

Specific IgE-dependent Sensitization, Atopy, and Bronchial Hyperresponsiveness in Apprentices Starting Exposure to Protein-derived Agents

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Atopy, specific IgE sensitization, and bronchial hyperresponsiveness (BHR) were examined in a cohort of 769 apprentices starting career programs in animal health or veterinary medicine (Group 1), pastry making (Group 2), and dental hygiene (Group 3). The hypothesis were that: (1) a proportion of subjects can be "sensitized" although no significant specific occupational exposure has occurred; and (2) there is a relationship between baseline specific sensitization to work-related antigens and host characteristics. Skin tests were administered using 11 common inhalants and specific allergens, including six laboratory animal extracts, three cereal antigens, α -amylase, and latex. Methacholine challenge tests were performed. The prevalence of atopy was 54.4% in Group 1, 58.1% in Group 2, and 52.5% in Group 3. Skin reactivity to work-specific proteins was as follows: laboratory animal proteins, 13.8% in Group 1, 14.0% in Group 2, and 15.6% in Group 3. No subject was sensitized to α -amylase, whereas 1.2% in Group 1, 5% in Group 2, and 4.1% in Group 3 were sensitized to flour. Five subjects reacted to latex. BHR ($PC_{20} \leq 8$ mg/ml) was present in 17.6%, 21.2%, and 14.8% of subjects in Groups 1, 2, and 3, respectively. Specific sensitization was associated with positive skin reactions to common allergens, work-related symptoms, and BHR. These results suggest that students starting career programs with exposure to high-molecular-weight allergens have a low but substantial frequency of specific sensitization to work-related allergens that is related to atopy and BHR. **Gautrin D, Infante-Rivard C, Dao T-V, Magnan-Larose M, Desjardins D, Malo J-L. Specific IgE-dependent sensitization, atopy, and bronchial hyperresponsiveness in apprentices starting exposure to protein-derived agents.**

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For the purpose of studying the natural history of occupational asthma (OA), workers can be evaluated when they enter a high-risk workplace and then monitored for the development of sensitization and incidence of disease. In addition, follow-up can take place after they are removed from exposure (Figure 1) (1, 2). If the occupational exposure is to a high-molecular-weight (HMW) agent whose mechanism of sensitization is IgE-dependent, OA becomes a satisfactory model with which to assess the natural history of common asthma.

Recent longitudinal epidemiologic studies of workers exposed to HMW agents were initiated in workforces with some cumulated exposure (3-5). In order to identify the relative role of personal and environmental factors in the develop-

ment of IgE-dependent sensitization, we initiated a prospective study among newly enrolled students starting exposure to HMW agents (animal-derived proteins for laboratory animal technicians and veterinarians, flour for pastry makers, and latex for dental hygienists). In the present work, we describe the baseline prevalence of reported atopy and asthma; atopic status; level of airway caliber and bronchial responsiveness to methacholine; specific IgE-mediated sensitization to the relevant occupational agents; and presence of work-related skin, eye/nose, or respiratory symptoms in these three groups. We more specifically wanted to: (1) verify that some individuals can be sensitized before starting exposure to specific occupational allergens, which may represent background sensitization and suggest cross-reactivity to common and occupational allergens; and (2) examine the relationship between baseline specific sensitization and host characteristics including atopic status, BHR, and work-related symptoms.

METHODS

Study Design

A cohort of students entering study programs in which there is a potential risk of sensitization to HMW agents was identified. As a first assessment, all participants answered a questionnaire, had allergy skin tests, and underwent spirometry and assessment of bronchial responsiveness to methacholine. The participants gave written consent to

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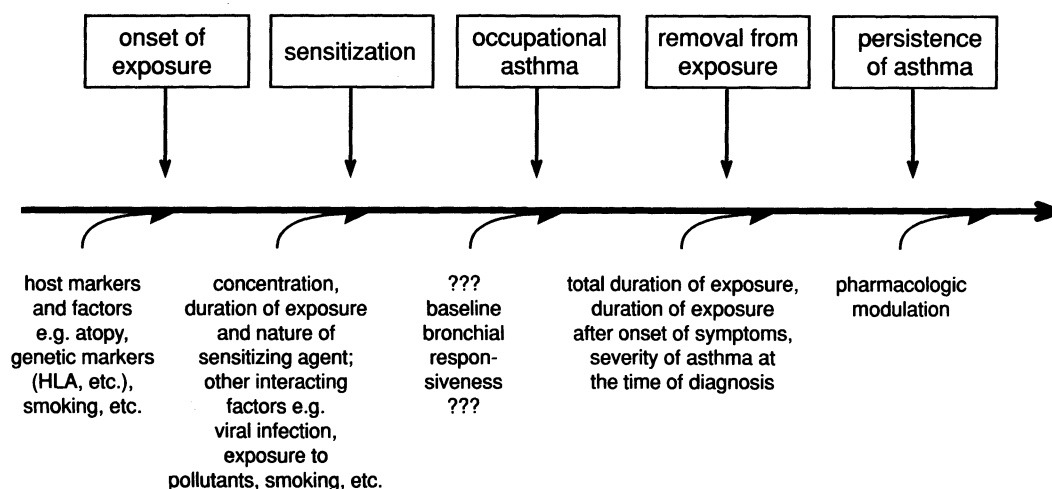


Figure 1. Natural history of asthma and occupational asthma. Schematic illustrates the chronologic steps (squares) in the behavior of asthma and occupational asthma before and after removal from the causal agent. Possible contributory and modulatory factors at each step listed under the line. Modified by permission from reference 24.

this participation. The protocol was accepted by the ethics committee of Sacré-Coeur Hospital.

Subjects

Teaching institutions offering a career program in animal health technology, pastry making, or dental hygiene technology in Québec, as well as the only school of veterinary medicine in Québec, were the sampling unit, if located within 300 miles from Montréal. The program in animal health technology is offered in five colleges, and the four eligible ones were selected. Thirteen high schools offer a program in pastry making; from nine eligible schools, the two with the largest number of full-time students in pastry making ($n = 40$ and $n = 30$, respectively), were chosen, and from among the remaining schools five were randomly selected, each with about 12 to 22 students. From the six (of seven) eligible colleges offering a program in dental hygiene, the two colleges located in Montréal were selected. In these institutions, the number of potentially registered students in animal health technology or veterinary medicine, pastry making, and dental hygiene technology totaled 224, 207, and 104 per year, respectively. This represented 87%, 69%, and 38%, respectively, of Québec first-year students in each of these programs in September 1991. The 14 targeted institutions agreed to collaborate.

The recruitment took place between September 1993 and December 1995. All students starting a career program in the selected institutions were invited to an information session presented by two of us (J.L.M. and D.G.). They were given an information letter and asked to participate. The only exclusion criterion was a history of cumulative exposure to the specific allergen(s) for 3 mo or more (> 420 h) before entering the program.

Study Measures

Questionnaire. A questionnaire derived from the standardized questionnaire of the International Union against Tuberculosis and Lung Disease (IUATLD) was administered by a trained nurse (6). Information was obtained on physician-diagnosed asthma, personal allergic conditions (childhood eczema, urticaria, hay fever, asthma) and familial asthma. A history suggestive of asthma was defined as at least two positive answers to questions about wheezing, chest tightness, shortness of breath, or cough under usual conditions or under such conditions as exercise, exposure to cold air, strong odors, smoke, and dusts. Nasal, eye, respiratory, and skin symptoms during exposure to the specific agent(s) present at work or study were also assessed, as were smoking habits.

Skin testing. Skin tests were done with the prick method (7) using 11 common inhalants: mixed trees, mixed grass and ragweed pollens; *Alternaria*, *Aspergillus*, and *Hormodendrum*; feathers; *Dermatophagoides farinae* and *pteronyssinus*; and cat and dog hair dander (Omega, Montréal, Canada). Histamine phosphate (1/200 mg/ml) was used as a positive control and diluent (glycerine, 50%) as a negative control. The largest wheal diameter was assessed 10 to 15 min after introduction of the antigen. A positive reaction was defined as a wheal ≥ 3 mm in the absence of reaction to the diluent and in the presence of a positive reaction to histamine phosphate. Atopy was defined as at least one positive reaction to the common inhalants. A skin-test index was calculated as the mean wheal diameter (≥ 3 mm) obtained with all common inhalants.

In addition, skin-prick tests were performed with extracts from aeroallergens potentially present in the working areas of students registered in the three career programs. These consisted of urinary proteins from rat, mouse, and rabbit (Pharmacia Allergon AB, Angelholm, Sweden), and hamster, guinea pig, and rabbit dander (Omega) in laboratories frequented by students in animal health technology or in veterinary medicine; mixed flours, wheat, and bran flour as well as α -amylase (Omega) in pastry-making workshops; and latex (Omega and Stallergènes, Institut Pasteur, Paris, France) from gloves used by students in dental hygiene technology. Skin-prick tests with these specific allergens were administered to all participants whatever their career program (except α -amylase, which was administered to pastry makers only).

Spirometry and nonspecific bronchial responsiveness. Spirometry with the assessment of FEV₁ and FVC was done with a Collins Survey/1 Plus apparatus (Collins, Braintree, MA) according to published standards (8). Methacholine inhalation tests were performed according to a standardized procedure (9), using a Wright nebulizer (output = 0.14 ml/min) at V_T breathing for 2 min. The maximum concentration of methacholine used was 32 mg/ml. The provocative concentration causing a 20% decrease in FEV₁ (PC₂₀) was interpolated from individual dose-response curves drawn on a semilogarithmic scale. A baseline FEV₁ of less than 2 L, or pregnancy, were contraindications to the methacholine test.

Reference values for FEV₁ and FEV₁/FVC were taken from Knudson and coworkers (10). Significant bronchial hyperresponsiveness (BHR) was set at 8 mg/ml (9) and 16 mg/ml, respectively, for these two measures (11).

Statistical Analysis

Chi-square analysis was used to test the association between group membership and the prevalence of atopy, specific sensitization to work-

TABLE 1

BASELINE ANTHROPOMETRIC, DEMOGRAPHIC AND SMOKING HABITS CHARACTERISTICS ACCORDING TO CAREER PROGRAM

		I Animal Health (n = 417)	II Pastry Making (n = 230)	III Dental Hygiene (n = 122)	All (n = 769)
Sex, M/F	n	57/360	56/174	2/120	115/654
	%	13.7/86.3	24.4/75.6	1.6/98.4	15.0/85.0
Age					
	Mean, yr	19.6	27.8	21.3	22.3
	± SD	± 3.2	± 10.0	± 5.2	± 7.3
Smoking status					
Current smokers	n	54	26	12	102
	%	12.9	15.7	9.8	13.3
Ex-smokers	n	30	34	8	72
	%	7.2	14.8	6.6	9.4
Nonsmokers	n	333	160	102	595
	%	79.8	69.5	83.6	77.3

related allergens, symptoms of asthma, and nonspecific bronchial responsiveness. Prevalence rates are presented with 95% confidence intervals (CI) for finite populations, with 81%, 73%, 71%, and 77% of the subjects sampled, respectively in animal health, pastry making, dental hygiene, and overall. Between subject comparisons of parameters of immunologic sensitization to common allergens (atopy, number of positive skin tests, skin-test index [mm], positive skin reaction to cat and/or dog dander, and positive skin reaction to grass pollen) with skin reaction to specific allergens and the other test substances, were made with Student's *t* test or chi-square analysis. The analysis was done separately for the animal health group and the pastry-making group. The associations between specific immunologic sensitization and work-related symptoms or BHR were studied through chi-square analysis. Analyses were done with the SPSS statistical software package (SPSS, Inc., Chicago, IL). All statistical tests were two-sided, a *p* value of 0.05 or less was considered statistically significant.

RESULTS

From the 1058 students invited to participate, 57 were excluded for previous exposure to the specific allergen(s) investigated in the study and 232 declined to take part. A total of 769 subjects, representing 77% of those eligible, were included in the study. The participation rate among students in animal health technology or veterinary medicine, pastry making, and dental hygiene was 81.3%, 73.1%, and 70.5%, respectively. As shown in Table 1, the study population included 417 subjects (54%) in the animal health program or veterinary medicine, 230 (30%) in pastry making, and 122 (16%) in dental hygiene. Most participants were nonsmoking (77.3%), the majority were females (85%), and 51.2% were less than 20 yr of age. The vast majority of participants were white (94.8%), whereas 2.5% were black and 2.7% Asian. As shown in Table 2, more than 50% of the participants in each program were atopic, and there was no significant difference in the frequency of atopy between the three groups. Approximately one-third (36.3%) of the participants were sensitized to pollens and the same proportion to mites. More bakers were sensitized to pollens (41.9%) than were apprentices in the animal health program (32.9%). Table 3 shows approximately 7% and 14% of apprentices, respectively, were sensitized to at least one laboratory animal urinary protein and one of the animal derived allergens used for skin-prick testing except cat and dog hair dander. The proportions were similar for all groups. The proportion of students sensitized to flour was equivalent in the pastry making and dental hygiene groups (4 to 5%), but this was significantly higher than that of the animal health group. No apprentice in pastry making had a positive reaction to α -amylase. Only five students altogether showed skin reactivity to latex, but they did not report any symptoms with regard to sensitization to at least one allergen specific to the program, a higher proportion of students in the animal health technology program (13.8%) were sensitized than were students in the pastry making (5.0%) or dental hygiene programs (0.8%).

TABLE 2

SKIN-TEST RESULTS FOR COMMON INHALANTS ACCORDING TO CAREER PROGRAM

	I Animal Health (n = 414)	II Pastry Making (n = 222)	III Dental Hygiene (n = 122)	All (n = 758)*
Atopy, n [†]	225	129	64	418
%	54.4	58.1	52.5	55.2
95% CI [‡]	(49.5–58.4)	(50.9–62.3)	(44.6–60.0)	(51.9–58.1)
Pollens, n [§]	136	93	46	275
%	32.9	41.9	37.7	36.3
95% CI	(27.9–36.3)	(37.7–49.2)	(30.4–45.4)	(33.0–39.1)
Molds, n	53	39	20	112
%	12.8	17.6	16.4	14.8
95% CI	(9.3–15.2)	(12.6–21.4)	(11.3–22.9)	(12.8–17.4)
Mites, n	151	80	44	275
%	36.5	36.0	36.1	36.3
95% CI	(31.8–40.4)	(31.2–42.4)	(28.7–43.6)	(33.0–39.1)
Feathers, n	20	11	6	37
%	4.8	5.0	4.9	4.9
95% CI	(3.1–7.1)	(2.8–8.1)	(2.0–9.1)	(3.7–6.4)
Dog and/or cat hair dander, n	74	49	26	149
%	17.9	22.1	21.3	19.7
95% CI	(14.7–21.7)	(18.7–28.6)	(15.3–28.1)	(17.6–22.6)

* n = 758 (11 apprentices refused skin-prick testing).

[†] At least one immediate reaction to a battery of 12 common inhalants.

[‡] 95% confidence limits.

[§] At least one immediate reaction to mixed trees, mixed grass or ragweed.

^{||} At least one immediate reaction to *Alternaria*, *Aspergillus*, or *Hormodendrum*.

[¶] At least one immediate reaction to *Dermatophagoides farinae* or *D. pteronyssinus*.

TABLE 3
SKIN TEST RESULTS TO SPECIFIC OCCUPATIONAL ALLERGENS ACCORDING TO CAREER PROGRAM

	I Animal Health (n = 414)	II Pastry Making (n = 222)	III Dental Hygiene (n = 122)	All (n = 758)*
Urinary proteins, n [†]	28	15	9	52
%	6.8	6.8	7.4	6.9
95% CI [‡]	(4.8–9.4)	(4.1–10.1)	(4.1–12.8)	(5.5–8.8)
Animal-derived allergens, n§	57	31	19	107
%	13.8	14.0	15.6	14.1
95% CI	(11.8–17.4)	(10.3–18.5)	(10.8–22.3)	(11.9–16.3)
Flour, n	5	11	5	21
%	1.2	5.0	4.1	2.8 [¶]
95% CI	(0.4–2.9)	(2.8–8.1)	(1.7–8.3)	(1.9–4.0)
Latex, n	3	1	1	5
%	0.7	0.5	0.8	0.7
95% CI	(0.4–2.6)	(0.08–2.4)	(0.01–3.2)	(0.3–1.4)
At least one allergen specific to the program, n	57	11	1	69
%	13.8	5.0	0.8	9.1**
95% CI	(11.8–17.4)	(2.8–8.1)	(0.01–3.2)	(8.2–12.0)

Definition of abbreviation: N/A = non-applicable: test not performed.

* n = 758 (11 apprentices refused skin-prick testing).

[†] At least one immediate reaction to mouse, rat, or rabbit urine.

[‡] 95% confidence limits.

[§] At least one immediate reaction to mouse, rat, or rabbit urine or to hamster, guinea pig, or rabbit dander.

^{||} At least one immediate reaction to mixed flours, wheat, or bran flour.

[¶] p < 0.05 in chi-square analysis.

** p < 0.001 in chi-square analysis.

Whereas approximately 10% of all subjects had a physician-based diagnosis of asthma, twice as many had symptoms compatible with asthma, more so among apprentices in pastry making than among students from either of the other groups (Table 4). Work-related symptoms of rhinitis or conjunctivitis (i.e., those occurring upon exposure to specific allergen(s) in the laboratory or the clinic after students started in their apprenticeship) were reported by 41 students, with a greater proportion reported among students starting in the animal health technol-

ogy program; work-related chest symptoms were present in a minority of subjects (13, or 1.7%) (data not shown).

Table 5 indicates that the mean FEV₁ percent predicted value was lower for the apprentices in pastry making, and that a larger proportion of apprentices in that group had an FEV₁ below 80% predicted. FEV₁/FVC values were, however, similar for all groups. The spirometry values are reported for a descriptive purpose, and no statistical testing was done to compare the groups. Nearly 20% of all subjects had a PC₂₀ ≤ 8 mg/

TABLE 4
SYMPTOMATOLOGY ACCORDING TO CAREER PROGRAM

	I Animal Health (n = 417)	II Pastry Making (n = 230)	III Dental Hygiene (n = 122)	All (n = 769)
Asthma, n*	41	30	11	82
%	9.8	13.0	9.0	10.7
95% CI [†]	(7.3–12.8)	(9.4–17.4)	(5.0–14.2)	(9.1–13.1)
Personal atopic history, n [‡]	91	61	34	186
%	21.8	26.5	27.9	24.2
95% CI	(18.5–26.0)	(21.8–32.1)	(21.1–35.0)	(21.4–26.8)
Symptoms of asthma, n§	76	68	19	163
%	18.2	29.6	15.6	21.2 [¶]
95% CI	(14.7–21.7)	(24.9–35.5)	(10.8–22.3)	(18.5–23.7)
Work-related rhinitis or conjunctivitis, n	33	5	3	41
%	7.9	2.2	2.5	5.3 [¶]
95% CI	(5.8–10.7)	(0.7–4.3)	(0.6–5.9)	(3.7–6.5)
At least one work-related symptom, n**	49	11	8	68
%	11.8	4.8	6.6	8.8
95% CI	(9.3–15.2)	(2.8–8.1)	(3.3–11.3)	(7.3–11.0)

* The question was: "Did a doctor ever tell you you had asthma?"

[†] 95% confidence limits.

[‡] Present in the case of a history of eczema, urticaria, or hayfever.

[§] Present if there were at least two relevant symptoms (wheezing, chest tightness, cough, and dyspnea).

[¶] Consisted of at least two symptoms of rhinitis or conjunctivitis at work.

^{||} p < 0.05 in chi-square analysis overall.

** Consisted of at least two work-related symptoms of at least one of the following: asthma, skin symptoms, rhinitis, or conjunctivitis.

TABLE 5
SPIROMETRY AND BRONCHIAL RESPONSIVENESS TO METHACHOLINE ACCORDING TO CAREER PROGRAM

	I Animal Health (n = 393)	II Pastry Making (n = 203)	III Dental Hygiene (n = 115)	All (n = 711)*
FEV ₁ , % pred				
Mean	104.2	101.5	104.6	103.5
SD	± 10.8	± 12.5	± 11.5	± 11.5
FEV ₁ , L/min				
Mean	3.52	3.36	3.34	3.44
SD	± 0.6	± 0.8	± 0.5	± 0.6
FEV ₁ , % pred < 80%				
n (%)	4 (1.0)	9 (4.4)	0	13 (1.8)
FEV ₁ /FVC, % pred†				
Mean	99.6	100.8	100.6	100.1
SD	± 6.4	± 6.6	± 5.9	± 6.4
FEV ₁ /FVC, % pred < 85%				
n (%)	6 (1.7)	1 (0.5)	1 (1.0)	8 (1.2)
PC ₂₀ ≤ 8 mg/ml				
n	69	43	17	129
%	17.6	21.2	14.8	18.1
95% CI‡	(14.7–21.7)	(15.6–25.0)	(9.8–21.0)	(15.7–20.5)
PC ₂₀ ≤ 16 mg/ml				
n	113	66	29	208
%	28.8	32.5	25.2	29.3
95% CI	(24.1–32.2)	(28.0–39.0)	(19.0–32.5)	(26.2–31.9)

Definition of abbreviations: FEV₁ = forced expiratory volume in 1 s; FVC = forced vital capacity; predicted values for FEV₁ and FVC derived from Knudson and coworkers (10).

* n = 711 (58 apprentices did not have the methacholine bronchial challenge test: 42 refused and the challenge was contraindicated for 16 by an initial FEV₁ of less than 2 L or by pregnancy).

† n = 651 with a reliable FVC measure.

‡ 95% confidence limits.

ml, and 30% had a PC₂₀ ≤ 16 mg/ml; the proportions were similar in each group.

The 57 students in the animal health program who were sensitized to at least one laboratory-animal-derived protein (Table 6) were more likely to be atopic and had a significantly greater number of skin reactions to common allergens and a greater skin-test index than did animal health students with no specific sensitization. Similar findings were made in the group of pastry makers sensitized to at least one cereal-derived protein as compared with nonsensitized apprentices. Among the animal health technicians with specific sensitization, 57.9% showed skin reactivity to dog and/or cat hair dander, and 73.7% were sensitized to grass pollen. Among apprentices in pastry making, most subjects sensitized to flour, were also sensitized to grass pollen (90.9%), whereas 63.6% were sensitized to dog and/or cat hair dander. These proportions were all significantly greater than those among subjects without work-specific sensitization (Table 6). In both programs, among students with baseline specific immunologic sensitization, the proportions of those reporting one or more work-related symptoms or symptoms of asthma in nonspecific circumstances, and those with an objective increase in BHR, were significantly greater than among nonsensitized students.

DISCUSSION

Very few prospective studies have been conducted with apprentices starting exposure to HMW agents. Most existing studies conducted with animal handlers, bakers, and workers exposed to latex have adopted a cross-sectional design and included subjects already entered into a profession (12). In some instances, the study design has been prospective but included individuals exposed to the specific allergen before the first assessment (13, 14).

One interesting finding of our study is that a small but not negligible proportion of subjects starting exposure to a specific allergen show skin reactivity to this allergen. The respective figures were 13.8% among animal handlers for animal-derived specific extracts (6.8% in the case of laboratory animal urinary proteins), 5% for flour-derived allergens among pastry makers, and 0.8% for latex among dental hygienists.

Cullinan and coworkers recently surveyed two groups of workers, one not previously exposed to laboratory animals (n = 238) and with an average of 21 mo of employment at the work site (3), and the other with a median duration of employment of 26 mo at the work site and not previously exposed to flour (n = 264) (4). At the first assessment, 10% of workers exposed to laboratory animals had positive skin tests to rat urinary aeroallergen (3), and 5% of those exposed to flour had positive skin tests to mixed flour and α-amylase, respectively (4). De Zotti and coworkers examined 144 trainee bakers and found positive skin tests to wheat flour in 3.5% and to α-amylase in 0.7% (15). The authors did not mention the time interval this survey was conducted in relation to the beginning of training. Allergic sensitization to animal hair was absent in the 38 technicians starting exposure to laboratory animals who were studied by Renstrom and coworkers (16), whereas in another study, 23% of 29 animal-handler students had skin reactivity to animal allergen (17); these discrepancies can be explained by the small number of participants.

In the case of the animal handlers and pastry makers, the presence of skin reactivity to specific allergens before the beginning of significant exposure (i.e., < 3 mo) can reasonably be explained by an increased susceptibility to immunologic sensitization in subjects with prior multiple sensitization to any common allergen through a nonspecific IgE reactivity mechanism, and/or by cross-immunologic-reactivity with common allergens derived either from other mammalian species related

TABLE 6
SPECIFIC IgE-MEDIATED IMMUNOLOGIC SENSITIZATION TO LABORATORY ANIMAL- OR
FLOUR-DERIVED ALLERGENS BY PARAMETERS OF IMMUNOLOGIC SENSITIZATION TO COMMON
ALLERGENS, WORK-RELATED SYMPTOMS AND SYMPTOMS OF ASTHMA AND BHR
AMONG STUDENTS IN ANIMAL HEALTH OR PASTRY MAKING PROGRAM

	Animal Health Students		Pastry Making Apprentices	
	Sensitization to Animal-derived Allergens*		Sensitization to Flour†	
	n	≥ 1	n	≥ 1
n	357	57	211	11
Mean ± SD				
Number of + skin tests	1.33 ± 1.83	5.16 ± 3.01‡	2.02 ± 2.50	6.18 ± 3.06‡
Skin test index, mm	1.89 ± 2.64	4.16 ± 2.35‡	2.15 ± 2.58	5.14 ± 2.21‡
%				
Atopy	48.5	91.2§	55.9	100
+ SPT to cat and/or dog hair dander	11.5	57.9§	19.9	63.6
+ SPT to grass pollen	15.1	73.7§	28.9	90.9§
≥ 1 work-related symptom	9.2	33.3§	4.3	36.4
Symptoms of asthma	14.6	40.4§	27.5	54.5
PC20 ≤ 8 mg/ml**	14.8	34.5‡	19.9	54.5‡

Definition of abbreviation: SPT = skin prick test.

* Animal-derived allergen: rat, mouse, or rabbit urinary proteins, or hamster, guinea pig, or rabbit dander.

† Flour: mixed flour, wheat or bran.

‡ p < 0.001.

§ p < 0.0001.

|| p < 0.01.

‡ p < 0.05 in chi-square analysis.

** Denominators are 337, 55, 186, and 11 for PC₂₀.

to laboratory animals or from grass taxonomically related to cereal grains. It is not impossible, however, that significant sensitization could have occurred at a very early stage of occupational exposure (our subjects were included if they had not been exposed for > 3 mo to the studied specific aeroallergens, and the study was conducted within the first 3 mo of starting the specialized course during which intermittent exposure to the specific allergen occurred). The latency for development of sensitization is unknown, although it can be suspected that it may be shorter in the case of animal-derived allergens than for flour or latex. The specific immunologic sensitization present before any significant exposure took place both in the group of animal health students and pastry makers was related to an increased prevalence of work-related skin, eye/nose, or respiratory symptoms, and to BHR that was either self-reported or assessed through a nonspecific challenge test. These results suggest that subjects with baseline specific immunologic sensitization may be at increased risk of developing early work-related symptoms. The longitudinal study of this cohort will help to verify this hypothesis. Any cross-sectional studies of workers with occupational exposures to the substances examined in the present study should therefore consider some "noise" due to these phenomena, which could not be assessed in cross-sectional studies involving professionals already incorporated in workforces. IgE-mediated immunologic-sensitization to latex can also be present before the beginning of exposure through inhalation during apprenticeship, although its frequency is less than that for sensitization to flour and animal-derived allergens in pastry makers and animal health technicians.

An interesting finding of this study is that sensitization to specific animal-derived allergens was not more common among subjects entering an animal health program than in the two other groups investigated. This is contrary to the expectation that students entering the animal health program would have been more likely to have been exposed to animals and

sensitized to pets beforehand. Additionally, atopy and symptoms of asthma or BHR were not less frequent in the group of students exposed to laboratory animals than in the other two groups. This suggests the absence of self-exclusion from the profession of animal health technician, at least at the first stage of selecting a profession, contrary to a widely accepted assumption that self-selection to avoid the profession of laboratory animal workers does occur (5, 18). However, we have no information on the atopic status or other relevant characteristics of the subjects registered in the animal health program who did not take part in our study (19% of the target population).

Although ours was not a random sample, we feel that the cohort of students selected for study is representative of the population of students in the programs of animal health technology, pastry making, and dental hygiene technology in the Province of Québec, in terms of age and sex ratio. The available provincial statistics indicate that for 14,946 students registered in biologic technology programs (including animal health and dental hygiene) in 1991, the mean age was 20.4 yr and the female/male ratio was 76%. Our findings show that: (1) Atopy, defined by at least one immediate skin reaction to a battery of common inhalants, is frequent (55%) in young adults starting a course in which they are exposed to HMW agents. These results compare with published data showing prevalence figures of atopy varying from 35% to 58% in young adults from general population samples or student populations (19–22); (2) Asthma symptoms and BHR are also common in this young-adult population; whereas a physician-based diagnosis of asthma was made in 10.7% of subjects, symptoms suggestive of asthma were present in 21% of subjects. A PC₂₀ ≤ 8 mg/ml was shown in 18% of subjects. The prevalence of BHR that we found is slightly higher than other figures reported in the literature for young adults (20–22). This could partly be explained by the predominance of young women in our population, as suggested by others (20, 21).

In conclusion, a significant proportion of students starting apprenticeship in a profession show skin reactivity to specific work-related HMW agents present in their new environment. Our analyses suggest that baseline skin reactivity to work-related agents may result from an increased propensity to develop IgE-mediated sensitization in individuals with immunologic sensitization to several common allergens (polysensitization). Alternatively, it could result from immunologic cross-reactivity.

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