

Latex sensitivity in dental students and staff: A cross-sectional study

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Background: Dental practitioners, like other health care providers who regularly use latex gloves, are at increased risk for latex sensitivity. They are also at risk for irritant or allergic contact dermatitis.

Objective: This study was carried out to determine the prevalence of latex sensitivity and possible risk factors in staff and students of a Faculty of Dentistry.

Methods: A cross-sectional study was performed by using a questionnaire and allergy skin prick testing.

Results: Two hundred three students and staff members completed the questionnaire. Five percent reported asthma symptoms on exposure to rubber products, 13% reported symptoms of rhinitis or conjunctivitis, and 17% reported pruritus or urticaria within minutes of exposure to rubber. Overall, 10% of 131 subjects who underwent skin prick tests had a positive response to natural rubber latex. Among the students tested, there were increasing percentages of positive skin test responses to latex with increasing years of study (0% of Year 1 and 2 students tested; 6% of Year 3; and 10% of Year 4). Positive responses were seen as early as Year 3 in students (in their second year of clinical activity and glove use). Positive skin prick test responses to latex were related to a personal history of atopy ($p = 0.005$), positive prick test responses to common allergens ($p < 0.005$), latex-attributed immediate pruritus or urticaria ($p < 0.05$), rhinoconjunctivitis ($p < 0.001$), and asthma symptoms ($p < 0.001$).

Conclusion: Dental school students and faculty are at high risk for latex sensitization. This occurs as early as the second year of glove use. Overall prevalence of skin sensitization was 10% of those tested. Preventive strategies in this group merit further investigation. (*J Allergy Clin Immunol* 1997;99:396-401.)

Key words: Latex allergy, dermatitis, occupational asthma

Over the past 6 years, there has been increasing recognition of allergic responses to latex.¹⁻⁵ Dental practitioners, like other health care professionals who regularly use latex gloves, are at increased risk for latex sensitivity.⁶⁻¹³ They are also at risk of developing irritant or allergic contact dermatitis,^{14, 15} and dermatitis is a possible risk factor for the development of natural rubber latex allergy.^{2, 4, 16, 17} Atopy is a risk factor for

both latex sensitization¹⁶⁻¹⁹ and irritant contact dermatitis,^{20, 21} though it has not been found to be a risk factor for allergic contact dermatitis.^{22, 23}

This report presents the results of a study designed to determine the prevalence of reporting of symptoms of possible latex sensitivity and positive prick test responses to latex and common environmental allergens, to characterize exposures in students and staff of a dental faculty, and examine relationships between the various outcomes and exposure characteristics.

METHODS

The design was a simple cross-sectional survey of a working population. The study protocol was approved by the Ethics Review Board of St. Michael's Hospital.

Population

The eligible population included all students and staff members of the Faculty of Dentistry, University of Toronto. Student lists for the four undergraduate years were obtained; the lists documented class sizes of 64, 65, 66, and 64 for the first, second, third, and fourth years, respectively. No other listings were available, so it has not been possible to clearly define the remainder of the eligible population (graduate students and staff).

Written informed patient consent to participate was obtained before the skin prick testing component of the study.

Questionnaire

The self-administered questionnaire collected basic demographic information and detailed work history, including cleansing preparations and gloves used, in addition to other potential cutaneous and respiratory hazards.

Information was obtained about respiratory and cutaneous symptoms and history. The respiratory questions were from a standardized questionnaire (American Thoracic Society). There are no accepted cutaneous questionnaires, so the questions used were an expanded version of a cutaneous questionnaire used by us in previous workplace studies. The questionnaire was modified on the basis of suggestions received from those reviewing the study protocol. The questionnaires were distributed during lectures and through the departmental nursing office.

Prick tests

Prick tests were carried out as previously described¹⁹ with a negative control solution (diluent, phosphate-buffered saline), a positive control solution (histamine 1:1000), and a solution of raw, low ammonia latex (all from Bencard, Mississauga, Ontario, Canada). The solution of latex was initially diluted up to 1:1000 for subjects with a history of latex allergy.¹⁹ If skin test responses to diluted latex solutions were negative, 10-fold stronger solutions were used serially up to the undiluted extract. Additional skin prick tests were performed with extracts of cat

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Supported by a grant from St. Michael's Hospital Research Centre, Toronto.

Received for publication Nov. 28, 1995; revised Aug. 8, 1996; accepted for publication Aug. 15, 1996.

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0091-6749/97 \$5.00 + 0 1/1/77360

ander (50% wt/vol), Eastern ragweed (P4E 25,000 Noon units/ml), and *Dermatophagoides farinae* (1% wt/vol). All the allergens were supplied by Bencard.

Responses were classified from the mean wheal diameter as negative (<1 mm), 1+ (1 to 2 mm), 2+ (3 to 5 mm), 3+ (6 to 9 mm), or 4+ (>9 mm) after subtraction of the response to diluent. Responses greater than or equal to 2+ were classified as positive.

Data analysis

Information from the questionnaire was coded and entered into a database file. Statistical analysis was carried out on the University of Toronto computing system with SAS software.

Simple descriptive statistics were used to evaluate the prevalence of various exposures, symptoms, and groups of symptoms in the population as a whole and by job category or student year. Various symptom outcomes were defined, and a number of demographic and exposure variables were compared between the different outcomes by using chi square and *t* tests.

RESULTS

A total of 203 staff members and dental students completed the questionnaire, and 131 of these also underwent skin prick testing. Three additional office staff members with no glove exposure and seven individuals who underwent skin testing but did not complete the questionnaire are excluded from analyses.

Participation in the study was greatest in the most senior student years. Eleven percent of the first-year class completed a questionnaire, but none had prick testing; 31% of the second-year class completed the questionnaire, and 31% also had skin testing. The similar percentages for the third-year class were 58% and 55%, respectively; and for the fourth-year class, the percentages were 83% and 60%, respectively, for the questionnaire and skin tests. Because many of the academic staff members taught on a part-time basis and numbers of staff were not centrally recorded, the degree of participation of this group could not be reliably determined.

Symptoms consistent with IgE-mediated responses to latex were described by 48 subjects (24%): local pruritus in 14%, urticaria in another 3%, rhinitis or conjunctivitis in 12%, and asthma symptoms in 5%. Symptoms suggestive of eczema, beginning hours to days after use of latex gloves, were present in a total of 44 subjects (22%).

Overall, the most common reported early onset symptom with latex gloves was contact pruritus, beginning within minutes of glove use in 28 subjects (58% of all subjects with a history suggestive of IgE-mediated latex allergy). Eleven of these 28 noted associated symptoms of rhinoconjunctivitis, and in addition, six had symptoms of asthma (cough or wheeze) with powdered latex glove exposure. Six additional subjects described contact urticaria with latex glove use; three had associated rhinoconjunctivitis, and two also had asthma symptoms. Fourteen subjects described rhinoconjunctivitis (including three who also had asthma symptoms) on latex exposure without contact pruritus or urticaria (a total of 29% of those with latex-attributed immediate-onset symptoms).

TABLE I. Comparison of questionnaire responses in different occupational groups

	Academic (n = 31)	Clinic (n = 52)	Students (n = 120)
Mean age (yr)	40.0	37.8	23.4
Sex (% female)	39	98	45
Smoking status			
Never (%)	65	67	94
Current (%)	6	19	3
Ex-smoker (%)	29	14	3
Personal history			
Hay fever (%)	26	26	30
Asthma (%)	6	14	13
Eczema (%)	3	6	7
Hives (%)	33	28	22
Family history			
Hay fever (%)	32	23	37
Asthma (%)	10	22	25
Eczema (%)	16	15	19
Current glove type			
Powdered latex (%)	67	37	51
Nonpowdered latex (%)	37	69	76
Other (vinyl) (%)	13	12	3
Changed glove (%)	50	73	56
Use liners (%)	7	10	8
Symptoms on exposure to latex			
Asthma (cough/wheeze/ shortness of breath) (%)	0	14	3
Rhinitis/conjunctivitis (%)	3	25	8
Urticaria (%)	3	2	3
Pruritus in minutes (%)	3	23	13
Eczema (%)	29	17	22

Comparisons between occupational groups

Characteristics of the three main work categories (students, clinic support staff, and academic staff) are shown in Table I. Expected variations in age and sex were found. Symptoms of pruritus, rhinoconjunctivitis, and asthma with latex glove use were more common among the clinic staff as compared with the students and academic staff (Table I). Comparisons were then made between students of different years and the other subjects, academic and clinic staff, and one postgraduate student (Table II). The first- and second-year students are grouped together for the analyses because of the very small number of first-year students assessed. The first-year students have little clinic exposure, and those in the second year are just starting their clinical experience and have less latex exposure than those in the third and fourth years.

There were no significant differences in demographic features such as age; gender; smoking history; or personal or family history of allergic rhinitis, asthma, eczema, or urticaria among the four groups (Table II). Differences in time and amount of latex exposure in the clinic setting appear related to the stage of training. Even early in training there were differences in voluntary practices, which might limit reactions. More of the fourth-year students were using liners ($p = 0.05$), and

TABLE II. Comparisons of students stratified by class year and staff

	Years 1 & 2	Year 3	Year 4	Staff*	p Value
Clinical activities					
Current hr/wk in clinic	16	21	27	28	0.0001
Total years in clinic	2	2	2	8	0.0001
Average hr/wk in clinic	15	18	25	30	0.0001
Glove use					
Time gloved (%)	36	63	78	61	0.001
Hours gloved in clinic	673	1317	2040	2000	0.001
Current type of glove					
Powdered latex (%)	33	23	11	32	NS
Nonpowdered latex (%)	37	38	56	39	NS
Other (vinyl) (%)	0	0	4	11	NS
Changed glove (%)	59	46	63	63	NS
Use liners (%)	4	3	16	8	NS
Symptoms on exposure to latex					
Asthma (%)	0	0	4	9	0.02
Rhinoconjunctivitis (%)	4	8	11	16	0.05
Pruritus in minutes (%)	11	21	7	15	NS
Urticaria (%)	4	0	6	2	NS
Eczema (%)	19	15	28	21	NS
Positive skin prick test results					
No. of subjects tested	20	36	39	36	
Cat (% positive)	0	19	3	3	0.005
Dust (%)	5	8	5	8	NS
Ragweed (%)	5	17	5	5	NS
Any positive (%)	10	28	10	16	NS
Latex (%)	0	6	10	25	0.02

*Includes academic staff, clinic support staff, and one postgraduate student.

fewer were using powdered latex gloves, although this latter difference was not statistically significant and was not apparent in the staff. Clinic support staff and academic staff showed a trend toward being more likely than students to have changed to use of vinyl gloves (11% vs 4% of fourth-year students).

The incidence of latex-attributed upper and lower respiratory tract symptoms increased with student years of training ($p < 0.05$), and in the staff, with increased total latex glove exposure characteristics (Table II). Differences in time and amount of exposure to gloves in the clinic setting are expected in the different categories, and in general, are exposure characteristics over which the individual has little control. However, there was no clear association between extent of glove use and symptoms of pruritus, urticaria, or eczema (Tables I and II).

Among the students who completed the questionnaire, all but one of the 26 with symptoms consistent with IgE responses to latex underwent skin testing (96% of those with symptoms). However, among the staff, only 13 of the 22 with symptoms, as indicated on the questionnaire, had skin tests performed (59%). Thirteen individuals of the total of 131 who were prick tested had a positive response to latex (10%). This included four who were tested with extract diluted 1:1000 (two at 4+, two at 3+), two tested with extract diluted 1:100 (one at 4+, one at 3+), one tested with extract diluted 1:10 (2+), and six tested with full-strength extract (five at 3+, one at 2+).

The prevalence of positive skin test responses to latex increased with student years among those tested and was greatest among the staff tested (25%), despite the relatively reduced participation of individuals with symptoms in that group (Table II). On the basis of a best case scenario, assuming all the other class members had negative responses, the prevalence of a positive response to latex would be 0% in Years 1 and 2, 3% in Year 3, and 6% in Year 4.

Comparison of those with and without a positive response to latex

Demographic, exposure characteristics, personal and family history, symptoms on exposure to rubber, skin prick test results, and hand examination findings were compared between those with and without a positive response to latex on prick testing (Table III). Those who had a positive response to latex were older, more likely to have a history of atopy and eczema and a family history of eczema, more likely to use nonlatex gloves, and more likely to have a positive response to other allergens on prick testing. They were clearly more likely to report asthma, rhinitis, or conjunctivitis symptoms on exposure to latex products.

Correlation between reporting and test results

Two-by-two tables comparing various history variables and the skin test responses to latex are presented in Table IV. Although there was obvious

TABLE III. Positive latex prick test results and possible associated features

	Prick test result		p Value
	Negative (n = 118)	Positive (n = 13)	
Personal characteristics			
Mean age (yr)	26.8	34.1	<0.05
Sex (% female)	63	62	NS
Personal history of atopy (%)	44	85	0.005
Personal history of eczema (%)	7	23	<0.05
Family history of atopy (%)	49	54	NS
Family history of eczema (%)	17	42	<0.05
Hives (%)	28	50	NS
Sweat (%)	80	100	NS
Current skin problem (%)	21	38	NS
Work characteristics			
Current hours in clinic	23.5	24.0	NS
Time gloved per week (%)	61	63	NS
Powderless gloves (%)	74	45	<0.05
Other gloves (%)	7	36	0.001
Changed gloves (%)	63	64	NS
Irritation (%)	40	40	NS
Allergy (%)	14	60	<0.01
Supply (%)	75	60	NS
Glove liners (%)	9	23	NS
Symptoms on exposure to latex			
Asthma (%)	2	46	<0.001
Rhinoconjunctivitis (%)	8	54	<0.001
Pruritus or urticaria in minutes (%)	22	46	<0.05
Eczema (%)	31	31	NS
Skin prick test results			
Cat (%)	30	69	<0.005
Ragweed (%)	32	54	NS
Dust (%)	28	62	<0.05
Any positive (%)	43	85	<0.005

TABLE IV. Correlations between history and latex prick test results

	Symptoms on exposure		Sensitivity	Specificity	PPV	NPV	p Value
	Yes	No					
Pruritus or urticaria within minutes							
Latex positive	6	7	46	77	18	93	<0.05
Latex negative	28	90					
Rhinoconjunctivitis							
Latex positive	7	6	54	92	41	95	<0.001
Latex negative	10	108					
Asthma							
Latex positive	6	7	46	98	67	94	<0.001
Latex negative	3	115					

PPV, Positive predictive value; NPV, negative predictive value.

correlation, there were a number of false-positive and false-negative results, indicating the problem of relying solely on self-reporting. A history of pruritus, urticaria, rhinoconjunctivitis, or asthma symptoms on exposure to latex gloves each had relatively low

sensitivity (46% to 54%), taking the latex skin test response as the gold standard. Asthma symptoms with latex exposure showed the highest specificity for latex skin test responses (98%) with a negative predictive value of 94%.

DISCUSSION

A high proportion (10%) of staff and students who were tested at this school of dentistry had positive skin test responses to natural rubber latex, which is even greater than that previously reported in operating room and other hospital staff.^{7, 8} Many of those participating in the survey had respiratory complaints with latex exposure (5% with asthma symptoms and 12% with rhinitis symptoms). Cutaneous problems were even more common: 14% reported local pruritus within minutes of latex contact, 3% reported urticaria, and 22% reported eczema. Other studies have shown that historical reporting is sensitive but not specific for occupational asthma,²⁴ and only two thirds of those with upper or lower respiratory tract symptoms self-attributed to latex gloves in this survey had positive skin test responses to latex, suggesting that other causes accounted for some of these symptoms.

Similarly, the low predictive value for self-reported pruritus and urticaria with latex glove contact may be explained in part by inclusion of urticaria from other exposure agents in dental practice. In addition, our questionnaire may not have been sufficiently reliable to distinguish IgE-mediated skin responses from irritant dermatitis and allergic contact dermatitis caused by rubber additives and other products used in dentistry. Our findings are consistent with the previously reported high prevalence of cutaneous symptoms attributed to latex gloves in dental workers⁶ and are higher than the prevalence of symptoms in hospital operating room staff.²⁵

The symptom and latex skin test response rates in this study might be biased in part because of greater participation of individuals with symptoms compared with those without symptoms, who might have less motivation to take part in the assessments. However, this is not likely to explain the observed greater prevalence of symptoms in fourth-year students, because this group also had the best participation rate (83%). The prevalence of positive skin test responses in students may have been subject to some selection bias because 96% of students who described latex-attributed symptoms had skin testing performed compared with only 80% of all students who completed questionnaires. Nevertheless, this would not explain the higher prevalence of positive skin test responses to latex in the staff among whom only 59% of those reporting symptoms had skin tests performed.

The best-represented student group was the fourth-year class: 83% participated in the questionnaire, and 53% of this class also underwent skin testing. Among these, the percentage with latex-attributed noncutaneous symptoms was similar to that of the entire group (4% asthma symptoms, 11% rhinitis and conjunctivitis symptoms); 7% described latex-induced local itching, 6% described urticaria, and 10% had positive skin test responses to latex. This suggests that at least in this class the prevalence figures are likely to be close to representative values. Even if all nonparticipants from the class

had negative skin test responses to latex, the prevalence of latex skin test responses would be 6%.

The percentage of students in the fourth-year class who were affected is lower than that of the clinic support staff who have had many more years of exposure, suggesting that the risk of sensitization increases with increasing exposure. Nevertheless, in some subjects sensitization was apparent as early as the second year of regular glove use.

The risk factors for latex skin sensitization in this study are similar to those previously reported.^{4, 16-19} These include a previous history of atopy and eczema; a family history of eczema; contact dermatitis, or respiratory symptoms with latex contact or exposure. Individuals with positive skin test results were also older, which is consistent with longer exposure to latex gloves. However, unlike studies that have included mainly hospital workers,¹⁹ there was no gender difference, suggesting that this previous finding likely relates to the increased prevalence and/or exposure to latex of female hospital staff members.

At the time of this survey, the school of dentistry had just changed their routine latex glove purchases from various relatively high-protein, powdered latex gloves to low-protein, nonpowdered latex gloves, such as would be expected to expose individuals to less latex allergen.²⁶⁻²⁸ This may provide the opportunity for prospective determination of the effectiveness of such a change in reducing new sensitization rates and latex-related symptoms in such a facility, particularly in the student population just beginning to have intensive use of gloves.

We thank Gaye Donnan, Dr. E. G. Sonley, and the staff and students of the Faculty of Dentistry, University of Toronto, for assistance and their participation in this study.

REFERENCES

1. Nutter AF. Contact urticaria to rubber. *Br J Dermatol* 1979;101:597-8.
2. Spanner D, Dolovich J, Tarlo S, Sussman GL, Buttoo K. Hypersensitivity to natural latex. *J Allergy Clin Immunol* 1989;83:1135-7.
3. Slater J. Rubber anaphylaxis. *N Engl J Med* 1989;320:1126-30.
4. Sussman G, Tarlo S, Dolovich J. The spectrum of IgE-mediated responses to latex. *JAMA* 1991;265:2844-7.
5. Kelly KJ, Viswanath K, Zacharisen M, Resnick A, Fink JN. Skin and serologic testing in the diagnosis of latex allergy. *J Allergy Clin Immunol* 1993;91:1140-5.
6. Berky Z, Luciano WJ, James WD. Latex glove allergy: a survey of the US Army Dental Corps. *JAMA* 1992;268:2695-7.
7. Lagier F, Vervloet D, Lhermet I, Poyen D, Charpin D. Prevalence of latex allergy in operating room nurses. *J Allergy Clin Immunol* 1992;90:319-22.
8. Bradley J, Arellano R, Sussman G. Prevalence of latex sensitivity in 100 hospital physicians at the University of Toronto [abstract]. *Can J Anaesth* 1991;38:A100.
9. Turjanmaa K. Incidence of immediate allergy to latex gloves in hospital personnel. *Contact Dermatitis* 1987;17:270-5.
10. Turjanmaa K, Reunala T. Contact urticaria from rubber gloves. *Dermatol Clin* 1988;6:47-51.
11. Beaudouin E, Pupil P, Jacson F, Laxenaire MC, Moneret-Vautrin DA. Allergie professionnelle au latex - enquête prospective sur 907 sujets du milieu hospitalier. *Rev Fr Allergol* 1990;30:157-61.