

# Prevalence and risk factors for latex allergy: a cross sectional study on health-care workers of an Italian hospital

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**Summary. Objectives:** The aim of this study was to determine prevalence and risk factors for latex hypersensitivity among health care workers (HCW) of an Italian general hospital.

**Methods:** 1747 HCW of the Ospedale Maggiore Policlinico of Milan were asked to fill in a questionnaire regarding latex-related manifestations (LRM) and personal medical history, and latex-specific IgE were measured by RAST-Cap system.

**Results:** 672 out of 1747 HCW (38.4%) answered to the questionnaire. LRM were reported by 168 out of 672 HCW (25%). The most common manifestation was hand dermatitis and itching (86.3%), followed by urticaria (3.5%), eczema (3.5%) and respiratory symptoms (2.9%). Among the HCW with LRM, 75 (44.6%) reported a personal history of atopy and 24 (14.3%) reported oral allergy syndrome, most commonly related to kiwi, tomato, peach and melon/watermelon. Latex-specific IgE were found in 62 out of 1747 HCW (3.6%). Among the subjects answering the questionnaire, latex-specific IgE positivity was associated with occurrence of LRM (most commonly allergic contact dermatitis) and a longer professional exposure. The risk of latex IgE sensitisation was four times higher in HCW reporting atopic manifestations than in HCW without atopic disorders. Prevalence of LRM and latex-specific IgE was significantly higher among workers of auxiliary staff than among other job categories. The highest latex-specific IgE levels were found in subjects with severe latex-related symptoms and a personal history of atopy.

**Conclusions:** A high prevalence of LRM was found among the HCW of an Italian general hospital, although a true latex sensitisation was detected only in a minority of cases. Members of the auxiliary staff, who wear latex gloves for several hours a day, had an increased prevalence of LRM and latex sensitisation. Atopy was a major risk factor for LRM and latex-specific IgE response.

**Key words:** allergy, health-care workers, IgE, latex

## Introduction

After the first report of an immediate allergic reaction to natural rubber latex in 1979 [1], a rapid increase in the prevalence of latex-related manifestations (LRM) has been documented by several studies [2,3]. In particular, LRM are an important health problem for hospital employees [4-6], rubber workers [7] and children with spina bifida and other congenital anomalies [8,9]. The frequent exposure to rubber products and latex-containing devices seems to be a major risk factor for the development of latex allergy

[10,11]. An increased prevalence of LRM has been observed in health-care workers (HCW), who are an occupationally exposed group [12,13]. According to several reports, the prevalence of latex allergy in the general population is less than 1% [14,15], whereas in HCW it ranges from 2.8% to 10.7% [13,17]. Latex antigen exposure can occur by cutaneous, percutaneous, mucosal and parenteral routes [18]. In addition, aerosol antigen transmission has been documented and the atmospheric glove powder acts as a vehicle for latex allergen, facilitating respiratory sensitisation in HCW [19-21]. Hand dermatitis associated with occupational

exposure to irritants, such as detergents and disinfectants, seems to be another risk factor for latex sensitisation. Irritant dermatitis disrupts the skin barrier and facilitates sensitisation to latex allergens [22,23]. A personal history of atopy and food allergy, including oral allergy syndrome (OAS) seems to be another important factor increasing the risk of latex sensitisation in exposed subjects [24-26].

It has been suggested that risk factors for latex allergy vary from country to country depending on the different pattern of glove use. Since few data from Italy are available, we carried out a cross sectional study on LRM in the HCW of a general hospital at Milan; furthermore, we tried to identify the major risk factors for latex sensitisation and we compared our findings with other studies performed in different countries.

## Subjects and methods

The study was carried out among the HCW of the Ospedale Maggiore Policlinico of Milan, a 600-bed general hospital with medical, surgical and intensive care units. Sterile and non-sterile latex gloves of different manufacturers are commonly used in all hospital departments and vinyl gloves are provided on special request only. Routine haematological examinations are performed in all hospital employees every other year. On the occasion of blood collection, the hospital employees were asked to consent to latex-specific IgE determination and to fill a questionnaire regarding LRM and potential risk factors for latex hypersensitivity. In particular, detailed information was asked concerning seniority of work, personal history of atopic disease, clinical symptoms after contact with latex devices, pre-existing hand dermatitis, food adverse reactions and the number of surgical procedures in the past. The subjects were classified in different job categories (nurses, nurse students, physicians, technicians, auxiliary staff) and occupational groups (laboratory, nurse students, internal medicine, operating room and surgeons, emergency room, other services). The employees assigned to patient cleaning and moving, room cleaning, and blood samples carriage from wards to laboratories were classified as auxiliary staff. Atopy was considered positive on the basis of personal history or previous positive diagnostic test (skin prick test, RAST) to at least one common allergen. Every subject gave an informed consent to latex-specific IgE determination.

The diagnosis of LRM was done on the clinical report of reactions following latex exposure, associated or not with RAST positivity. Type 1 latex allergy was diagnosed on the basis of clinical manifestations and RAST positivity.

## Specific IgE determination

A blood sample was drawn from all consenting subjects

for serologic analysis. Natural rubber latex-specific IgE was measured by RAST-CAP System (Pharmacia, Uppsala, Sweden), and reported in kU/l. Concentrations above 0.35 kU/l were considered positive.

## Statistical analysis

Statistical analyses were performed by using chi-square test, Mann-Whitney U test and Spearman's rank correlation. All P values were 2-tailed, and those below 0.05 were considered significant. Odds ratio (OR) and relative risk (RR) were calculated with an estimated sensitivity of greater than 95% to be established with a 95% confidence interval.

## Results

### Latex-related manifestations (LRM)

Six hundred seventy-two out of 1747 HCW (38.5%) filled in the questionnaire regarding personal medical history and LRM. Participation rate was significantly higher among people working in operating rooms, radiology and nurse students, whereas it was significantly reduced among people working in laboratory, internal medicine and other services (administration, caretakers, switchboard) (table 1). LRM were reported by 168 out of 672 workers (25%) whose mean age and mean professional exposure were not significantly different from those of subjects without LRM (table 2). However, M/F ratio was significantly lower among the former than among the latter ( $p < 0.001$ , OR 0.47, RR 0.56). The most common manifestation in workers with LRM was hand dermatitis and itching, which was complained by 145 out of 168 subjects (86.3%). Personal history of atopy was reported by 75 workers with LRM (44.6%) vs. 157 HCW without LRM (31.1%,  $p < 0.001$ , OR 1.7, RR 1.5). Asthma and rhinoconjunctivitis were the most common atopic manifestations, which were complained by 28 (37.3%) and 21 (28%) HCW, respectively. OAS symptoms were reported by 24 out of 168 subjects with LRM (14.2%,  $p < 0.001$ , OR 2.5, RR 2.3 vs. subjects without LRM). The most frequently OAS-associated fruits were: kiwi (37.5%), tomato (29.1%), peach (16.6%) and melon/watermelon (16.6%). Prevalence of LRM was significantly increased among members of auxiliary staff ( $p < 0.0001$ , OR 3.16, RR 2.15), whereas it was reduced among nurse students ( $p < 0.001$ , OR 0.008, RR 0.1).

### Latex-specific IgE determination

Latex-specific IgE antibodies were found in 62 out of 1747 HCW (3.6%). Among the 672 subjects answering the questionnaire, 30 (4.4%) had latex-specific IgE; their

Table 1. Participation rate in the latex study according to the occupational setting of health care workers

Occupational group	Subjects answering the questionnaire (%)	Subjects not answering the questionnaire (%)	p value
Different services	9 (5.6)	151 (94.3)	<0.0001
Laboratory	31 (20.4)	121 (79.6)	<0.0001
Internal Medicine	111 (27.3)	296 (72.7)	<0.0001
Emergency	115 (34.4)	219 (65.6)	n.s.
Nurse students	35 (52.2)	32 (47.8)	<0.03
Radiology	46 (51.1)	44 (48.9)	<0.02
Operating room	325 (60.5)	212 (39.5)	<0.0001
Total	672 (38.5)	1075 (61.5)	

n.s.: not significant

Table 2. Characteristics of the HCW with and without LRM

	LRM	No LRM	p value§	Unadjusted OR
No. of subjects (%)	168 (25)	504 (75)		
Sex M/F, n (%)	40/128 (23.8/76.2)	199/305 (39.5/60.5)	0.0003	OR 0.47 (RR 0.56)
Age (mean ± SD)	38.6 ± 8.1 yrs	36 ± 11.6 yrs		
Seniority of work (mean ± SD)	9.8 ± 7.5 yrs	10.5 ± 9.1 yrs		
<b>Subjects with personal history of atopy, n (%)</b>	75 (44.6)	157 (31.1)	0.001	OR 1.7 (RR 1.5)
<b>Atopic symptoms, n (%) *</b>				
Rhinoconjunctivitis	21 (28)	33 (21)		
Lower respiratory tract symptoms	28 (37.3)	67 (42.6)		
Food allergy	2 (2.6)	5 (3.18)		
Drug allergy	14 (18.6)	31 (19.7)		
Metal allergy	7 (9.3)	10 (6.3)		
Urticaria/eczema,	3 (4)	7 (4.4)		
Other allergies		4 (2.5)		
<b>Oral allergy syndrome, n (%)**</b>	24 (14.2)	31 (6.1)	0.001	OR 2.5 (RR 2.3)
<b>Latex-specific IgE positive, n (%)**</b>	20 (11.9)	10 (1.9)	<0.0001	OR 6.6 (RR 6.0)
<b>Latex-associated symptoms, n (%) ***</b>				
Contact dermatitis/pruritus	145 (86.3)			
Urticaria	6 (3.5)			
Eczema	6 (3.5)			
Respiratory and cutaneous symptoms	5 (2.9)			
Respiratory symptoms only	5 (2.9)			
Anaphylactic shock	1 (0.5)			
<b>Job category, n (%)</b>				
Nurse students	1 (3)	34 (97)	0.0009	OR 0.08 (RR 0.10)
Auxiliary staff	42 (47)	48 (53)	< 0.0001	OR 3.16 (RR 2.15)
Nurses	80 (25)	241 (75)		
Physicians	31 (19)	132 (81)		
Laboratory technicians	6 (19)	25 (81)		
Radiology technicians	4 (21)	15 (79)		
Other services	4 (31)	9 (69)		

§ p value is not indicated if not significant

\* results are expressed as the numbers of subjects with and without LRM reporting a determined atopic manifestation; the percentages are calculated over the total numbers of subjects with and without LRM reporting a personal history of atopy.

\*\* the percentages of subjects with oral allergy syndrome or with latex-specific IgE are calculated over the total numbers of subjects with or without LRM.

\*\*\*results are expressed as the numbers of subjects complaining of a determined latex-associated symptom; the percentages are calculated over the total numbers of subjects reporting LRM.

M/F ratio was 8/22 and the mean age was  $36 \pm 9.1$  years. Mean professional exposure of these subjects was  $13.7 \pm 9.1$  years, which was significantly higher than that of subjects without latex-specific IgE ( $10.5 \pm 8.6$  years,  $p < 0.005$ ) (table 3). Latex-specific IgE were detected in 20 out of 168 subjects (11.9%) with LRM. Indeed, LRM were significantly more frequent in subjects with latex-specific IgE than in subjects without latex-specific IgE ( $p < 0.0001$ , OR 6.6, RR 6.0). Twenty out of 30 subjects (66.6%) with latex-specific IgE complained of at least one symptom related to latex exposure.

Allergic contact dermatitis was reported by 14 out of 20 (70%) subjects with latex-specific IgE ( $p = 0.002$ ,

OR 3.3, RR 3.1). In contrast, 133 (89.8%) HCW with LRM, but without latex-specific IgE, complained of irritative contact dermatitis.

The risk of latex IgE sensitisation was four times higher in workers reporting atopic manifestations than in workers without atopic disorders (21/232, 9% vs. 9/440, 2%,  $p < 0.0001$ , OR 4.7, RR 4.4). Allergic rhinoconjunctivitis was the most common atopic manifestation reported by subjects with latex-specific IgE ( $p < 0.001$ , OR 5.5, RR 4.5). Furthermore, subjects reporting OAS were more likely to have positive latex-specific IgE than subjects without latex-specific IgE (26.6% vs 7.3%,  $p < 0.0001$ , OR 8.4, RR 5.4). Prevalence

Table 3. Characteristics of the HCW with and without latex-specific IgE

	Latex-specific IgE positive	Latex-specific IgE negative	p value§	Unadjusted OR
Subjects, n (%)	30 (4.4)	642 (95.5)		
Sex M/F, n (%)	8/22 (26.7/73.3)	231/411 (36/64)		
Age (mean $\pm$ SD, yrs)	$36 \pm 9.1$	$37 \pm 10.2$		
Seniority of work (mean $\pm$ SD, yrs)	$13.7 \pm 9.1$	$10.47 \pm 8.6$	0.004	
<b>Subjects reporting LRM, n (%)</b>	20 (66.6)	148 (22)	<0.0001	OR 6.6 (RR 6)
<b>Latex-associated symptoms, n (%) *</b>				
Contact Dermatitis	14 (70)	133 (89.8)	0.002	OR 3.3 (RR 3.1)
Urticaria	1 (5)	4 (2.7)		
Eczema	0	6 (4)		
Respiratory/cutaneous symptoms,	4 (20)	1 (0.6)	0.0007	OR 36.7 (RR 8.15)
Anaphylactic shock	1 (5)	0		
Respiratory symptoms	0	4 (2.7)		
<b>Subjects with atopic disease, n (%)</b>	21 (70)	211 (32.8)	<0.0001	OR 4.7 (RR 4.4)
<b>Atopic symptoms, n (%) **</b>				
Rhinoconjunctivitis	13 (61.9)	48 (22.7)	0.0003	OR 5.5 (RR 4.5)
Lower respiratory tract symptoms	5 (23.8)	84 (39.8)		
Food allergy	1 (4.7)	6 (2.8)		
Drug allergy	2 (9.5)	43 (20.3)		
Urticaria/eczema	0	9 (4.2)		
Metal allergy	0	16 (7.5)		
Other allergies	0	5 (2.3)		
<b>Oral allergy syndrome, n (%) ***</b>	8 (26.6)	47 (7.3)	<0.0001	OR 8.4 (RR 5.4)
<b>Job category, n (%)</b>				
Auxiliary staff	8 (9)	82 (81)	0.048	OR 2.48 (RR 2.35)
Nurses	9 (3)	312 (97)		
Physicians	7 (4.3)	156 (96)		
Nurse students	2 (5.6)	33 (94.3)		
Radiology technicians	2 (10.5)	17 (89.5)		
Laboratory technicians	2 (6.5)	29 (93.5)		
Other services	0	13 (100)		

§ p value is not indicated if not significant

\* results are expressed as the numbers of latex-specific IgE-positive or -negative subjects complaining of a determined latex-associated symptom; the percentages are calculated over the total numbers of latex-specific IgE-positive or -negative subjects reporting latex-associated symptoms

\*\* results are expressed as the numbers of latex-specific IgE-positive or -negative subjects complaining of a determined atopic manifestation; the percentages are calculated over the total numbers of latex-specific IgE-positive or -negative subjects reporting atopy.

\*\*\* the percentage of subjects reporting oral allergy syndrome is calculated over the total numbers of subjects with or without latex-specific IgE.

of latex-specific IgE was significantly increased among members of the auxiliary staff ( $p < 0.05$ , OR 2.48, RR 2.35), in comparison with other job categories.

No significant correlation was found between latex-specific IgE concentrations and numbers of clinical symptoms ( $r = 0.16$ , *p* n.s.). However, four subjects with the highest latex-specific IgE levels (ranging between 7.4 and 24.2 kU/l), reported severe latex-related symptoms (anaphylactic shock in one case, asthma, rhinoconjunctivitis, urticaria and dermatitis in the other three cases).

## Discussion

The findings of the epidemiological survey carried out at the Ospedale Maggiore Policlinico of Milan demonstrate a high prevalence of LRM among Italian HCW, since 25% of the participants complained of latex-associated symptoms. Although preferential participation of certain employees who were more likely to be exposed to latex devices carries the risk of over-estimation, LRM are certainly a common problem for the general population of HCW.

The most frequent manifestation was hand dermatitis and itching, and only in a minority of cases respiratory symptoms (asthma and/or rhinitis) were reported. Latex-specific IgE was found in 3.6% of the hospital employees and in 11.9% of the subjects reporting LRM. The overall prevalence of serum positivity for latex-specific IgE is in line with published data on HCW, although quite large variations have been found in different countries (latex-specific IgE antibodies have been found in a percentage of HCW ranging from 0.5% to 8.9%) [27,28]. The observation that only a minority (11.9%) of subjects reporting LRM had latex-specific IgE is not surprising since the most common clinical manifestation, i.e. hand dermatitis, is usually unrelated to an IgE-mediated mechanism. The high prevalence of irritant dermatitis without latex sensitisation may be partly explained by the occlusion effect of gloves, the irritative effects of soaps and disinfectants or by a chemical sensitisation towards additive substances added during the rubber-manufacturing process like vulcanisers and accelerators (thiurams, dithiocarbamates, thiazoles and xanthates) [29-31].

Furthermore, the use of cornstarch-powdered gloves has led to an increase of adverse manifestations related to glove powder exposure. Although a true allergic reaction towards cornstarch powder is uncommon, it must be noted that it has the capacity to bind and release latex allergens, hence favouring local or airborne sensitisation [32,33].

The presence of latex-specific IgE was associated with an increased risk of LRM. We believe that those subjects who have latex-specific IgE, but do not complain of any manifestation related to latex exposure, should be anyway considered at risk for this kind of

problem, and should be carefully followed-up. High levels of latex-specific IgE were found in the subjects presenting the most severe symptoms.

LRM were not related to age and seniority of work. However, M/F ratio was significantly lower among subjects with LRM than among subjects without LRM. This can be explained by female predominance among job categories with the highest numbers of subjects reporting LRM, i.e. auxiliary staff and nurses. Prevalence of LRM was significantly increased among members of the auxiliary staff, whereas it was decreased among nurse students. This result can be ascribed to the fact that members of the auxiliary staff wear latex gloves for several hours a day. Also the risk for development of a latex-specific IgE response was significantly increased among members of the auxiliary staff. Seniority of work was significantly higher in the subjects with latex-specific IgE than in those without specific IgE. Therefore, the duration of the exposure to latex-containing products seems to increase the risk for the development of a latex-specific IgE response.

An increased prevalence of atopic disorders was found either in subjects with LRM or in subjects with latex-specific IgE, indicating that atopy is a risk factor for latex sensitisation. Rhinoconjunctivitis and asthma were the atopic manifestations most commonly associated with LRM and with latex-specific IgE. This may be explained by the observations of Fuchs et al. [34] who have identified a high-molecular-weight cross-reactive glycoprotein allergen in timothy grass pollen, ragweed pollen and latex; this could provide an explanation for sensitisation to latex in certain individuals with pollen allergy [35].

OAS was quite a common problem in the subjects reporting LRM, most commonly after ingestion of kiwi, tomato, peach, banana and melon/watermelon. This observation confirms the so called "latex-fruit syndrome" [36,37], which is related to clinical and immunochemical cross-reactivity between latex and fruit or vegetable allergens, and this could suggest an alternative way of sensitisation in subjects with latex-specific IgE who do not complain of any symptom after latex exposure [38-40].

In conclusion, prevalence of LRM among HCW of an Italian general hospital is high, although a true latex sensitisation occurs only in a minority of cases. Since latex sensitisation carries the risk of serious hypersensitivity reactions, we suggest that early detection of LRM in the working place is important to avoid potential risks and life-threatening reactions. All HCW should fill in a questionnaire regarding LRM and allergic disorders and further investigations should be performed if necessary. Preventive measures should be adopted in occupational settings where subjects with LRM are employed [41,42]. These measures include the use of allergen-free gloves for subjects who are already sensitised to latex and the use of nonpowdered gloves for subjects at risk for latex sensitisation [43].

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