

Incidence of sensitization, symptoms, and probable occupational rhinoconjunctivitis and asthma in apprentices starting exposure to latex

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Latex is a well-known sensitizer. Prospective studies in apprentices beginning to be exposed to latex have not been carried out. We wanted to determine the incidence of skin reactivity, cutaneous symptoms, rhinoconjunctivitis (RC) symptoms, respiratory symptoms, probable occupational RC, and asthma in apprentices in dental hygiene. A total of 122 students starting a program in dental hygiene technology were recruited between 1993 and 1995. A questionnaire, skin-prick tests with common aeroallergens and latex, and assessment of spirometry and responsiveness to methacholine were carried out on entry and at follow-up visits at 20 and 32 months after the start of exposure. Of the 110 subjects who participated for at least 1 follow-up visit, skin reactivity to latex developed in 7. Cutaneous symptoms developed in 6 of the 7, RC symptoms developed in 2, and respiratory symptoms developed in 1. Five of the 7 subjects had significant changes in methacholine responsiveness and fulfilled the definition of probable occupational asthma. Sensitized subjects were more likely to be atopic and to have a previous history of asthma and respiratory symptoms on exercise than were nonsensitized subjects. Three subjects at the 20-month assessment and 4 subjects at the 32-month visit showed skin reactivity. The cumulative incidences for skin sensitization, probable occupational RC, and occupational asthma to latex were 6.4%, 1.8%, and 4.5%, respectively. (*J Allergy Clin Immunol* 2001;107:921-3.)

Key words: Asthma, occupational asthma, immunological sensitization

Latex is a well-known cause of hypersensitivity reactions, as was recently reviewed.¹ Seaton et al² and Lagier et al³ were the first to report asthmatic reactions due to inhaled latex. Many reports have been issued on the prevalence of IgE-mediated allergic reactions and asthma in the general population, glove-producing manufacturers, and health care workers, as summarized elsewhere.^{1,4} The largest study in 273 hospital workers

Abbreviations used

OA:	Occupational asthma
PC ₂₀ :	Provocative concentration causing a 20% fall in FEV ₁
RC:	Rhinoconjunctivitis
SIS:	Specific immunologic sensitization

showed a prevalence of 4.7% for sensitization to latex and of 2.5% for occupational asthma (OA).⁵ Tarlo et al⁴ assessed dental students after a period of 1 to 4 years from entry into the program and found a prevalence of skin sensitization of 10% among 131 subjects. The only prospective study, carried out by Sussman et al,⁶ showed that 4 of 435 (1%) health care workers had skin reactivity to latex during a 1-year follow-up period.

We initiated a prospective study in 769 apprentices, 417 in animal health technology, 230 in pastry-making, and 122 in dental hygiene technology, starting exposure to high-molecular-weight allergens (laboratory animals, flour, latex), to determine the incidence of immunologic sensitization, symptoms, probable disease, and risk factors during their training period.^{7,8} In this report we describe the results in the 122 students exposed to latex.

METHODS

Subjects

Recruitment of 122 of 173 (participation rate = 70.5%) students took place between September 1993 and December 1995 in 2 schools offering 3-year programs in dental hygiene technology. Students were eligible for the cohort study provided that they had not been exposed to latex in an apprenticeship or job for at least 3 months before entering the career program, as assessed during a preliminary visit. The 2 follow-up assessments took place 20 and 32 months after students entered the program. All subjects gave written consent to their participation in the study. The protocol was approved by the ethics committee of the Sacré-Coeur Hospital.

Methods

The questionnaire we used has previously been described.⁷ At each visit, the nurse asked whether the subjects had experienced (since the previous visit) nasal, ocular, respiratory, and skin symptoms while working in the laboratory and/or clinic when latex gloves were used. We also obtained information from the program coordinator of each school on the number of hours per term the students used latex gloves for the 6-term-duration program and the type of gloves used (powdered or nonpowdered, examination or sterile).

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TABLE I. Baseline characteristics and outcomes of subjects with incident-specific sensitization to latex

Subject No.	Age (y)	Atopic status*	Hay fever†	Asthma†	FEV ₁ (% predicted)	PC ₂₀ baseline (mg/mL)	PC ₂₀ follow-up (mg/mL)	Time to incidence of outcome (y)					
								SIS	WR cutaneous symptoms	WR RC symptoms	WR respiratory symptoms	Occupational RC	OA
1	24	+	+	—	109	>32	ND	2.9	1.2	—	—	—	—
2	29	+	—	—	129	>32	>32	2.8	2.8	—	—	—	—
3	19	+	—	+	92	18	4.4	1.8	0.2	3.2	3.2	3.2	1.8
4	25	+	+	—	104	>32	15	1.8	1.8	—	—	—	2.9
5	26	+	+	+	115	0.6	0.001	2.8	1.9	1.9	—	2.8	2.8
6	19	+	—	—	105	14.5	3.2	1.8	—	—	—	—	1.8
7	17	+	+	+	95	0.9	0.001	2.9	2.9	—	—	—	2.9

Values for age, atopic status, hay fever, asthma, and FEV₁ are baseline characteristics.

WR, Work-related; ND, not done.

*+ = at least 2 immediate skin reactions to 11 common allergens.

†+ = presence of the characteristic.

TABLE II. Selected baseline characteristics and incident work-related symptoms according to incident latex-sensitization status

	Sensitized (%)	Nonsensitized (%)	P value*
No. of subjects	7	103	
Characteristics at baseline			
Asthma†	3 (42.9)	7 (6.8)	.02
Respiratory symptoms on exposure to cold air	3 (42.9)	12 (11.7)	.05
Hay fever	2 (28.6)	13 (12.6)	.24
Atopy‡	7 (100)	40 (38.8)	<.01
PC ₂₀ (mg/mL)§			
≤32	4 (57.1)	40 (41.2)	.45
≤16	3 (42.9)	24 (24.7)	.37
≤8	2 (28.9)	14 (14.4)	.29
Incident work-related symptoms			
Cutaneous	4 (57.1)	31 (30.1)	<.01
RC	2 (28.6)	6 (5.8)	<.01
Dyspnea and/or wheezing	1 (6.4)	0 (0)	.06

*Derived from χ^2 analysis or Fisher exact test.

†Diagnosed by a physician.

‡Atopy defined as at least 2 immediate reactions to 11 common aeroallergens.

§A total of 104 subjects accepted the bronchial challenge test at baseline.

Details of skin testing procedure, extracts used, and interpretation of results have recently been published.⁷ Skin-prick tests were also performed with 2 nonammoniated latex extracts originating from Omega (Montreal, Quebec, Canada) and Stallergenes (Institut Pasteur, Paris, France). All extracts were obtained before the beginning of the study in sufficient amounts to perform the estimated number of skin tests through the end of the project. Each glycerinated extract was prepared from the same batch. The same nurse performed the skin-prick testing throughout the study.

Information on spirometry and methacholine inhalation procedures has been detailed previously.⁸ The methacholine challenge test was repeated at the remaining visit or visits for subjects in whom specific immunologic sensitization (SIS) to latex developed (hereafter referred to as *cases of SIS*), as well as for a group of subjects with no incident positive reaction to a latex skin test. The latter group was made of up to 2 subjects matched with each case of SIS on the basis of atopy (yes/no), baseline PC₂₀ (provocative concentration causing a 20% fall in FEV₁) (≤ 16 / >16 mg/mL), and school.

Incident cases of probable OA were defined as subjects who experienced SIS to at least 1 extract of latex and a significant decrease in bronchial responsiveness (ie, PC₂₀ reduction by a 3.2-fold concentration or more from the value at recruitment). Probable occupational rhinoconjunctivitis (RC) was defined as the incidence of both a positive test result to latex and work-related RC symptoms.

Statistical analysis

Fisher exact tests or χ^2 tests were used (SPSS software package, version 9.0 for Windows; SPSS, Chicago, Ill). The level of statistical significance was set at $P < .05$ (2 sided).

RESULTS

Two of the 122 participants were male. The mean $\pm$ SD age was 21.4 ± 5.2 years. Twelve subjects were current smokers, and 8 were ex-smokers. A total of 110 of 122 students (90%) attended at least 1 of 2 follow-up visits; 109 of 122 (89.3%) attended the first, and 100 of 122 (81.9%) attended the second, whereas 99 attended both.

During the study period, skin reactivity to latex developed in 7 subjects, that is, 6.4% of those who attended at least 1 of the follow-up visits; the incidence density was 2.5% (7/282 person-years). The incidences during the study period of probable occupational RC and OA to latex were 1.8% and 4.5%, respectively, and the incidence densities were 0.7% (2/282 person-years) and 1.8% (5/282 person-years), respectively. Results of selected characteristics in the 7 subjects in whom incident sensitization to

latex developed are listed in Table I. All subjects were atopic. At the initial assessment 4 subjects reported hay fever symptoms, and 3 reported physician-diagnosed asthma. Three subjects had significant bronchial hyperresponsiveness ($PC_{20} \leq 16$ mg/mL) at the initial visit. Six subjects experienced cutaneous work-related symptoms, 2 work-related RC symptoms, and 1 work-related respiratory symptoms. Two subjects fulfilled criteria for probable occupational RC, and 5 fulfilled criteria for probable OA.

Table II shows a comparison of the frequency of subjects with incident sensitization and those with no incident sensitization to latex for selected characteristics. Physician-diagnosed asthma, respiratory symptoms on exposure to cold air and atopy on entry, and development of work-related cutaneous symptoms were more common in subjects sensitized to latex than in nonsensitized subjects.

The students used latex gloves on average 10 hours per week from the time of entry into the program to the 20-month assessment; their use increased to 30 hours per week during the third grade. All subjects used powdered latex gloves, either examination or sterile.

Three subjects had evidence of sensitization when they were assessed at 20 months and 4 others between 20 and 32 months after starting exposure. All subjects reacted to the Omega latex-derived extract, and of those, 2 also reacted to the Stallergènes extract.

DISCUSSION

This study shows that the incidences of skin sensitization, probable occupational RC, and OA to latex were 6.4%, 1.8%, and 4.5%, respectively. The incidence of skin reactivity to latex was significantly higher among apprentices in dental hygiene than among subjects in the other 2 groups in our cohort (ie, 4/394 or 1% in the animal health program and 3/186 or 1.6% in the pastry-making program).⁷ In the only comparable prospective study carried out in health professionals from 2 institutions who had already been exposed to latex for a mean duration of 5 and 12 years, respectively, Sussman et al⁶ found that 4 of 435 participants (1%) had skin sensitization to latex at the 1-year follow-up. This is close to our incidence density figure of 2.5% (7/282 person-years).

Interestingly, 5 of the 7 (71%) sensitized subjects also had evidence of probable OA. This proportion is higher than for animal-derived allergens (30/67 [45%] sensitized apprentices of a cohort of 394 subjects⁹). Therefore our findings in both groups suggest that the development of skin sensitization to specific work-related allergens is highly associated with the development of probable OA.

We defined the onset of probable OA as the association of incident skin reactivity to latex and increased bronchial responsiveness. Having a positive reactivity to a high-molecular-weight allergen and significant bronchial hyperresponsiveness results in an approximately 80% probability that exposure to the relevant allergen will result in an asthmatic reaction.^{10,11} Interestingly, only 1 of the 5 subjects with skin reactivity and bronchial hyperresponsiveness reported respiratory symptoms on exposure to latex.

In almost all cross-sectional studies summarized elsewhere,¹ atopy is associated with latex allergy. All of our subjects with sensitization to latex were atopic at baseline. However, because almost 40% of the rest of the subjects were also atopic, atopy does not seem to be a reliable predictor of specific sensitization; this same conclusion was reached in the case of apprentices exposed to laboratory animal-derived allergens.⁷

Our group has previously documented the concentration of latex aerosol in 1 of the 2 training institutions during usual clinical work.¹² The geometric mean concentration of latex obtained by personal air samplers was 54.7 ng m⁻³, an exposure level previously reported among health care workers.¹² It is likely that reducing the degree of exposure to latex will reduce the incidence of latex sensitization and related diseases in the same way as for prevalence.¹³

In conclusion, the start of exposure to latex results in a substantial risk of immunologic sensitization, RC, and asthma during the first 3 years of exposure. The incidence over a longer time period remains to be determined.

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