as a guide to indicate which allergens should be given.^{2,7,8}

Research workers also attach considerable weight to the allergy history when evaluating new tests for determining sensitization to individual allergens.⁹⁻²⁰ In several such studies the new allergy test has been validated by comparing its results with information obtained by an experienced aller-

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Supported, in part, by a grant from the British Columbia Lung Association.

Received for publication June 6, 1994; revised Dec. 13, 1994; accepted for publication Jan. 31, 1995.

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0091-6749/95 \$5.00 + 0 1/1/63838

gist when taking a careful history.^{9, 15, 17, 19, 21} In these studies, however, the questions put to patients are not defined, making it difficult for others to repeat the study. Even in studies for which the questions are given, they are either mentioned in a general way or summarized and paraphrased.* Only in one study, limited to dog and cat allergy, are the questions given verbatim.¹² No study refers to the validity of the questions asked.

The objective of our study was to determine, first, whether standardized questions elicit a history as accurately as do more detailed questions asked by an experienced allergist and, second, to assess the accuracy of certain standardized questions for predicting sensitization to individual groups of allergens. To do this, we standardized several questions that allergists ask patients.^{3, 9-14, 20, 22-24} A trained interviewer put these questions to a group of patients, and the answers were compared with those obtained by a pediatric allergist. In our assessing the accuracy of the questions for predicting sensitization, the results of skin prick tests were taken as the "gold standard."

We realize that skin prick test results may be positive in some persons with no clinical history of allergy, and negative in some with a positive history, but this applies to all tests for clinical allergy. Skin prick test results agree well with the best of them—with radioallergosorbent tests,^{10, 12, 19, 25, 26} with basophil histamine release,²⁷ and with provocation tests of the conjunctiva,¹⁷ nose,^{10, 28} and bronchi.^{15, 27}

The questions were asked of parents whose children had been newly referred to the Allergy Clinic of our Children's Hospital. We recognized that replies given by parents on behalf of their children might be less accurate than those given by adults about their own symptoms, but we thought it important to establish the accuracy of the questions in a pediatric setting. Questions of proven value could decrease the number of skin tests that need be performed on small children; inhalant allergens are generally thought to play an important role in pediatric asthma; and unwelcome remedies, such as removing pets and giving immunotherapy injections, may sometimes have undesirable effects on children.

SUBJECTS AND METHODS

The study group comprised those children who complained of frequent nose, eye, or chest symptoms and who were seen consecutively by one of us (A. B. M.).

Their ages ranged from 1 to 17 years, and each had been newly referred, because of suspected allergic disease, to the Allergy Clinic of B.C.'s Children's Hospital in Vancouver from August 1986 through June 1991. Of these children, 48% were found to have allergic rhinitis, asthma, allergic bronchitis, or allergic conjunctivitis, with positive skin prick test results to inhalant allergens. The remainder had rhinitis, sinusitis, asthma, bronchitis, or conjunctivitis with negative skin tests results to inhalant allergens, or had recurrent respiratory infection or respiratory symptoms of behavioral or emotional origin. Four children with cystic fibrosis were excluded from the study group. Also excluded were 140 infants and small children, a group comprising those whose parents did not want them to have skin tests and those who had recently received antihistamine medication. Trained interviewers put questions to the accompanying adults, who were, in 97% of cases, the children's parents. The questions used were based on those that allergists have asked of patients for many years.^{3, 10-14, 20, 23, 24} The questions were standardized and are given in the Appendix.

Parents were first asked whether the child's nose was often runny, sneezy, or itchy, or whether the child often snorted, sniffed, or rubbed his or her nose, or often had watery, itchy, red or swollen eyes, or often coughed. Those who claimed that their child had one or more of these symptoms were asked whether the symptoms had persisted for more than 3 weeks at a time. Inquiry was also made about whether the child had wheezed or had asthma in the preceding 12 months. Parents of children with one or more of these symptoms were then asked whether there was any seasonal variation in the symptoms. They were next asked whether the child exhibited any nose, eye, or chest symptoms in different special situations, or whether the symptoms changed in these situations (Appendix). After the questioning by the trained interviewer, the first 151 patients and their parents were seen by an experienced pediatric allergist who asked the same questions and then elaborated on them. The questions were put not only to the parents but also to the child, if 7 years of age or older. When the allergist asked about symptoms that occurred when sweeping, for example, the question was scored positive if it affected the child when the sweeping was done indoors, but not if the child had symptoms only during sweeping done outdoors. Similarly, for the question about contact with dogs, the answer was marked negative if the child had symptoms only when in a house with both cats and dogs but had no symptoms when exposed to dogs alone. On the other hand, the question about dogs would be marked positive if the child owned a dog and had chronic symptoms in his own house and in other houses with dogs, but cleared up when staying in houses with no dogs. If there was disagreement between the parents' and the child's response, the positive response was accepted as the correct one, regardless of whether it came from the parents or the child.

All parents were contacted a month before the ap-

*References 10, 11, 13, 14, 18, 20, and 22.

TABLE I. Accuracy of standardized questions, put to the parent by a trained interviewer, for predicting the answers obtained by an experienced pediatric allergist

Questions	Accuracy (%)
Months when symptoms are worse	94
Worse in bed at night	95
Worse in morning on awakening	96
Better when out-of-doors	95
Better when in dry areas of the country	96
Worse when with dogs	97
Worse when with cats	97
Worse when vacuuming or dusting	93
Worse when blankets are shaken	96
Worse when among trees in March and April	85
Worse when in grass	97

Number of patients interviewed: 151

Accuracy %

$$= \frac{(\text{True positive} + \text{True negative}) \times 100}{(\text{True positive} + \text{True negative} + \text{False positive} + \text{False negative})}$$

pointment and were instructed to stop giving the child any antihistamines that might interfere with the skin tests. (Short-acting antihistamines were permitted until 2 days before the appointment.) Two days before the appointment they were again contacted and told to give no more antihistamine of any sort. They were once more questioned about antihistamine use on arrival at the Allergy Clinic. After all interviews had been completed, skin prick tests were performed independently by a laboratory technician, by a standard method.²⁹ The following test materials were applied to the child's back: a negative saline control solution, a positive histamine control solution, and extracts of 1% *Dermatophagoides pteronyssinus* and *D. farinae* (Bencard Division of Beecham Laboratories, United Kingdom), 1/10 extracts of alder tree pollen (*Albus rubra*), birch tree pollen (*Betula* spp.), cottonwood pollen (*Populus trichocarpa*), mixed Pacific grass pollens (Greer Laboratories, Lenoir, N.C.), and 1/20 acetone precipitated extracts of dog and cat hair and epithelium (Hollister-Stier, Spokane, Wash.). A prick was made through each drop by means of a Greer pen (Greer Laboratories).³⁰ Reactions with a wheal whose smallest diameter measured 2 mm more than that caused by the saline test were recorded as positive.

Pollen and mold spores were collected by means of a Burkhard spore trap, which was placed on the roof of the hospital. It operated continuously from January 2, 1988, through June 30, 1991. The collecting tape was changed

at the end of every week, when the numbers of pollen grains trapped each day were counted. In addition, slides were exposed in a Durham gravity trap and were examined weekly throughout the study period.

Although weed pollens and mold spores, in addition to the above mentioned pollens, were identified on the tape taken from the trap, we did not investigate the association between these allergens and features in the history, for a number of reasons. Mold extracts gave positive skin test reactions in only 6.7% of the children. As well, mold spores were airborne year round in Vancouver and showed great variation from year to year, making a seasonal history of symptom severity less valuable than in places where mold spore counts decrease markedly and predictably during the winter, when snow covers the ground for prolonged periods.¹² Weed pollen was not included in the study because Vancouver has no weed that pollinates as profusely in a short season as does ragweed. Our weed pollen season varies greatly from year to year, and the daily count seldom exceeds 10 grains/m³.

RESULTS

The pollinating months for alder, birch, and cottonwood were February, March, April, and May, with levels reaching a peak of 500, 4000, and 200 grains/m³, respectively, in April. Grass pollens were present in excess of 10 grains/m³ in April, May, June, July, and August, with daily counts exceeding 20 grains/m³ in June.

The questions used in the study had an accuracy for predicting the answers to questions asked by the allergist of between 93% and 97% for all the questions except one. That question had an accuracy of 85% (Table I).

The frequency with which the allergens that were studied gave positive skin tests were as follows: house dust mite (*D. pteronyssinus* or *D. farinae*) 28.6%; cat hair/epithelium, 25.3%; dog hair/epithelium 12.1%; tree pollen (alder or birch or cottonwood pollen) 15.6%; grass pollen 32.0%.

The results of the questions for predicting skin test reactions are organized according to the individual allergen groups. Under the heading of each allergen group are questions about the circumstances in which the child's symptoms are expected to change if he or she is allergic to one or more members of that allergen group (Tables II through V).

Among the questions thought to be relevant to house dust mite sensitization, the lowest accuracy is found in the one inquiring about symptoms when in bed at night: of children who are worse in bed, 30% have a positive mite test result; of those who are not worse in bed, 27% have a positive mite test result (i.e., the test result for mite is positive in only 3% more of those with than without aggravation of symptoms when in bed). The accuracy of this

TABLE II. Positive and negative predictive values of the questions for predicting skin prick test results, where a positive reaction is defined as one with a wheal ≥ 2 mm in diameter

Allergen tested, and expected change in symptom severity	Positive predictive value		Negative predictive value	
	n	%	n	%
Dust mite				
Worse in bed	180/595	30.3	413/565	73.1
Worse in early morning	163/482	33.8	509/678	75.1
Better when out of doors	86/225	38.2	689/935	73.7
Better in dry areas	41/106	38.7	754/1040	72.5
Worse when house cleaned	99/261	37.9	666/899	74.1
Worse when beds made	37/83	44.6	782/1077	70.6
Worse in December	113/361	31.3	580/799	72.6
Dog				
Worse with dogs	71/227	31.3	858/925	80.6
Cat				
Worse with cats	163/297	54.9	720/846	85.1
Tree pollen				
Worse among trees during March or April	44/130	33.8	893/1030	86.7
Worse during April	94/346	27.2	727/814	89.3
Grass pollen				
Worse when lawn mowed	163/290	56.2	663/870	76.2
Worse during June	97/181	53.6	706/979	72.1

$$\text{Positive predictive value \%} = \frac{\text{True positive} \times 100}{(\text{True positive} + \text{False positive})}$$

$$\text{Negative predictive value \%} = \frac{\text{True negative} \times 100}{(\text{True negative} + \text{False negative})}$$

question (i.e., the percentage of replies that correctly predict the presence or absence of sensitization) is 51.1% (Table III). The chance of the question predicting the "correct" answer is therefore no greater than the chance that heads will turn up when one flips a coin. Greater accuracy, 70.6%, was found when parents were asked whether the child's symptoms were worse when the bed was made or when the blankets were shaken out. Although the accuracy of this question is reasonably high, and its specificity is 94.4%, its sensitivity is only 11.1%. The question fails to detect 88.9% of children who are sensitized to house dust mites.

Questions relevant to sensitization to dogs, cats, tree pollens, and grass pollens also have a low sensitivity, though it is generally higher than that for questions relevant to house dust mites. The accuracy of the questions concerning house pets and pollens, too, is greater than those for house dust mites (Table III).

If the criterion for a positive skin test reaction is raised from 2 mm to 5 mm larger than the control

reaction, the accuracy of the questions and their negative predictive value tends to increase, but the positive predictive value decreases, quite markedly so for some questions. Fewer of those with a positive reply to the question have a positive skin test result to the appropriate allergen (Tables II to V).

DISCUSSION

The logic of taking an allergy history rests on the patient noticing two things: that the symptoms are worse in situations in which exposure to the suspected allergen is high and that the symptoms improve when exposure is low. This reasoning seems to have been the basis of the questions that experienced allergists have been asking for many years.^{4, 10-14, 20, 23, 24} Our findings indicate that the expected aggravation or remission may not occur, or may not be noticed. There are several reasons why this may be so.

One possible explanation for failure to notice symptoms when a child is exposed to the appropri-

TABLE III. Sensitivity, specificity, and accuracy of the questions for predicting skin prick test results, where a positive reaction is defined as one with a wheal ≥ 2 mm in diameter

Allergen tested, and expected change in symptom severity	Sensitivity %	Specificity %	Accuracy %
Dust mite			
Worse in bed	54.2	49.9	51.1
Worse in early morning	49.1	61.5	57.9
Better when out of doors	25.9	83.2	66.8
Better in dry areas	12.5	92.1	69.4
Worse when house cleaned	29.8	80.4	65.9
Worse when beds made	11.1	94.4	70.6
Worse in December	34.0	70.0	59.7
Dog			
Worse with dogs	51.4	84.6	80.6
Cat			
Worse with cats	56.4	84.3	77.3
Tree pollen			
Worse among trees in March or April	24.3	91.2	80.8
Worse in April	51.9	74.3	70.8
Grass pollen			
Worse when lawn mowed	44.1	83.9	71.2
Worse in June	26.2	89.4	69.2

$$\text{Sensitivity \%} = \frac{\text{True positive} \times 100}{(\text{True positive} + \text{False negative})}$$

$$\text{Specificity \%} = \frac{\text{True negative} \times 100}{(\text{True negative} + \text{False positive})}$$

$$\text{Accuracy \%} = \frac{(\text{True positive} + \text{True negative}) \times 100}{(\text{True positive} + \text{True negative} + \text{False positive} + \text{False negative})}$$

ate allergen is that the degree of sensitization may be insufficient to give rise to overt symptoms. To explore this possibility further, we reanalyzed our data, redefining a positive test result as one whose smallest diameter was 5 mm, rather than 2 mm, greater than that of the negative control test. Because a large skin test reaction indicates a greater degree of sensitization to the allergen in question,^{7, 31, 32} more noticeable symptoms may be anticipated in a person with a large skin test reaction. Although this new definition did improve both the sensitivity and the accuracy of most questions, neither was increased by more than 10% in any single instance, and the positive predictive value was decreased for all questions. This decrease was quite marked in some.

Other possible reasons why worsening of symptoms may not be noticed include the age of the patient and the duration of symptoms. Parents might become aware of patterns in the fluctuation

of symptom severity only after the child has been clinically allergic for several years. Further, studies performed on adult patients report a stronger association between a "careful history" and positive skin prick tests results than we find between standardized questions and skin test results in children.^{10, 13, 18, 22} To explore these possibilities, we studied the subgroup of children who were aged 7 years or over. To our surprise, we found that the accuracy of the questions was no better in this older group. Therefore all results reported are on the total population, aged from 1 to 17 years.

In some instances it seems that although symptoms are aggravated by exposure to the offending allergen, the aggravation is not noticed. One reason for this failure to appreciate increased severity of symptoms is multiple sensitization. An example is the apparent lack of seasonal variation of symptoms in children who are sensitized to house dust mites. Children who have a positive skin test result

TABLE IV. Positive and negative predictive values of the questions for predicting skin prick test results, where a positive reaction is defined as one with a wheal ≥ 5 mm in diameter

Allergen tested, and expected change in symptom severity	Positive predictive value		Negative predictive value	
	n	%	n	%
Dust mite				
Worse in bed	116/595	19.5	463/565	81.9
Worse in early morning	112/482	23.2	572/678	84.4
Better when out of doors	65/225	28.9	782/935	83.6
Better in dry areas	25/106	23.6	850/1040	81.7
Worse when house cleaned	73/261	28.0	754/899	83.9
Worse when beds made	26/83	31.3	885/1077	82.2
Worse in December	75/361	20.8	656/799	82.1
Dog				
Worse with dogs	19/227	8.4	909/925	98.3
Cat				
Worse with cats	63/297	21.2	806/846	95.3
Tree pollen				
Worse among trees in March and April	31/130	23.8	961/1030	93.3
Worse in April	57/346	16.3	771/814	94.7
Grass pollen				
Worse when lawn mowed	128/290	44.1	742/870	85.3
Worse in June	79/181	43.6	802/979	81.9

$$\text{Positive predictive value \%} = \frac{\text{True positive} \times 100}{(\text{True positive} + \text{False positive})}$$

$$\text{Negative predictive value \%} = \frac{\text{True negative} \times 100}{(\text{True negative} + \text{False negative})}$$

only to mites are known to often experience aggravation of symptoms in December,¹¹ a month when the concentration of mite allergen levels in the house is high.³³ In the present study, also, those with a positive skin prick test result to mite alone noticed worsened symptoms in December, when compared with remainder of the children (46.7% vs 29.8%), but such children with a single positive skin test result to mite were in the minority. The majority of mite-sensitized subjects had a positive test to other allergens as well, and these children reported a December exacerbation no more frequently than did those with a negative skin test result to mite (Table III). The additional allergen to which children with mite sensitization most often had a positive skin test was grass pollen (55%). In that children with this double sensitization may be expected to have symptoms in both summer and winter, their failure to report a seasonal difference is understandable.

Incorrect identification of the source of the child's symptoms also seemed to be a cause of inaccuracy. This happened even when the cause

was fairly obvious, as in the case of pets. Although many children who were sensitized to cats became sensitized to dogs as well, 62% were not. Yet in this group who were sensitized only to cats, the parents of 29% believed that the symptoms became worse when the child was near dogs. Therefore it seems likely that parents of some cat-sensitive children who notice symptoms when the children are in houses where there are both dogs and cats mistakenly believe that the children are allergic to both species.

Another factor causing decreased accuracy of questions appeared to be the occurrence of several different allergenic groups in the same location. To investigate this possibility we calculated the associations between all the individual questions and all the separate allergenic groups. These additional tables revealed that some questions predicted sensitization to several other allergens besides the allergen for which they have been traditionally used. For example, a positive reply to the question about aggravation of symptoms while vacuuming and dusting predicted sensitization to house pets

TABLE V. Sensitivity, specificity, and accuracy of the questions for predicting skin prick test results, where a positive reaction is defined as one with a wheal ≥ 5 mm in diameter

Allergen tested, and expected change in symptom severity	Sensitivity %	Specificity %	Accuracy %
Dust mite			
Worse in bed	53.2	49.2	49.9
Worse in early morning	51.4	60.7	59.0
Better when out of doors	29.8	83.0	73.0
Better in dry areas	11.6	91.3	76.3
Worse when house cleaned	33.5	80.0	71.3
Worse when beds made	11.9	93.9	78.5
Worse in December	34.4	69.6	63.0
Dogs			
Worse with dogs	54.3	81.4	80.6
Cats			
Worse with cats	61.2	77.5	76.0
Tree pollen			
Worse among trees in March or April	31.0	90.7	85.5
Worse in April	57.0	72.7	71.4
Grass pollen			
Worse when lawn mowed	50.0	82.1	75.0
Worse in June	30.9	88.7	75.9

$$\text{Sensitivity \%} = \frac{\text{True positive} \times 100}{(\text{True positive} + \text{False negative})}$$

$$\text{Specificity \%} = \frac{\text{True negative} \times 100}{(\text{True negative} + \text{False positive})}$$

$$\text{Accuracy \%} = \frac{(\text{True positive} + \text{True negative}) \times 100}{(\text{True positive} + \text{True negative} + \text{False positive} + \text{False negative})}$$

and pollens almost as often as it did to mites. There was an affirmative reply in 37.9% of those with a positive skin test results to mites, and there was also an affirmative reply in many with a negative skin test result to mites; in 32.4% if they were cat-positive, in 32.4% if dog-positive, and in 28.2% if grass-pollen positive. Presumably the latter groups have symptoms because animal danders and pollens, as well as mites, are often found in house dust and become airborne during house cleaning.^{33, 34} Similarly, tree pollens, like grass pollens, settle on lawns, and both become airborne and may cause symptoms when the lawn is mowed.^{13, 35} Lawn mowing aggravated symptoms in 32.3% of our subjects who were sensitized to tree pollen but not grass pollen, and in 37.7% of those who were sensitized to grass pollen but not tree pollen. That symptoms during lawn mowing were largely caused by sensitization to one or other of these allergens rather than by other factors, however, was suggested by the considerably lower percentage that experienced symptoms if they had

negative skin test results to both tree and grass pollens: the percentage reporting symptoms was 14.8% if they had positive skin tests results only to mite, cat, or dog, and 15.6% if all the above mentioned skin tests results were negative.

Although our questions were of limited value for predicting sensitization to any particular allergen, they were of more help for excluding sensitization. The negative predictive values for the best questions to identify sensitization to the different allergens varied from 89.3 in those who were no worse in April and had negative test results to tree pollens to 72.5% in children whose symptoms were no better in dry areas and who had negative skin prick test results to mites.

In our present study population, in which approximately half have at least one positive skin test result, the overall utility of each question is well indicated by the percentage of occasions on which it evokes a correct response (i.e., by its accuracy). This would not be the case, however, if the study were repeated on the general population, where

the percentage with positive skin test results would be lower, and the percentages for specificity, negative predictive value, and accuracy accordingly inflated.

In conclusion, many of the questions have a high specificity and are therefore helpful for identifying those who will have a negative skin test result. Children are unlikely to be sensitized to mites if they are no better when outdoors or in dry areas, or are no worse when the house is cleaned or when the beds are made. Similarly, those who are no worse near dogs and cats are usually not sensitized to dogs and cats, respectively. As well, those who are no worse when among trees in March or April are usually not sensitized to tree pollen, and those who are no worse in June, or are no worse when the lawn is mowed, are unlikely to be sensitized to grass pollen. In contrast, most of the questions have a low sensitivity; the question was not very helpful for detecting those who had a positive skin test result to any particular allergen. Although questions about dogs and cats are moderately helpful for identifying sensitization to dogs and cats, respectively, and the question as to symptoms being worse in April is equally useful for detecting sensitization to tree pollen, these questions identify little more than half of those who are sensitized to the appropriate allergen. The possible reasons for the modest degree of accuracy of the questions include multiple sensitization in many patients, the occurrence of several different allergens together in the house dust and on the lawn, and incorrect identification of the cause of the symptoms by the patient or parent. Finally, in view of the low sensitivity of all the questions we asked, and the low specificity of some of them, those who plan to use the clinical history as the gold standard when evaluating a test for allergy should first establish the sensitivity and specificity of the questions they choose to ask, and report the questions verbatim, so that others can use their best questions in similar studies. This has not been done to date.

We thank Mr. Ronnie Sizto for computer programming, Mrs. Radana Vaughan and Mrs. Carol Curtis for interviewing the parents, Mrs. Huguette Brown for performing the skin tests and pollen counts, and Mrs. Rita Bayda for stenographic help.

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APPENDIX

A. After it was ascertained that the child's nose was often plugged, runny, sneezy, or itchy, or that the child often snorted, sniffed, or rubbed his or her nose, or that the child often had watery, itchy, red, or swollen eyes, or often coughed or wheezed or had asthma,

the following questions were asked, naming the child's symptoms in each question:

1. *If the child often had nose symptoms:* "In which months are his/her (nose symptoms) worse?" If there was uncertainty, the parents were asked about each month individually, that is, "Are the (nose symptoms) worse in January? February? March?"
2. *If the child often had eye symptoms:* "In which months are his/her (eye symptoms) worse?" If there was uncertainty, the parents were asked about each month individually.
3. *If the child often had a cough:* "In which months is his/her cough worse?" If there was uncertainty, the parents were asked about each month individually.
4. *If the child had wheezing or asthma:* "In which months are his/her wheezing/asthma worse?" If there was uncertainty, the parents were asked about each month individually.

B. Parents of children with symptoms were asked about change of symptoms in the following situations:

1. "Are his/her nose or eyes or chest worse in bed at night?"
2. "Are his/her nose or eyes or chest worse on awakening in the morning?"
3. "Are his/her nose or eyes or chest better when he/she is outside than when he/she is in the house?"
4. "Are his/her nose, eyes, or chest better when in dry areas, such as the Okanagan or Southern California?"
5. "Are his/her nose, eyes, or chest worse when near cats?"
6. "Are his/her nose, eyes, or chest worse when near dogs?"
7. "Are his/her nose, eyes, or chest worse when someone is vacuuming, sweeping, or dusting?"
8. "Are his/her nose, eyes, or chest worse when beds are made or when blankets are shaken out?"
9. "Are his/her nose, eyes, or chest worse when someone mows the lawn or when he/she plays in long grass?"
10. "Are his/her nose, eyes, or chest worse when he/she plays among trees or in the park in March or April?"