



## The Prevalence of Specific IgE Antibodies to Natural Rubber Latex in Healthcare Workers in Israel

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Key words: natural latex rubber, IgE-specific antibodies, healthcare workers

### Abstract

**Background:** According to studies from different countries, the prevalence of natural rubber latex sensitization in healthcare workers ranges from 2.9 to 17%.

**Objective:** To estimate the prevalence of NRL-specific IgE antibodies in healthcare workers in Israel.

**Methods:** Three hundred healthcare workers, mostly from a major pediatric tertiary care facility, and 15 non-healthcare workers completed a questionnaire on signs and symptoms of NRL allergy and other respiratory and food allergies. NRL-specific IgE antibodies were assayed with the DPC AlaSTAT-ELISA method.

**Results:** Seventy of the 300 workers (23.3%) reported symptoms of NRL allergy: hand eczema and pruritus in 63, upper respiratory tract and ocular symptoms in 10, shortness of breath in 2, and generalized rash in 6. None had anaphylaxis due to latex exposure. There was a significant correlation of symptoms of NRL allergy with atopy and job category (nurses, laboratory technicians, nurse assistants and dental medicine workers), but not with gender, age, or years of employment. The *in vitro* tests for specific IgE antibodies against NRL were positive ( $\geq 0.70$  IU/ml) in five workers (1.66%).

**Conclusions:** This is the first study of the prevalence of NRL-specific IgE antibodies in healthcare workers in Israel. Our 1.66% sensitization rate is much lower than that reported for healthcare workers in other countries. This difference may be due to our inclusion of a study population with a relatively low exposure to latex gloves (pediatricians compared to surgeons). Further studies are needed in this and other high risk populations in Israel.

*IMAJ 2000;2:154-157*

The barrier properties, elasticity, and shape memory of natural rubber latex make it the preferred material for surgical and examination gloves and other medical prod-

ucts [1]. NRL was introduced for use in surgical gloves in the 1930s, and for over 50 years was considered relatively harmless, causing only contact dermatitis or irritant dermatitis. In the past decade, however, immediate-type I allergic reactions have been reported in a growing number of people [2]. The reason is still unclear, but it is apparently related to the increased demand for latex gloves following the 1987 publication in the USA of the universal precautions against infection [3].

Today, medical products, especially surgical gloves, remain the largest single source of exposure to latex and the major cause of type I allergic reactions to latex rubber proteins in susceptible individuals. Type I NRL allergy is manifested by contact and/or generalized urticaria, rhinoconjunctivitis, bronchospasm and anaphylaxis (especially during surgery or invasive procedures) [3,4]. Exposure may be by direct contact or by inhalation of the allergen carried by the cornstarch powder that coats latex gloves [5].

Several populations have been recognized to be at risk of NRL allergy, namely healthcare workers, children with spina bifida, children with other congenital abnormalities (mainly urologic), patients who have undergone multiple surgical procedures, and workers in the rubber industry [6].

The diagnosis of NRL allergy is made on the basis of a convincing history of an immediate latex-induced reaction and the demonstration of NRL-specific IgE antibodies (sensitization) by positive skin test or the presence of specific IgE serum antibodies or both [7-9]. Studies from multiple centers in different countries report a 2.9-17% prevalence of latex sensitization in healthcare workers, including dental staff, with the highest rates noted in operating units where latex gloves were in daily use [10-16].

The aim of the present study was to estimate the prevalence of NRL-specific IgE antibodies in healthcare workers in Israel.

### Methods

A uniform questionnaire was administered to healthcare workers, mainly from a major pediatric and a general ter-

NRL = natural rubber latex

tiary care center in Israel, and non-healthcare workers who agreed to participate in the study. The questionnaire assessed the following:

- Personal data (age, gender, job or professional category, years of employment)
- History of allergic reactions attributed to exposure to products made from NRL (hand pruritus and eczema, urticaria, angioedema, rhinitis, shortness of breath and wheezing, syncope and hypotension)
- Co-existence of atopy and/or other allergies (allergic rhinitis, bronchial asthma, eczema, food or drug allergy)
- Presence or absence of allergic reaction during or after undergoing surgical or other medical procedures (if applicable).

Blood samples were obtained by venipuncture, and the serum was separated and analyzed for NRL-specific IgE antibodies with the AlaSTAT ELISA assay (Diagnostic Products Corp., Los Angeles, USA) (FDA-approved). In brief, ligand-labeled latex and serum samples were incubated in ligand-coated tubes. Anti-ligand was added, and IgE-latex complexes were immobilized in the tubes. Unbound antibodies were removed by washing, and IgE was detected with enzyme-labeled anti-IgE. After adding the substrate, the absorbance was read at 490 nm. Results of class II (0.70 IU/ml) AlaSTAT or higher were considered positive [7].

Multivariate logistic regression analysis was used to examine the association between self-reported NRL allergy and age, gender, job category, years of employment, and history of surgeries. Chi-square test, or Fisher's exact test if required, was used to examine the prevalence of self-reported NRL allergy. The study was approved by the local ethics committee.

## Results

Three hundred healthcare workers and 15 non-healthcare workers completed the questionnaire and were tested for the presence of specific IgE antibodies against NRL. The different professional groups are presented in Table 1. Except for the seven dental medicine personnel who were employed in an external clinic, 94% of the healthcare workers worked at the Schneider Children's Medical Center of Israel and 6% at the Rabin Medical Center.

Seventy (23.3%) healthcare workers reported symptoms that they attributed to NRL exposure, mainly (90%) hand eczema and pruritus [Table 2]; and 140 reported other allergic diseases, namely drug allergy (n=105), rhinorrhea and sneezing (n=69), eczema (n=44), bronchial asthma (n=24), and food allergy (n=6: 2 to kiwi, 1 to figs, 2 to peaches, and 1 to peanuts). The 15 non-healthcare workers did not report any symptoms attributed to NRL exposure.

**Age and gender:** There was no statistically significant correlation between self-reported NRL symptoms and age

Table 1. Job or professional categories of 300 healthcare workers examined for NRL sensitization

Category	No. of workers (%)	Self-reported NRL Allergy No. (%)
Physicians	87 (29.0)	11 (12.6)
Nurses	102 (34.0)	23 (22.5)*
Laboratory workers	41 (13.7)	21 (51.2)**
Technicians	10 (3.3)	1 (10)
Dental medicine practice workers	7 (2.3)	7 (100)***
Nurse assistants	13 (4.3)	5 (38.4)****
Orderlies	5 (1.6)	0 (0)
Medical/nursing students	8 (2.6)	0 (0)
Administrative workers	17 (3.6)	1 (5.8)
Paramedical workers (psychologists, dietitians, social workers, physiotherapists)	10 (3.3)	2 (20)
Non-healthcare workers	15	0 (0)

\*  $P=0.039$

\*\*  $P\leq 0.001$

\*\*\*  $P<0.00001$

\*\*\*\*  $P=0.0153$

Table 2. Self-reported symptoms of NRL allergy among 70 healthcare workers

Symptoms	No. of workers (%)
Hand eczema and pruritus	63 (90)
Generalized rash with or without angioedema	6 (8.5)
Rhinoconjunctivitis	10 (14.3)
Shortness of breath	2 (2.8)
Anaphylaxis	0
More than one symptom	7 (10)

and gender of the respondents ( $P=0.517$ ) (data not shown).

**Job category:** Table 1 presents the rates of self-reported NRL allergy symptoms by job or professional category. Rates ranged from zero for students, orderlies and non-healthcare workers to 100% for dental medicine workers. Comparison of the findings with a group of administrative workers (n=17) together with the 15 non-healthcare workers (representing the general population) yielded a significantly higher rate of self-reported NRL allergy in nurses ( $P=0.039$ ), laboratory workers ( $P\leq 0.001$ ), dental workers ( $P<0.00001$ ), and nurse's aids ( $P=0.0153$ ).

**Years of employment:** Of the 300 healthcare workers, 158 had been employed in the same job for 0–9 years, 60 for 10–19 years, 63 for 20–29 years, and 19 for 30 years or more. No correlation was found between self-reported NRL allergy symptoms and years of employment ( $P=0.1594$ ).

**History of surgery:** There was no significant correlation of self-reported NRL symptoms with history of surgery ( $P=0.7515$ ) (data not shown). Specifically, none of the workers reported an allergic reaction during surgery.

**Atopy:** Of the 300 participants 140 had symptoms of atopic diseases and other allergies, including 50 (36%) with NRL allergy, and 160 had no such symptoms, including only 20 (12.5%) with NRL allergy. The correlation between self-reported NRL allergy and the presence of

Table 3. Data for the healthcare workers with positive test for specific IgE antibodies against NRL

No.	Professional category	AlaSTAT test (IU/ml)	Symptoms of atopy	Symptoms and signs of NRL allergy
1	Laboratory worker	0.87 (class II)	Rhinitis, eczema	Hand eczema
2	Laboratory worker	0.77 (class II)	None	None
3	Dentist	1.15 (class II)	None	Hand erythema, generalized rash, rhinoconjunctivitis and shortness of breath when wearing latex gloves
4	Pediatrician	7.29 (class III)	Rhinitis, asthma	Hand redness and vesicles after prolonged glove wearing
5	Dentist	34.25 (class IV)	Rhinitis	Hand erythema, generalized rash, rhinoconjunctivitis and shortness of breath when wearing gloves; shortness of breath after IV line

atopic diseases and other allergies was statistically significant ( $P=0.0001$ ).

**Specific IgE antibodies:** Five workers had a positive test for specific (class II) IgE antibodies against NRL. One of them did not report any symptoms attributed to NRL exposure. The details of these five workers are presented in Table 3. Thus, the rate of NRL sensitization in our study group of health care workers was 1.66%.

## Discussion

The personal and institutional consequences of latex allergy are considerable. Sensitized workers may develop occupational asthma, which may lead to persistent impairment [17]. Medical procedures on sensitized personnel may be complicated by anaphylactic events [4]. Sensitized workers must be provided with a safe environment, including use of non-latex gloves to avoid direct contact with the offending allergen [18]. All workers should use non-powdered latex gloves to prevent airborne latex exposure. It is important that all healthcare workers be evaluated for latex sensitization.

We conducted a survey of NRL-specific IgE antibodies in 300 healthcare workers, most of them (94%) employees at the Schneider Children's Medical Center of Israel. Seventy (23.3%) workers reported symptoms attributed to latex glove exposure, mainly (90%) hand eczema and pruritus. No anaphylactic events were noted. The AlaSTAT test demonstrated specific IgE antibodies against NRL ( $\geq$  class II) in five participants at a rate of 1.66%, which is much lower than that reported in healthcare workers in other countries. We assume that the low rate of specific IgE antibodies against NRL in our study, compared to others, was due mainly to the composition of our study population, namely pediatricians and pediatric nurses (63%) whose use of latex gloves is lower than among surgeons and operating unit nurses.

The diagnosis of NRL allergy is made on the basis of a convincing history of an IgE-mediated reaction to NRL, together with positive latex prick skin test and/or *in vitro* tests for specific IgE antibodies against NRL. The latex prick skin test was found to have a sensitivity of 95% and specificity of 100% at a concentration of 100  $\mu$ g/ml, and 99% sensitivity and 96% specificity at a concentration of 1 mg/ml [8]. We did not perform latex skin tests because the reagent has not yet been approved by the Israel Ministry of Health. Instead, we performed the AlaSTAT test to detect specific IgE antibodies against NRL. The AlaSTAT test has been reported to have 73.3% sensitivity and 97.2% specificity [9]. However, we cannot relate to the AlaSTAT sensitivity and specificity in our study, since most of the self-reported symptoms of NRL allergy (90%) were hand eczema and pruritus, which can be an irritant dermatitis, i.e., not immunologically mediated, or contact dermatitis. Contact dermatitis is a type IV hypersensitivity reaction, and latex gloves are known to be the most frequent cause of contact dermatitis in healthcare workers [6]. Furthermore, irritant and contact hand dermatitis are predisposing factors for NRL sensitization [15]. A study conducted in the Netherlands reported glove-related hand dermatitis in 36.9% of 98 interviewed laboratory workers; and a positive patch test result for rubber additives was seen in 6.6% [16]. Two of our workers with a class II–III positive AlaSTAT test had symptoms of hand eczema/dermatitis only.

A statistically significant difference in the rate of self-reported NRL allergy was found between the non-healthcare workers including administrative workers, representing the general population, and the healthcare workers, including nurses, laboratory workers, dental medicine workers and nurse's aids, all of whom use latex gloves frequently and for prolonged periods. A positive test for specific IgE antibodies was found in 28.6% of dentists and dental assistants (2 of 7), 4.9% of laboratory workers (2 of 41) and 1.2% of physicians (1 of 87), but owing to the small number of positive AlaSTAT tests no statistical analysis could be done. Other studies have reported sensitization rates of 10% in dentists [11], 7.4% in surgeons, 5.6% in operating room nurses [12–14], 5% in laboratory workers [16], and 8% in housekeeping personnel [19]. The high rate of NRL sensitization in dentists in our study was probably due to their non-random recruitment to the study: they volunteered for the study because they had clinical symptoms of NRL allergy. The low rate of NRL sensitization among the physicians was apparently due to the fact that most were pediatricians, who use latex gloves relatively less than surgeons.

Like other reports in the literature on healthcare workers [10], we did not find any correlation between years of employment and NRL sensitization. Such a correlation, however, was found in greenhouse workers [20]. Therefore, we suspect that our finding can be explained by the fact that the tenured workers had been using latex gloves

continuously only for the last 5 years. Neither did we find any correlation between the workers' gender and self-reported NRL allergy and NRL sensitization. According to the literature, NRL allergy is more prevalent in women [7].

Atopy is a known risk factor for NRL allergy [21]. Arrelano et al. [13] found that the prevalence of NRL allergy was higher in the healthcare workers who had atopic symptoms, and 24% of them had a positive latex skin test. We also found that 36% of the workers with symptoms of other allergies also had symptoms of NRL allergy, compared to 12.5% of those without other allergic symptoms. Furthermore, 60% (3 of 5) of the workers with a positive AlaSTAT test were atopic, compared to 46% (135 of 295) of those with a negative AlaSTAT test. This finding is in accordance with the results of Sussman et al. [3], who reported that 57% of patients with NRL allergy were atopic compared to 20% in the general population.

There is a high prevalence of NRL allergy in atopic patients with fruit allergy (kiwi, avocado, banana). These fruit-allergenic proteins are homologous with NRL proteins [22]. We found four workers who reported allergic reactivity to fruit (kiwi, figs, peach), but none of them reported NRL allergy, and the AlaSTAT test was negative in all of them.

In summary, we noted a low prevalence of specific IgE antibodies to NRL (1.66%) among 300 healthcare workers, the majority of whom were pediatricians and pediatric nurses. Most of the relevant symptoms were local (on the hand), which appeared after the wearing of latex gloves and could be attributed to irritant dermatitis or contact dermatitis (not IgE-mediated). Further studies are needed to determine the prevalence of NRL sensitization in health-care workers and other at-risk populations in Israel.

**Acknowledgment:** The authors thank Gabriel Chodick, MSc, for the statistical analysis, Yafa Aurbach, PhD, Tehila Dan, MSc, and Shula Peleg, MSc, from the Schneider Children's Medical Center of Israel for performing the AlaSTAT assays, and Charlotte Sachs and Gloria Ginzach of the Editorial Board, Rabin Medical Center (Beilinson Campus), for their editorial assistance.

This study was performed as part of the requirements for the MD degree of S. Lieberman, Hebrew University Hadassah Medical School, Jerusalem.

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*Dignity does not consist in possessing honors, but in deserving them.*

*Aristotle*