

Latex Sensitization: Occupational Versus General Population Prevalence Rates

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Background Natural rubber latex (NRL) has become an important occupational health concern in recent years, particularly among health care workers. It has been suggested in some reports that the prevalence of latex sensitization among occupationally exposed groups is not different from that in the general population.

Methods The findings of prevalence studies conducted among occupationally-exposed and general population groups were reviewed to determine whether there is evidence to support this suggestion.

Results Numerous surveys of HCWs have demonstrated that the prevalence of sensitization to latex ranged in most studies from 5 to 12%; sensitization of HCWs may produce clinical effects including urticaria, rhinoconjunctivitis, occupational asthma, and potentially life-threatening anaphylactic shock. More than a decade ago, data from Finland indicated that the prevalence of latex allergy in the general population was less than 1%. Recent reports from Finland have confirmed this, with observations that 0.7–1.1% of large series of patients were NRL-allergic, while among 804 unselected patients, the prevalence of latex skin prick test (SPT) positivity was 0.12%. In contrast, other studies have suggested that from 4 to 6.4% of individuals tested were positive for serum latex-specific IgE antibodies. However, the specificity of these assays has been reported to be low. In three recent studies based on SPTs, published in 1997, the prevalence of positive reactions to latex was about 1% or less. The prevalence was 0.7% (95% CI 0.3–1.4) among 758 apprentices in Quebec, Canada; and 1.1% among more than 3,000 children tested in Finland (1.0% confirmed on latex use test). There were no first- and second-year dental students with positive latex SPTs in Ontario, Canada.

Conclusions These recent investigations provide further evidence consistent with earlier studies based on skin testing that the prevalence of latex sensitization in occupationally-unexposed groups is quite low (<1%). The marked differences in the findings based on serological assays may relate to the nonspecificity of these assays and deserve further investigation. *Am. J. Ind. Med.* 35:196–200, 1999. © 1999 Wiley-Liss, Inc.

KEY WORDS: latex sensitization; prevalence; occupational; general population; skin testing; AlaSTAT assay; specificity

INTRODUCTION

Natural rubber latex (NRL) allergy has become an important occupational health concern in recent years, particularly among health care workers (Sussman and Beezhold, 1995; Slater, 1994; Sussman et al., 1991; Charous, 1994; Hunt et al., 1995). Type I (IgE-mediated) NRL allergy includes urticaria, angioedema, rhinitis, conjunctivitis, bronchospasm, and anaphylaxis. It has been suggested in some reports, as described below, that the prevalence of

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TABLE I. Examples of Latex Prevalence Studies in Occupationally Exposed Groups

Study	Group studied	Method used to determine latex sensitization	Latex prevalence
Turjanmaa (1987; Finland)	Hospital employees	Latex glove scratch chamber test	4.5% of 512 hospital employees; 6.2% of 145 operating room employees; 0.8% of 130 controls (patients)
Arellano et al. (1992; Canada)	Hospital physicians at Toronto Hospital	Confirmation with latex prick and use tests SPT (commercially available latex skin test reagent)	2.9% of hospital employees 9.9% of 101 staff surgeons, anesthesiologists, and radiologists
Lagier et al. (1992; France)	Operating nurses working in public hospitals in Marseilles	Prick test (commercial extract of latex, Stallergenes)	10.7% of 197 having skin tests
Vandenplas et al. (1995; Belgium)	Employees of primary care hospital	SPT (commercial extract of natural latex)	4.7% (95% CI 2.6–8.1) of 273 (5% of nurses, 4% of cleaning staff, 5% of technologists)
Grzybowski et al. (1996; USA)	Registered nurses at large metro hospital	AlaSTAT assay for latex-specific IgE antibodies	8.9% (95% CI 6.7–10.8)
Liss et al. (1997; Canada)	Health care workers (hospital employees)	SPT (commercially available latex skin test reagent)	12.1% (95% CI 10.3–13.9) of 1,326 employees

latex sensitization among occupationally exposed groups, such as health care workers, is not different from that in the general population. In this report, we consider the evidence for this suggestion.

FINDINGS IN WORKPLACE SETTINGS

The major source of workplace exposure has been powdered latex glove use by health care workers (HCWs). Workers involved in glove manufacturing may also be affected (Tarlo et al., 1990). Surveys of HCWs (summarized in Table I) have demonstrated that the prevalence of sensitization to latex ranged from 2.9% in Finland (Turjanmaa, 1987) to 4.7% in Belgium (Vandenplas et al., 1995) among hospital employees as a group, and from 6.2% among operating room staff in Finland (Turjanmaa, 1987) to 9–10% among operating room nurses in France (Lagier et al., 1992), and surgeons, anesthesiologists, and radiologists in Canada (Arellano et al., 1992). Recently, Grzybowski et al. (1996) found that 8.9% of 741 registered nurses in Michigan tested positive for anti-latex IgE antibodies. We recently reported the baseline findings of a prospective study of latex sensitization among 1351 HCWs in Canada (Liss et al., 1997). We observed that the prevalence of latex sensitization based on latex skin-prick testing (SPT) was 12.1% (95% confidence interval [CI] 10.3%–13.9%), with a minimum prevalence of 9.5% among the entire eligible population, which was in the upper range of previous reports. There were significant associations with atopic status, positive skin tests to certain foods, work-related symptoms, and departmental use of gloves per HCW. In our study, about 60% of latex SPT-positive participants had work-related symptoms. Van-

denplas et al. (1995) documented 2.5% of HCWs to have latex-induced occupational asthma confirmed with specific inhalation challenge.

Sensitization of HCWs may involve high costs, both in terms of day-to-day risks at work, as well as potentially fatal anaphylactic shock. Disability from latex sensitivity is an increasing problem due to latex product substitution, personnel re-assignments, and workers' compensation claims.

To underscore the importance of allergic reactions to NRL in the workplace, the National Institute for Occupational Safety and Health (NIOSH) (1997) in the United States published a Latex Alert in June of 1997. The Alert described recommendations for minimizing latex-related health problems, including the need to use powder-free gloves with reduced protein content when choosing latex gloves. A recent commentary in the journal *Lancet* (Poole, 1997) noted the availability of low protein powder-free gloves.

STUDIES IN THE GENERAL POPULATION

To put the relative or attributable risk of NRL associated with occupational exposure in perspective, comparison has often been made to the prevalence of latex sensitization in the general population. Although latex is a common allergen, prevalence and incidence estimates for NRL allergy in the general population remain unknown. A major patient group at risk is spina bifida patients among whom the prevalence of sensitization has ranged from 30 to 65%.

Although Turjanmaa (1987) reported over a decade ago that the prevalence of latex allergy in the general population was less than 1%, a range of estimates up to 6% has been reported (Ownby et al., 1996). Turjanmaa and Reunala

TABLE II. Latex Prevalence Studies in General Population Groups, Based on Skin Test Outcome

Study	Group studied	Method used to determine latex sensitization	Latex prevalence	Comments
Turjanmaa (1987; Finland)	Consecutive patients admitted to Lab of Department of Dermatology for routine prick testing	Latex glove scratch chamber test	0.8% of 130	Served as controls for hospital employees (see Table I)
Turjanmaa and Reunala (1990; Finland)	Patients	Latex prick test	1988: 0.8% of 1,051 0.7% of 1,220 1989: 1.1% of 1,089 0.8% of 1,342	Dermatology clinic Private laboratory Dermatology clinic Private laboratory
Turjanmaa et al. (1995; Finland)	Mostly atopic children tested for food allergies	SPT to NRL	2% of 300	Increased proportion of atopics may have increased prevalence (unpublished findings)
Turjanmaa et al. (1995; Finland)	Consecutive unselected adults patients tested before surgery, Tampere University Hospital	SPT with latex glove eluates	0.12% of 804	
Gautrin et al. (1997; Canada)	Apprentices starting careers in animal health, pastry making, and dental hygiene	Skin testing with commercially available reagent (Staller-genes)	0.7% (95% CI 0.3–1.4) of 758	Skin tests done before significant exposure; prevalence similar across 3 occupations
Tarlo et al. (1997; Canada)	Dental students	SPT with commercially available reagent (Bencard)	0% of 20 1st and 2nd year students	6% of 36 3rd and 10% of 39 4th year students were positive
Ylitalo et al. (1997; Finland)	Children seen for inhalation or food allergy testing	Skin prick tests with latex glove extracts	1.1% of 3,269	1.0% confirmed to be latex allergic based on RAST and latex glove use test

(1990) found in 1988, the frequency of NRL allergy by prick testing to be 8 (0.8%) of 1,051 patients at a dermatological clinic and 9 (0.7%) of 1,220 patients at a private laboratory. In 1989, the corresponding numbers were 12 (1.1%) of 1,089 and 11 (0.8%) of 1,342. In a recent review, Turjanmaa et al. (1995) also included further unpublished findings indicating that of 1,198 mainly atopic patients who underwent skin prick tests (SPTs) in 1993 with a latex glove eluate at the Allergy Laboratory of the Department of Dermatology at Tampere, Finland, a total of 15 (1.3%) of patients were found to be NRL-allergic. NRL allergen was also included in the food SPT series for atopic babies; of the 300 children tested, 6 (2%) were SPT positive to NRL. It should be noted that the *increased proportion of atopics may have inflated these prevalences*. Turjanmaa et al. (1995) also found that the frequency of NRL allergy among 804 unselected patients prick-tested before surgery was 0.12% (or an estimated prevalence of 124 per 100,000 inhabitants in a nonselected population). Prevalence studies in general population groups, based on skin tests, are summarized in Table II.

Latex-Specific Antibodies

Different estimates emerge from data examining the prevalence of serum latex-specific IgE antibodies (Table III). For example, Merret et al. (1995) tested 1,436 adult blood donors in the United Kingdom and found that between

4.1 and 7.9% had latex-specific IgE. Ownby et al. (1996) measured anti-latex IgE antibodies in residual serum samples from 1,000 volunteer Red Cross blood donors in Michigan using the AlaSTAT assay. They found that 64 (6.4%, 95% CI 4.9%–8.1%) of the samples were confirmed as repeatedly positive for anti-latex IgE (at a cut-off of 0.35 IU/ml or greater), and 23 of these, 2.3% of the 1,000, were strongly positive (anti-IgE concentrations of 1.5 IU/ml or greater). The prevalence of positive samples was not related to age or race, although samples from male donors were more likely to be positive than those from female donors. Although the authors concluded that the prevalence of anti-latex IgE in this unselected adult population was higher than previous estimates, they acknowledged that the *clinical significance of these observations needs further evaluation*.

Porri et al. (1997) in France estimated the prevalence of latex sensitization among subjects aged 20 to 40, attending for health screening (or check-ups). However, only 258 of 747 subjects visiting the health care center agreed to undergo skin and RAST tests. They were evaluated with skin tests to common inhalant allergens and a commercial extract of ammoniated latex (Stallergenes, France) and RAST to latex for which the threshold of positive was set at 0.35 KU/ml. Sensitization to latex was defined by either a positive SPT or a positive RAST. The prevalence of atopy by questionnaire was similar among participants (33%) and nonparticipants

TABLE III. Latex Prevalence Studies in General Population Groups, Based on Serological Assays

Study	Group studied	Method used to determine latex sensitization	Latex prevalence	Comments
Merret et al. (1995; UK)	Adult blood donors	Latex-specific IgE	4.1%–7.9% of 1,436 donors	Published in abstract form
Ownby et al. (1996; USA)	Volunteer Red Cross blood donors	AlaSTAT assay	6.4% (95% CI 4.9%–8.1%) of 1,000 donors	Cut-off of 0.35 IU/ml used
Porri et al. (1997; France)	Subjects 20–40 attending for checkups	RAST and skin test with commercial extract of ammoniated latex (Stallergenes)	17 (6.6%) of 258 positive; 9 (3.5%) had positive RAST; 8 (3.1%) had positive SPT	Low participation rate (only 258 of 747 agreed to undergo skin testing); None had both tests positive High prevalence of atopy
Sosovec et al. (1998; USA)	NHANES III data	AlaSTAT assay	Prevalence of “positive” latex-specific IgE: 18.0% among HCWs, no different than among other occupations	

(34%), but this was higher than expected in the general population. Of the 258 participants, 17 (6.6%) were sensitized to latex: 9 had a positive RAST and 8 had a positive SPT. None had both tests positive. Among the 17 latex-sensitized patients, four reported clinical manifestations when wearing latex gloves. The source of gloves is not noted, but this suggests that there may have been exposure at work, although latex gloves can be used in domestic or non-work settings. Of interest, the prevalence of atopy according to skin tests and/ or RAST tests was very high: 76.5% among latex-sensitive and 42.3% among non-sensitized subjects, suggesting selection bias in the participants. Thus, although this study found a prevalence of latex sensitization of 6.6%, serious methodological problems were present including: (1) the low participation rate; (2) discrepancy between the results of skin tests and RAST to latex; and (3) the high prevalence of atopy in the study group, which may not have been representative of that in the general population. Finally, the fact that 4 of the 17 reported symptoms when wearing latex gloves suggests the possibility of work-related latex exposure in this group. The authors noted that sensitization without symptoms of latex allergy does not mean that an allergic reaction will occur.

Consistent with this, Turjanmaa et al. (1995), commenting on the interpretation of blood tests for IgE antibodies to NRL, noted that “the clinical significance could not always be estimated.” Ebo and colleagues (1997) from Belgium recently compared latex-specific IgE tests and skin testing in patients with latex allergy. They concluded that latex skin tests and latex-specific IgE assessments are sensitive and specific methods for establishing the diagnosis of latex allergy, “although the specificity of the AlaSTAT-RIA was very low [33%] when interpreted according to the threshold of 0.35 kU/L.”

Most recently, Sosovec et al. (1998) described an analysis of latex sensitivity rates among occupations, using

data from the third National Health and Nutrition Examination Survey (NHANES III), which was conducted between 1988 and 1991 with a nationwide sample of approximately 40,000 people. Of these, 5,524 subjects representing 40 different occupations were tested for latex “allergies” (specific IgE antibodies to NRL), using the AlaSTAT test. The authors found that the prevalence of “positive” latex-specific IgE among health care workers was no different than that among workers in other occupations. These authors suggested from these data that the prevalence of latex sensitization is no different among health care workers (latex-exposed workers) than in the general population. However, this study has a number of important limitations that must be noted. These include the lack of details about how the information on exposure (i.e., occupation) was obtained; no description of the clinical significance (i.e., symptoms) of the findings; failure to take into account atopy (and food cross-reactions) on an individual basis, which represent important confounding factors; and the low specificity (high false positive rate) of the AlaSTAT assay (with specificity of 33% reported by Ebo et al., 1997, as noted above). Moreover, the prevalence rates for latex-specific IgE in various occupations ranged from 13.5% among secretaries, 18.0% in “health diagnosing, assessment, treating” to 20.5% in construction workers, and 29.1% among writers, entertainers, and athletes. These prevalence rates are much higher than and not consistent with, those reported previously in occupational as well as general population studies, calling into question the validity of the data as presented.

RECENT STUDIES INVOLVING SKIN TESTING (Table II)

A more accurate, perhaps less flawed estimate of the prevalence of latex sensitivity was reported recently from

Montreal, Canada, by Gautrin et al. (1997), who examined apprentices starting careers in animal health or veterinary medicine, pastry making, and dental hygiene. They administered skin tests to common inhalants and work-related antigens including laboratory animal extracts, cereal antigens, α -amylase, and latex to the apprentices **before any significant exposure** took place. Only 5 (0.7%, 95% CI 0.3–1.4) showed skin reactivity to latex and this was consistent across groups: 3 (0.7%) of 414 starting in animal health, 1 (0.5%) of 222 starting in pastry making, and 1 (0.8%) of 122 starting dental hygiene.

Tarlo et al. (1997) conducted a cross-sectional study of dental students and staff in Ontario, Canada using a questionnaire and skin prick testing (Bencard latex). They found that none of 20 first- and second-year dental students tested had positive SPTs to latex (prior to significant exposure), compared to 6% of 36 third- and 10% of 39 fourth-year students tested. Ylitalo et al. (1997) reported that 1.1% of 3,269 children seen for inhalant or food allergy testing at their allergy laboratory in Finland had persistent positive latex SPTs and 1.0% were confirmed to be latex allergic based on RAST and latex glove use tests.

CONCLUSION

There is inconsistency in the findings across studies of the prevalence of latex sensitization in general population groups, including methodological problems in some reports, different outcomes studied (serological vs. skin tests), lack of standardized skin tests, and the possibility of work exposures in some studies. Moreover, the clinical significance (symptoms or disease attributable to the sensitization) has not been assessed.

The three recent investigations based on skin testing, published in 1997 and summarized above, provide further evidence that is consistent with earlier studies that the prevalence of latex sensitization in the general population (or occupationally-unexposed groups) is quite low (1% or less). The marked differences in the findings based on serological assays may relate to the nonspecificity of these assays and deserve further investigation.

REFERENCES

- Arellano R, Bradley J, Sussman G. 1992. Prevalence of latex sensitization among hospital physicians occupationally exposed to latex gloves. *Anesthesiology* 77:905–908.
- Charous BL. 1994. The puzzle of latex allergy: some answers, still more questions [editorial]. *Ann Allergy* 73:277–281.
- Ebo DG, Stevens WJ, Bridts CH, De Clerck LSD. 1997. Latex-specific IgE, skin testing, and lymphocyte transformation to latex in latex allergy. *J Allergy Clin Immunol* 100:618–623.
- Gautrin D, Infante-Rivard C, Dao T-V, Magnan-Larose M, Desjardins D, Malo J-L. 1997. Specific IgE-dependent sensitization, atopy, and bronchial hyperresponsiveness in apprentices starting exposure to protein-derived agents. *Am J Respir Crit Care Med* 155:1841–1847.
- Grzybowski M, Ownby DR, Peyser PA, Johnson CC, Schork MA. 1996. The prevalence of anti-latex IgE antibodies among registered nurses. *J Allergy Clin Immunol* 98:535–544.
- Hunt LW, Fransway AF, Reed CE, Miller LK, Jones RT, Swanson MC, Yunginger JW. 1995. An epidemic of occupational allergy to latex involving health care workers. *J Occup Environ Med* 37:1204–1209.
- Lagier F, Vervloet D, Lhermet I, Poyen D, Charpin D. 1992. Prevalence of latex allergy in operating room nurses. *J Allergy Clin Immunol* 90:319–322.
- Liss GM, Sussman GL, Deal K, Brown S, Cividino M, Siu S, Beezhold DH, Smith G, Swanson MC, Yunginger J, Douglas A, Holness DL, Lebert P, Keith P, Wasserman S, Turjanmaa K. 1997. Latex allergy: epidemiologic study of 1351 hospital workers. *Occup Environ Med* 54:335–342.
- Merret TJ, Merrett J, Bhambri S, Kekwich R. 1995. Prevalence of latex-specific IgE antibodies in the United Kingdom. *J Allergy Clin Immunol* 95:154 (abstract).
- NIOSH. 1997. Alert: Preventing allergic reactions to natural rubber latex in the workplace. National Institute for Occupational Safety and Health. Cincinnati, Ohio: DHHS (NIOSH) Publication No. 97–135. June 1997.
- Ownby DR, Ownby HE, McCullough J, Shafer AW. 1996. The prevalence of anti-latex IgE antibodies in 1000 volunteer blood donors. *J Allergy Clin Immunol* 97:1188–1192.
- Poole CJM. 1997. Hazards of powdered surgical gloves. *Lancet* 350:973.
- Porri F, Lemiere C, Birnbaum J, Guilloux L, Lanteaume A, Didelot R, Vervloet D, Charpin D. 1997. Prevalence of latex sensitization in subjects attending health screening: implications for a perioperative screening. *Clin Exp Allergy* 27:413–417.
- Slater JE. 1994. Latex allergy. *J Allergy Clin Immunol* 94:139–149.
- Sosovec D, Bourne G, Davis D. 1998. Clinical assessment and effective management of latex allergy. *Surg Serv Manage* 4:11–15.
- Sussman GL, Beezhold DH. 1995. Allergy to latex rubber [editorial]. *Ann Intern Med* 122:43–46.
- Sussman GL, Tarlo S, Dolovich J. 1991. The spectrum of IgE-mediated responses to latex. *JAMA* 265:2844–2847.
- Tarlo SM, Sussman GL, Holness DL. 1997. Latex sensitivity in dental students and staff: A cross-sectional study. *J Allergy Clin Immunol* 99:396–401.
- Tarlo SM, Wong L, Roos J, Booth N. 1990. Occupational asthma caused by latex in a surgical glove manufacturing plant. *J Allergy Clin Immunol* 85:626–631.
- Turjanmaa K. 1987. Incidence of immediate allergy to latex gloves in hospital personnel. *Contact Dermatitis* 17:270–275.
- Turjanmaa K, Reunala T. 1990. Incidence of positive prick test results to rubber protein. *Contact Dermatitis* 23:279 (abstract).
- Turjanmaa K, Makinen-Kiljunen S, Reunala T, Alenius H, Palosuo T. 1995. Natural rubber latex allergy: the European experience. *Immunol Allergy Clin North Am* 15:71–88.
- Vandenplas O, Delwiche J-P, Evrard G, Aimont P, Van der Brempt X, Jamart J, Delaunois L. 1995. Prevalence of occupational asthma due to latex among hospital personnel. *Am J Respir Crit Care Med* 151:54–60.
- Ylitalo L, Turjanmaa K, Palosuo T, Reunala T. 1997. Natural rubber latex allergy in children who had not undergone surgery and children who had undergone multiple operations. *J Allergy Clin Immunol* 100:606–612.