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Influence of Occupational Exposure to Latex on the Prevalence of Sensitization and Allergy to Latex in a Swiss Hospital

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Key Words

Latex allergy · Latex gloves · Skin prick tests to latex · IgE to latex · Occupational exposure · Cumulative occupational exposure

Abstract

Background: Replacement of powdered latex gloves has been recommended in order to prevent the development of latex allergy in health care workers. The conclusion that occupational exposure to latex gloves represents a risk factor for latex allergy is mainly based on studies without exposure controls. Atopy is also thought to be a risk factor for the development of latex allergy. **Objective:** To determine the prevalence of atopy, sensitization to latex, and symptoms following latex exposure in professionally exposed and nonexposed hospital personnel by means of a cross-sectional study. **Methods:** Six hundred randomly sampled individuals working in medicine and surgery departments and in surgery theaters and 300 sex- and age-matched individuals classified as administrative personnel were selected from the employee data base of the Geneva University Hospital. A questionnaire about exposure to latex and symptoms following this exposure was sent to all individuals. Skin prick test reactions and serum IgE to latex as well as standard environmental allergens were determined in both groups. **Results:** Respiratory and skin (local) symptoms

but not objective tests of latex sensitization (positive skin prick test and specific IgE to latex) were significantly associated with occupational exposure to latex ($p < 0.001$). Only among atopics subjects was 15 years or more of occupational exposure associated with a significantly higher prevalence of local symptoms than among those who were exposed from 1 to 9 years (odds ratio: 3.2; 95% confidence interval: 1.6–6.5). Atopy was significantly associated with sensitization to latex (odds ratio: 10.3; 95% confidence interval: 4.0–26.6) but not with local symptoms. Tests of latex sensitization were both frequently positive, less frequently negative, resulting in low kappa values. **Conclusion:** These results support the current preventive health care recommendation to replace powdered latex gloves. In atopics, increasing years of occupational exposure increase the risk of developing latex allergy. In contrast to questionnaires about local symptoms, skin prick tests and specific serum IgE to latex are of limited value in epidemiologic studies of latex allergy.

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Introduction

Occupationally exposed health care workers are considered at risk for immediate-type allergy to natural rubber latex, essentially from latex gloves. Aside from induc-

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ing local symptoms after contact in allergic individuals and general symptoms in a minority, starch-powdered latex gloves can produce airborne respiratory and systemic symptoms in allergic individuals.

The conclusion that health care workers are at risk for latex allergy is mainly based on studies on the prevalence of positive skin prick tests and specific IgE to latex determined in unrelated studies of either health professionals or of occupationally nonexposed subjects. The reported prevalence varies between 1.5 and 16.9% for health care workers [1, 2] and from 0.12 to 4.5% in occupationally nonexposed populations [2]. In the absence of a control group it is unclear whether these differences can be attributed to exposure to latex. A recent study in a US hospital comparing occupationally exposed to occupationally nonexposed personnel did not find any association between the use of latex gloves and sensitization to latex, measured by specific serum IgE determination, although it was a risk factor for local symptoms [3].

Nonetheless, based on the results of earlier studies, various recommendations have been made, including replacement of powdered latex gloves by nonpowdered latex gloves and/or latex-free gloves and the promotion of latex-free hospitals. Replacing powdered latex gloves in hospitals may increase costs [4–6], but it may also diminish the concentration of latex allergens in the air [3, 7, 8]. However, it is not entirely clear whether it decreases symptoms [9], latex-specific IgE in the serum of health care workers [8], or skin prick test (SPT) conversion rate in health care workers [7].

We conducted a study in exposed and nonexposed hospital employees to provide a sounder rationale for the implementation of preventive health care policies in hospitals (e.g. replacement of powdered latex gloves).

Materials and Methods

Study Design

Two groups of hospital personnel were selected from the hospital employee database to participate in the study (fig. 1). A group of medical workers ('medical group') with potential occupational exposure to latex included all surgeons, anesthetists, nurses and other employees working in operating theaters and in various medicine and surgery departments, including pediatric surgery and obstetrics. A random sample of 600 persons was invited to participate in the study. The second group was a sample ($n = 300$) of nonmedical personnel ('nonmedical group') working in hospital administration and presumably not occupationally exposed to latex. This sample was matched to the medical group by gender and age in groups of 10 years. Seventy-five individuals from the medical sample and 36 from the nonmedical sample were not eligible because they no longer worked at the hospital or because they were on long-term sickness

leave. We could not check whether these exclusions were related to latex exposure, although this is unlikely as similar proportions of persons were not eligible in the medical and nonmedical group. Thus, 525 individuals were eligible for the study in the medical group and 264 in the nonmedical group.

All selected individuals received a letter explaining the objective of the study and a questionnaire. They were invited to schedule a free appointment at the allergy unit and to return the filled questionnaire during the consultation. Objective tests for sensitization to latex and common aeroallergens were performed and used to measure sensitization and allergy to latex as well as atopy status.

The participation rate was 70.5% in the medical group and 69.3% in the nonmedical group. Sixteen subjects from the medical group and 23 from the nonmedical group were excluded from the analysis because of incomplete information on exposure or because of difficulties interpreting the SPT (negative control that was positive or positive control that was negative). Persons with dermatographism were not excluded. Finally, 354 subjects from the medical and 160 from the nonmedical group were included in the analysis.

Exposure to Latex Gloves

Sterile and nonsterile powdered latex gloves were used in this hospital at the beginning of the study. Occupational exposure to latex was assessed using a questionnaire. Participants were asked whether they, or somebody near them, used latex gloves while working, currently or in the past. Active exposure, when the participant wore latex gloves, and, passive exposure, when somebody next to the participant wore gloves, were separately assessed. In both situations, duration and intensity of each episode of exposure were assessed: beginning and end of exposure, its overall duration and the average intensity (number of hours per week). We only show results using the number of years of exposure to latex gloves as exposure variable, but the results did not differ using intensity of exposure (number of hours per week times number of years exposed). Among those who were occupationally exposed, almost all reported having both, active and passive exposure. It is reasonable to assume that these exposures took place simultaneously, e.g., in a surgical ward. Thus, the comparison can only encompass active exposure to latex gloves.

Twenty-eight percent of subjects in the nonmedical group reported occupational exposure to latex gloves (fig. 1). We re-interviewed some subjects to check whether they were or had been exposed. They all confirmed previous occupational exposure to latex gloves either because they had previously worked in medical positions or because they had part-time medical activity despite being registered as administrative personnel. All except 1 person in the medical group reported being occupationally exposed to latex. Exposure status was therefore defined by the exposure to latex gloves reported in the questionnaire and not by the initial group assignment (medical and nonmedical groups).

Sensitization to Latex

Sensitization to latex was defined as a positive SPT to latex (Stallergènes, Antony, France) and/or specific latex IgE >0.35 UI/ml (CAP RAST, Pharmacia-Upjohn, Uppsala, Sweden). SPT were considered positive if the diameter of the papule was more than 3 mm in diameter and greater than the negative control (glycerin).

Symptoms in Response to Latex Exposure

The following symptoms appearing after exposure to latex at the workplace were recorded. Local symptoms included skin reactions

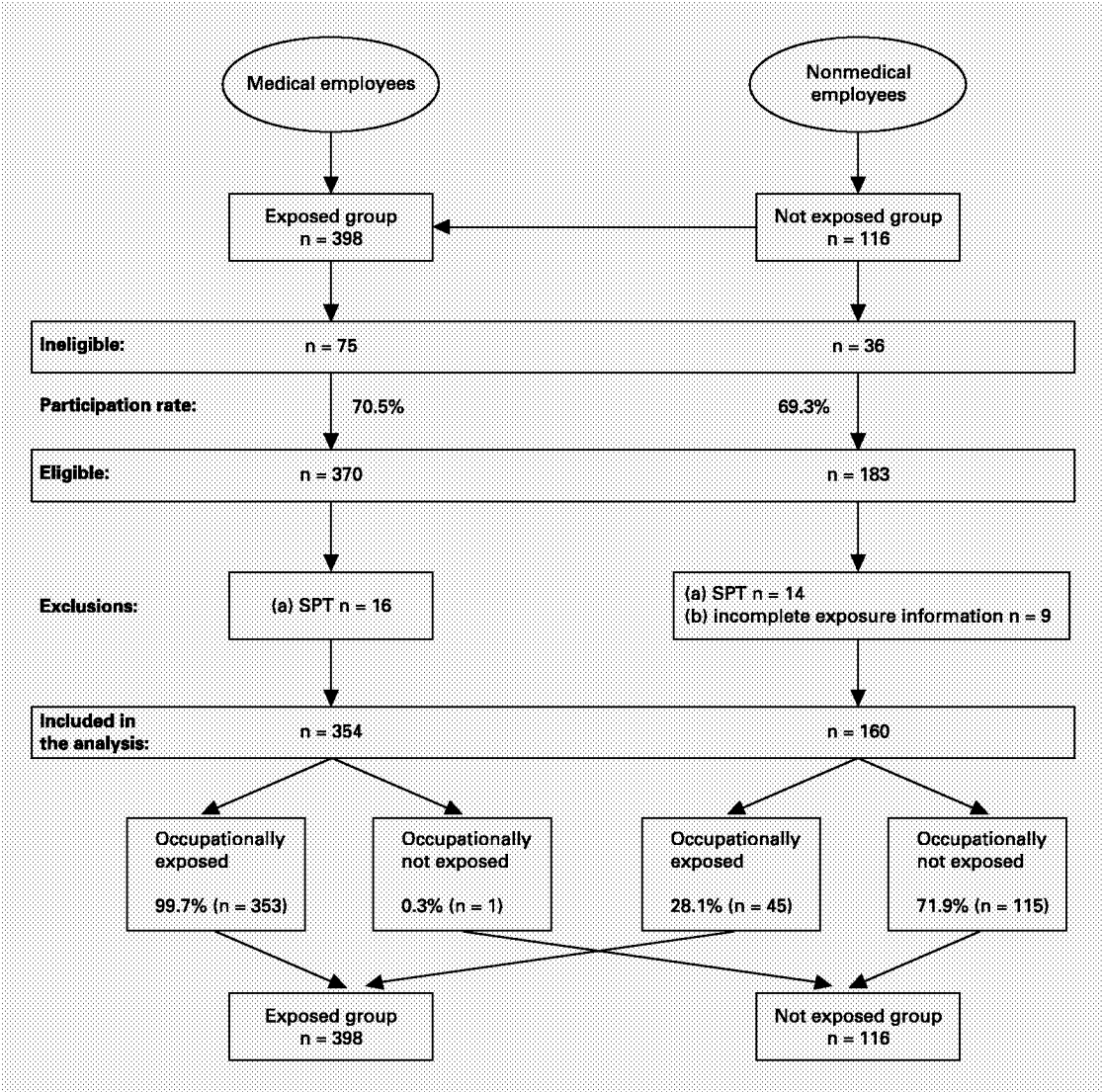


Fig. 1. Study design.

except on the hands (itching, urticaria and others), edema (lips, face, mouth or throat), eyes (redness, itching, watery eyes), nose (runny nose, itching, obstruction), respiratory problems (asthma, sneeze, cough). Presence of urticaria on the hands was also recorded but not included as there may be some ambiguity with symptoms of irritant and allergic contact dermatitis. Generalized symptoms after occupational exposure were present if participants reported vertigo or loss of vision, loss of consciousness, low blood pressure or anaphylactic shock.

Whether subjects avoided occupational exposure to latex or whether they were taking drugs for latex allergy treatment or prevention was also recorded.

Atopy

Atopy was defined by the presence of at least one positive SPT to an aeroallergen (excluding latex) and/or a positive serologic screening test (Phadiatop®, Pharmacia-Upjohn) (index ≥ 1). Positive SPT

controls were performed with histamine and negative SPT controls with glycerin.

The following aeroallergen extracts were used for SPT: a mixture of pollen from early blooming trees, a mixture from late blooming trees, a mixture of pollen from grass, a mixture of pollen from cereals, a mixture of pollen from Herbaceae, cat, dog and *Dermatophagoides pteronissinus* (all ALK-Abello, Trimedal, Brüttisellen, Switzerland).

Statistical Analysis

We categorized the exposure to latex gloves in tertiles of exposure duration (in years). The number of individuals included in each group did not exactly correspond to a third of the group as numerous individuals were tied by the same number of years of professional exposure and could not be separated. Other categorizations yielded similar results.

The risk of sensitization and of allergy to latex was obtained using multiple logistic regression and estimated with the odds ratio (OR)

Table 1. Descriptive characteristics and prevalence of atopy, sensitization and allergy to latex in occupationally exposed and not exposed subjects (University Hospital of Geneva, Switzerland, 1998–1999)

	Occupationally not exposed (n = 116), %	Occupationally exposed (n = 398), %	p value ^c
Gender			
Men	35.3	36.9	
Women	64.7	63.1	0.8
Atopy ^a	50.9	49.0	0.7
Asthma	4.6	8.1	0.2
Positive latex IgE	3.5	6.1	0.2
Positive latex SPT	3.5	7.8	0.1
Sensitization to latex ^b	6.0	10.8	0.1
Symptoms following professional exposure to latex			
Local	0.9	11.6	0.001
Generalized symptoms	0	0.8	0.5 ^d

^a Positive global IgE and/or positive SPT.
^b Positive latex IgE and/or positive latex SPT.
^c T test to assess differences between means and χ^2 to assess differences between proportions.
^d Fisher's exact test.

and its 95% confidence interval (CI). We tested whether there was a linear increase of risk introducing the exposure variable as a score in the model, and whether there was a threshold effect introducing the exposure as indicator variables. All analyses were adjusted for age and gender.

We assessed the agreement between sensitization (latex-specific SPT $\pm$ latex-specific IgE) and reported symptoms with the proportion of subjects in each of the four cells and the kappa statistic (proportion of subjects with positive and negative agreement taking into account the agreement that it is expected by chance alone). Kappa values range from -1 to 1. Values of zero mean no agreement and values between 0 and 0.4 are considered of low agreement [10]. We used SAS software (SAS Institute, Cary, N.C., USA) for the statistical analysis.

Results

The mean age (38.8 in the occupationally nonexposed group and 38.9 in the occupationally exposed group) and gender distribution did not differ between occupationally exposed and nonexposed subjects (table 1). The prevalence of atopy was also similar in both groups while the prevalence of asthma was almost twice as high in the exposed vs. the nonexposed group, although it did not reach statistical significance ($p = 0.2$). The prevalence of sensitization to latex (SPT and/or positive specific IgE) did not differ between the two groups. In contrast, exposed subjects reported local symptoms (respiratory and skin excluding hands) about 12 times more frequently than those not exposed ($p < 0.001$). Very few subjects

reported generalized symptoms, whether they were exposed or not. Further stratification of local symptoms into skin, nasal and bronchial symptoms did not yield any significant association with latex exposure or the duration of occupational latex exposure.

Regardless of occupational exposure, atopic individuals had a 10 times higher risk of sensitization to latex (OR = 10.3; 95% CI: 4.0–26.6) but not of having local symptoms (OR = 1.2; 95% CI: 0.7–2.3). Atopy did not significantly contribute to the risk of local symptoms in individuals who were occupationally exposed (OR = 1.9; 95% CI: 0.9–4.1). Eighty-four percent (11/13) of the subjects sensitized to latex and reporting no symptoms were atopic.

Although all nonatopics sensitized to latex were occupationally exposed (table 2), the overall frequency of sensitization among nonatopics was too low for a meaningful analysis. Among atopics, exposure to latex gloves slightly increased the risk of sensitization compared to those not exposed but remained nonsignificant. The risk of sensitization, however, tended to decrease with increasing years of exposure without being significant.

In nonatopics, no association was identified between local symptoms due to latex exposure and the number of years of exposure to latex gloves at work (table 3). This is in contrast to atopics, who were 10 times more likely to have local symptoms after ≥ 15 years of occupational exposure to latex gloves than atopics with ≤ 10 years of

Table 2. Proportion of subjects sensitized to latex and OR of sensitization^a by length of occupational exposure (University Hospital of Geneva, Switzerland, 1998–1999)

Atopy	Duration of exposure	Total	Sensitization, % ^a	OR ^b	95% CI
Absent	not exposed	57	0.0	– ^c	
	exposed				
	1–9 years	66	1.5	–	
	10–14 years	50	2.0	–	
	≥ 15 years	87	3.5	–	
Present	not exposed	59	11.9	1.0	(reference)
	exposed				
	1–9 years	75	22.7	2.1	0.8–5.6
	10–14 years	69	18.8	1.7	0.6–4.6
	≥ 15 years	51	15.7	1.5	0.5–4.8
	Linear trend			1.1	0.8–1.5

^a Positive SPT to latex and/or positive latex-specific IgE.
^b Adjusted for age and gender.
^c Not computed because of small number of sensitized subjects.

exposure (OR = 10.2; 95% CI: 2.5–42.3). The risk of local symptoms increased linearly with the number of years of occupational exposure.

The positive agreement and kappa statistic between sensitization and local symptoms (table 4) were low, especially among atopic subjects (positive agreement: non-atopics: 4.4; atopics: 0.8) (kappa values: nonatopics 0.2; atopics: 0.1). The negative agreement was high in atopics and nonatopics (90.7 and 76.7, respectively). Eighty-four percent (11/13) of the subjects sensitized to latex and reporting no symptoms were atopic.

Discussion

In this study population, symptoms but not objective tests of latex sensitization were associated with occupational exposure to latex gloves. Further, we found an association between the presence of local symptoms following latex exposure and the number of years of occupational

Table 3. Proportion and OR of local symptoms^a by level of occupational exposure, in atopic and nonatopic subjects (University Hospital of Geneva, Switzerland, 1998–1999)

Atopy	Duration of exposure	Total	Local symptoms after occupational exposure, % ^a	OR ^b	95% CI
Absent	1–9 years	66	10.6	1.0	(reference)
	10–14 years	50	6.0	0.6	0.1–2.3
	≥ 15 years	87	11.5	1.3	0.4–3.9
	Linear trend			1.1	0.6–2.0
Present	1–9 years	75	6.7	1.0	(reference)
	10–14 years	68	14.7	2.8	0.9–9.0
	≥ 15 years	51	21.6	10.2	2.5–42.3
	Linear trend			3.2	1.6–6.5

^a Local symptoms included skin reactions except on the hands (itching, urticaria and others), edema (lips, face, mouth or throat), eyes (redness, itching, watery eyes), nose (runny nose, itching, obstruction), respiratory problems (asthma, sneeze, cough).
^b Adjusted for age and gender.

Table 4. Agreement between sensitization^a to latex and local symptoms (University Hospital of Geneva, Switzerland, 1998–1999)

Sensitization ^a	Local symptoms	Nonatopic		p value ^b	Atopic		p value ^b
		n	%		n	%	
Present	present	2	0.8		11	4.4	
Present	absent	3	1.2		32	12.9	
Absent	present	19	7.4		15	6.0	
Absent	absent	234	90.7	0.001	191	76.7	0.05

^a Positive SPT to latex and/or positive latex-specific IgE.
^b p value obtained with Fisher’s exact test.

exposure to latex gloves in atopics. Both findings support the current preventive health policy of replacing powdered latex gloves.

Our results confirm the findings of the single previous study comparing individuals exposed to latex gloves with a group of nonexposed controls [3]. In this study, no significant association with latex-specific IgE but a significant association with rhinoconjunctivitis and hand symptoms was found.

The risk of being sensitized to latex decreased with longer duration of occupational exposure. Survival bias could explain these results, that is, atopic subjects may leave or change their jobs resulting in more nonsensitized people remaining among workers who have been exposed for a higher number of years. Local symptoms after occupational exposure but not sensitization to latex were strongly associated with occupational exposure to latex. Reporting bias among exposed subjects could explain these results. Exposure to latex is a delicate issue among hospital employees. In addition, the participants were probably aware of the hypothesis being tested in the study. However, the dose-response relation between the number of years of exposure and the presence of symptoms among atopic subjects supports the plausibility of this association. The association between local symptoms and professional exposure was only found in the group of atopics suggesting also that these results were not due to overreporting among professionally exposed subjects.

Generalized symptoms due to latex exposure were very uncommon in our study. The explanation that there is no risk of severe symptoms from professional exposure to latex is unlikely. It is more probable that those who had generalized symptoms changed their jobs and thus are not part of the study population. This speculation is supported by our routine clinical practice as allergists. We discourage or forbid nursing students to continue their profession, depending on the severity of symptoms induced by occupational exposure to latex. In other risk groups, such as children with spina bifida, a strong association of generalized symptoms appears to exist with nonoccupational exposure to latex [11, 12]. Children with spina bifida also differ from our risk group in that atopy and the duration of exposure (number of surgical interventions with latex contact) are independent risk factors for latex allergy [13–16].

Atopy is thought to be a risk factor for latex sensitization [17, 18]. Our study supports this notion. In contrast, atopy per se did not increase the risk to develop local symptoms upon latex exposure. In occupationally exposed atopics, however, increasing number of years of

latex exposure increased the risk of developing local symptoms, underscoring the importance of the duration of occupational exposure to latex for atopic subjects. The low agreement between sensitization and local symptoms was principally due to atopics who were sensitized but did not report local symptoms upon exposure to latex.

The main strength of this study is a comprehensive occupational exposure assessment. A possible enhancing effect of passive exposure or the effect of passive exposure alone could not be determined as both kinds of exposure took place at the same time. The participation rate was high and, more important, similar between the two groups, therefore limiting participation bias. Subjects currently working in administrative positions reported occupational exposure to latex gloves (28%). This fact highlights the need to fully assess present and past exposure in studies of latex exposure. It also stresses that hospital databases may not be reliable for information relating to occupational exposure.

In conclusion, these results support the current recommendation to replace powdered latex gloves. The novel argument for this recommendation is that in atopics, increasing years of professional exposure to latex gloves increases their risk to develop local symptoms compatible with latex allergy.

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