

A hospital-based screening study of latex allergy and latex sensitization among medical workers in Taiwan

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Background and Purpose: Natural rubber latex is the most important occupational allergen among medical workers, and remains a significant occupational health issue in Taiwan. We conducted this large-scale hospital-based screening study to understand the incidence of latex allergy and latex sensitization among medical workers in Taiwan over the past 5 years.

Methods: 1253 medical workers were enrolled in this study. Subjects were interviewed using a screening questionnaire. Skin prick testing with commercial latex extract was performed for 1139 of the subjects.

Results: 152 subjects (12%) had positive latex skin prick test, suggesting that they had been sensitized to latex proteins. Seventy nine subjects (6%) had immediate allergic reactions to latex products. The prevalence of contact hand dermatitis from latex gloves was 35%. The intensive care unit and medical laboratory department accounted for the highest prevalence of allergy among all hospital departments. Most subjects developed immediate latex allergy by 9000 h of total latex exposure. The prevalence of positive latex skin prick test increased with increasing duration of latex exposure.

Conclusions: Latex allergy continues to be an important occupational allergy among medical workers in Taiwan. The addition of a routine screening examination in medical employees' health check-ups will help in the early identification of sensitized cases and facilitate preventive strategies.

Key words: Allergens; Health personnel; Hypersensitivity, immediate; Latex hypersensitivity; Occupational exposure

Introduction

Natural rubber latex (NRL) is the milky sap from the *Hevea brasiliensis* tree [1]. It is widely used in elastic medical appliances and consumables. The use of latex gloves has increased 25-fold since the universal precaution announced by the Centers for Disease Control, United States, to decrease the spread of human immunodeficiency virus and hepatitis B and C viruses at the end of 1980s [2]. With the increasing use of latex gloves, the prevalence of immediate latex allergy has been rising, and it has become the most important occupational allergen among medical workers in western countries [3-7].

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There are 2 types of hypersensitivity reactions induced by NRL products, contact dermatitis and immediate-type immunoglobulin (Ig) E-mediated allergy. Contact dermatitis is the most common reaction to NRL. Patients typically have eczematous lesions over the hands, wrists, or forearms where latex gloves have made contact [8,9]. The involved skin is itchy and red, with papules or vesicles, and sometimes becomes fissured. In terms of mechanism, these reactions can be irritant or allergic [10]. Irritant contact dermatitis is caused by multiple irritants, such as hand washing, moisture trapped inside the gloves, occlusion, friction, glove-donning powder, or other irritant chemicals added during the manufacturing of latex gloves. Irritant contact dermatitis may be improved by shifting to powder-free latex gloves [11].

Allergic contact dermatitis is a delayed-type T-cell-mediated immunologic reaction to the proteins in

NRL. The condition generally occurs 1 to 2 days after exposure, but can occur from several hours to several days after exposure. In patients with allergic contact dermatitis, the lymphocytes are sensitized to the proteins in the latex product; therefore, only switching to non-latex gloves can solve the problem. A definitive diagnosis of contact versus allergic dermatitis requires latex skin patch test [12]. Patients with latex contact dermatitis have a higher risk of developing immediate latex allergy than controls unaffected by dermatitis [13,14].

Immediate allergy to latex develops within 30 to 60 min of exposure. As the latex protein particles can become airborne and be suspended in the air, the immediate allergic reaction can occur on contact with the skin, mucosa, or serosa, or by inhalation. Allergic reactions have varied from mild skin redness, pruritis, and wheals (urticaria), itchy watery eyes and itchy watery nose (rhinoconjunctivitis) to severe reactions, such as asthmatic attack, angioedema of the face, or even anaphylactic shock [15,16].

The prevalence of latex allergy in hospital employees was reported to be 6.8% by Lai et al at National Taiwan University Hospital, Taipei, Taiwan in 1997 [17], and 8.6% by Chen and Lan in central Taiwan in 2002 [14]. Hevamine and Hev b 1 are the primary allergens from latex gloves among medical workers in Taiwan, which differs from the situation in western countries [18].

To understand the incidence of latex allergy and latex sensitization among medical workers in Taiwan over the past 5 years, we conducted a large-scale hospital-based screening study.

Methods

The project was reviewed and approved by the Institutional Review Board of Taichung Veterans General Hospital, Taichung, Taiwan. 1253 medical workers who needed to wear latex gloves during their daily work were enrolled from 6 hospitals and 2 medical professional associations.

Subjects were interviewed by a doctor or a nurse specialist using a screening questionnaire. Gender, age, job category, years of employment, mean hours of exposure to latex gloves per week, and history of atopy were recorded. Atopy was defined as the pre-existence of allergic rhinitis, allergic asthma, or atopic dermatitis. All immediate allergic reactions (within 1 h of exposure) were recorded, including anaphylaxis, asthmatic attack, urticaria, angioedema, and rhinoconjunctivitis after

wearing latex gloves while working, or on exposure to other latex-containing products, such as condoms, diaphragms, or household NRL products, as well as reactions during a medical procedure after exposure to latex gloves worn by doctors. Subjects who reported itching, vesicular formation, or drying and fissuring of the skin after using latex gloves were considered to have latex glove-related contact dermatitis, regardless of whether it was irritant or allergic in nature. Subjects who consented to skin prick testing were tested with commercial latex extract (100 IR/mL; Stallergenes SA, Town, France) using epicutaneous sterile disposable Sharp Test[®] applicators (Greer Laboratories, Lenior, NC, USA). Histamine (1 mg/mL) and 50% phosphate-buffered saline-glycerol were used as positive and negative controls, respectively. All skin test results were read 20 min after placement. A response with a wheal and erythema 3 mm larger than the reaction produced by the negative control were considered positive.

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) for Windows (Version 12.0; SPSS, Chicago, IL, USA). Mann-Whitney *U* test, Pearson's chi-squared test and Fisher's exact test were used to evaluate the association between latex allergy and variables.

Results

1253 subjects were enrolled in the study; 1069 were women and 184 were men. There were 694 nurses, 210 laboratory technicians, 60 administrators, 58 dentists, 34 medical expeditors, 33 physicians, 32 pharmacists, 28 radiologists, 26 surgeons, 10 pathologists, 5 anesthesiologist assistants, 5 respiratory therapists, and 58 in other job categories. 1139 subjects received latex skin prick testing.

435 of 1253 subjects (35%) reported hand dermatitis when using latex gloves. 152 subjects (12%) had positive skin prick test to latex, suggesting that they had been sensitized to latex proteins. Those reporting immediate allergic reactions to NRL products plus positive skin prick test to latex were considered to have latex allergy, and comprised 79 subjects (6%) [Table 1].

The frequencies of symptoms of immediate latex allergy are shown in Fig. 1. Three subjects experienced asthmatic attack, 2 subjects experienced anaphylactic shock during operation, and 1 subject had angioedema on exposure to latex. Fifty five subjects reported rhinoconjunctivitis and 63 had allergic reactions to condoms or diaphragms. Six subjects reported itchy skin reac-

Table 1. Incidence of contact dermatitis, positive latex skin prick test, and immediate latex allergy among 1253 medical workers

Variable	Hospital A	Hospital B	Hospital C	Hospital D	Hospital E	Hospital F	Others	Total No. (%)
No. of subjects tested	941	103	28	40	28	15	98	1253 (100)
Contact dermatitis	337	41	13	11	12	2	19	435 (35)
Latex skin prick test-positive	76	36	10	5	7	2	16	152 (12)
Immediate latex allergy	46	16	6	2	5	2	2	79 (6)

tions when using household NRL products, such as raincoats.

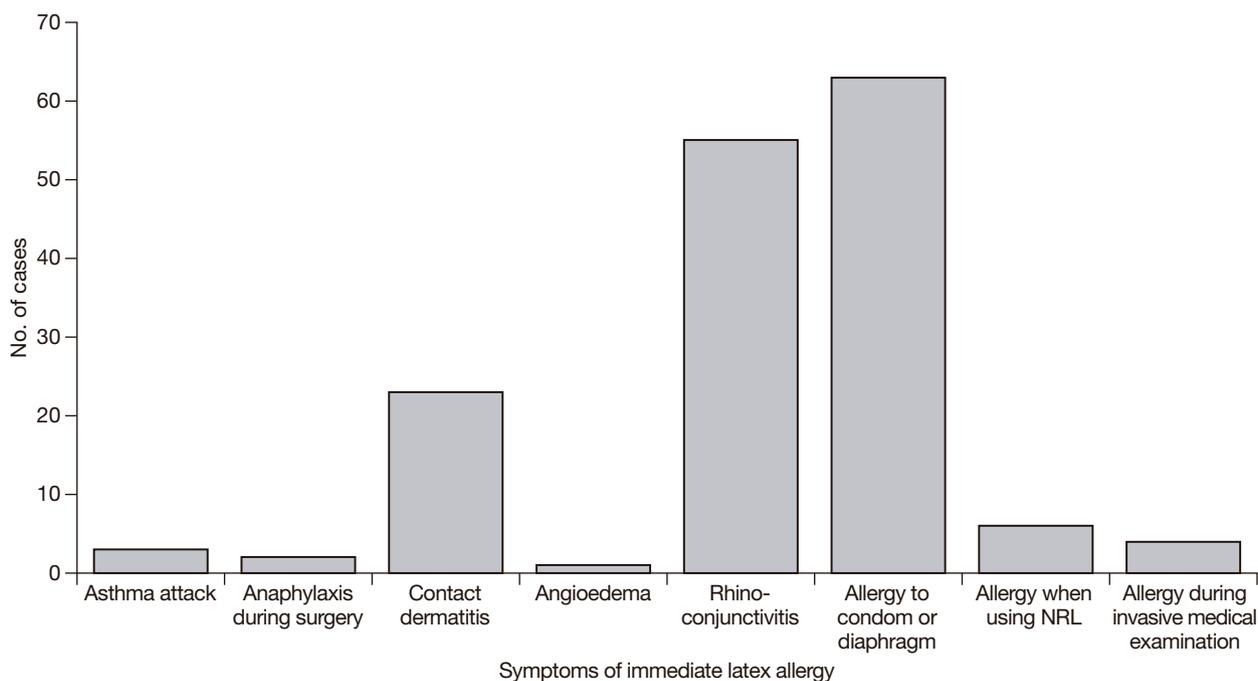
Data for cumulative number and prevalence of latex allergy and positive latex skin prick test according to different job categories are shown in Fig. 2. Nurses and laboratory technicians comprised the largest groups developing immediate latex allergy, while respiratory therapists had the highest incidence. We further analyzed immediate latex allergy in Hospital A according to working departments. Workers in the intensive care unit (ICU; 8 nurses) and department of medical laboratory (7 laboratory technicians) had the highest prevalence among the various departments (Fig. 3), suggesting that workers in these departments are at highest risk of developing latex allergy.

Fig. 4A and Fig. 4B show the cumulative proportion survival curves of immediate latex allergy and positive latex skin prick test (latex sensitization) as demonstrated by total latex exposure hours. Cumulative numbers of subjects with immediate latex allergy

and positive skin prick test (latex sensitization) by total latex exposure hours (Fig. 5) show that 81.5% of subjects developed immediate latex allergy by 9000 h of total latex exposure.

Discussion

This large-scale hospital-based screening study was conducted to evaluate the incidence of latex allergy among medical workers in Taiwan. More than 1000 subjects underwent skin-prick testing with latex to determine the prevalence of not only latex allergy, but also sensitization to latex. In the present study, the prevalence of immediate latex allergy was 6% and that of hand dermatitis was 35%, results which are comparable to our previous study [14]. However, up to 12% of study subjects had positive skin prick test results, suggesting that approximately one-half of the subjects were unaware of being sensitized to latex proteins. Furthermore, subjects working in the

**Fig. 1.** Frequency of symptoms associated with immediate latex allergy. NRL = natural rubber latex.

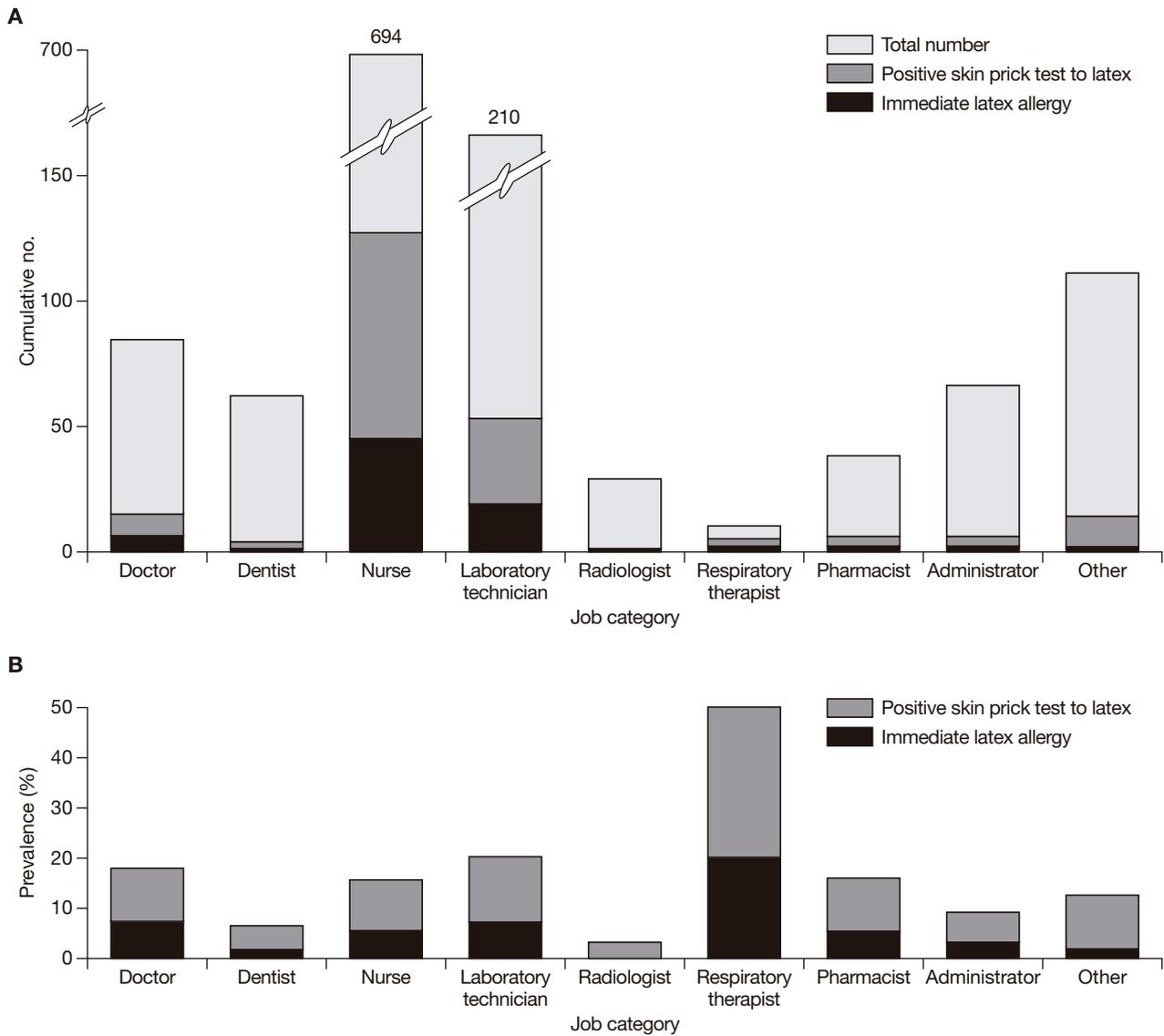


Fig. 2. Immediate latex allergy and positive skin prick test to latex according to job category. (A) Cumulative number; and (B) prevalence.

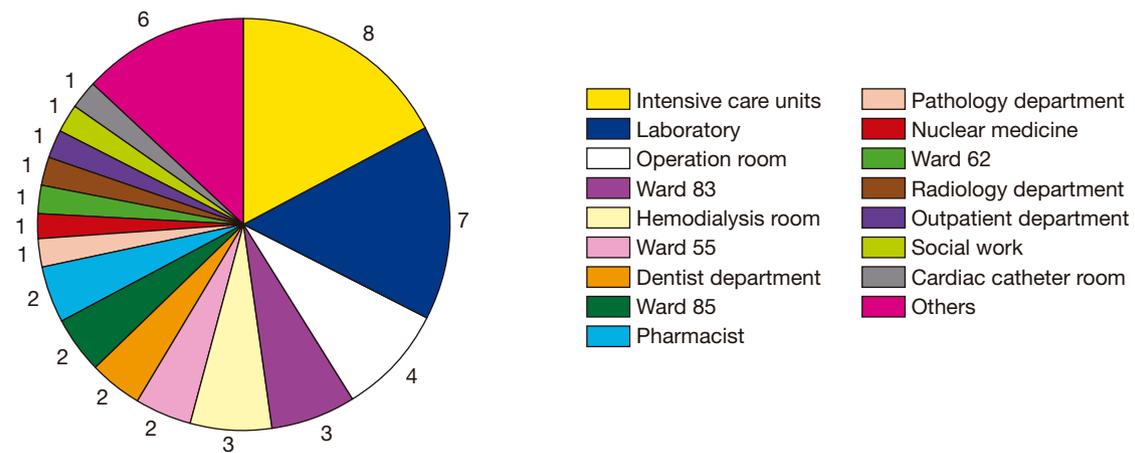


Fig. 3. Frequency of immediate latex allergy according to working department in Hospital A.

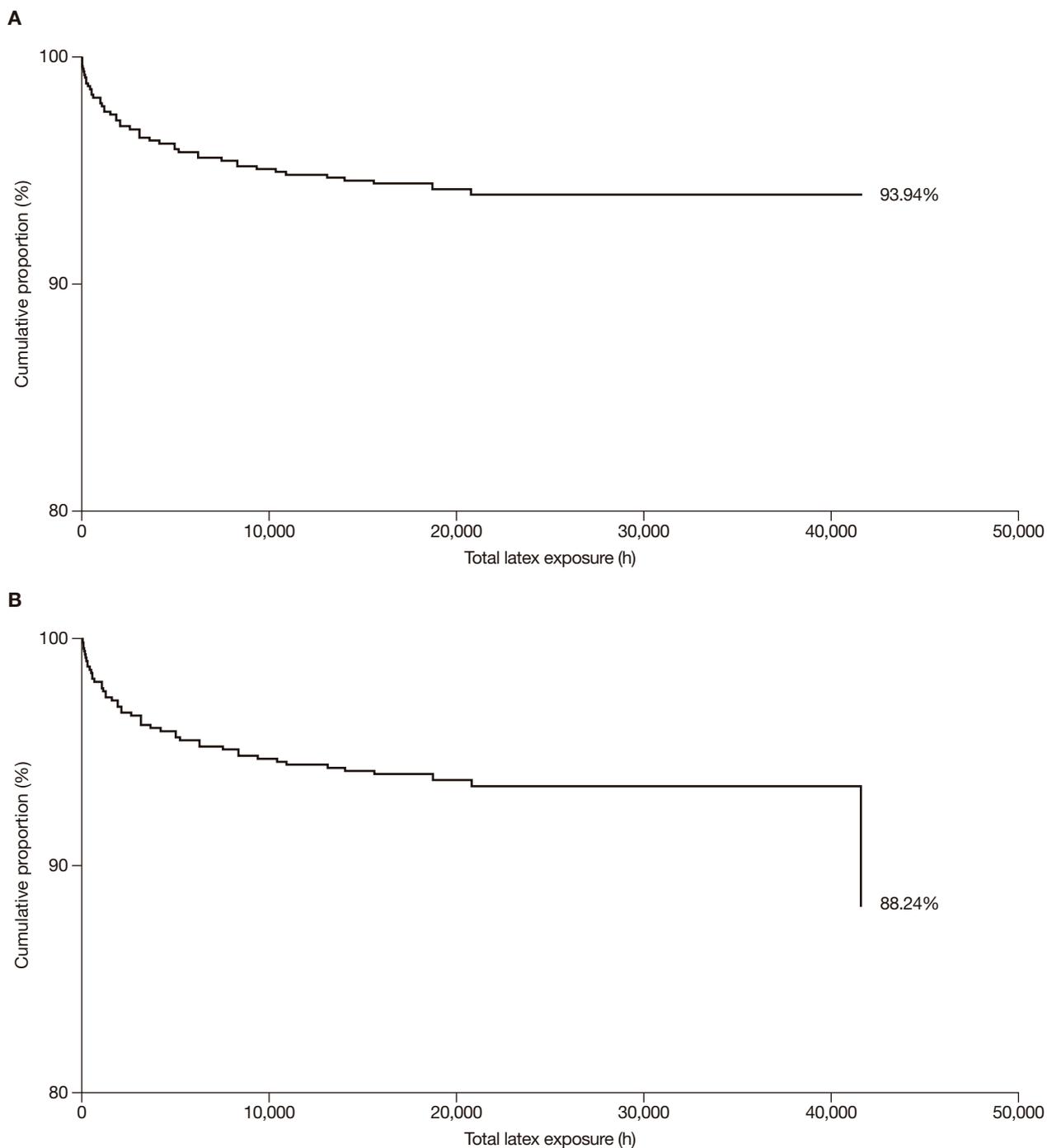


Fig. 4. Cumulative survival curve according to total latex exposure hours. (A) Immediate latex allergy; and (B) latex sensitization.

ICU and medical laboratory are at highest risk of developing immediate latex allergy. We speculate that this may result from the relative closeness of the working environment in these 2 work settings. There has been a report that latex allergen exposure is more likely to occur when gloves are changed as a result of suspension from reservoirs of powder in the room and clothing [19], and this is likely to contribute to the

increased concentrations of latex particles in the ICU and medical laboratory [20].

A retrospective study by Chen et al reported the prevalence of latex allergic contact dermatitis as 4.4% (99/2235) [12] in the general population in Taiwan, but the prevalence was as high as 35% in our study. We have previously reported that the development of hand dermatitis accounts for the highest personal risk

of developing immediate latex allergy (odds ratio, 72.8) [14]. These subjects are likely to develop immediate latex allergy if they continue to be exposed to latex allergens during their daily work.

It is generally thought that contact dermatitis is Th1-mediated, whereas immediate hypersensitivity is Th2-mediated. However, there have been reports of a higher prevalence of immediate latex sensitization in atopic subjects compared with non-atopic subjects [21]. Several studies also document the high coexistence rate of contact dermatitis and immediate latex allergic reaction, which is consistent with our findings [17,22]. The high correlation of type IV hypersensitivity with atopic history seems to suggest a tendency of Th2-like reaction in latex contact dermatitis rather than a Th1-like reaction. Bohle et al found that T cell responses to Hev b 3, one of the major latex allergens. They found that more than half of the latex-allergic T-cell clone reactions were classified as Th2-like according to their cytokine production pattern [23]. Wang et al reported that epicutaneous exposure to ovalbumin in mice induces delayed hypersensitivity with contact dermatitis prior to later predominant the presence of a Th2-like response with high IgE production [24]. The detailed mechanism of the switching between cutaneous T-cell reactions and IgE-mediated immediate latex allergy is not well understood, but may be associated with a more invasive exposure to NRL proteins after breaking of the skin barrier by contact hand dermatitis.

Fig. 5 shows a peak for total latex exposure time of less than 2000 h. Most subjects developed latex allergy within 2000 h of exposure (approximate 2 years of working time), and more than 80% of the subjects developed immediate latex allergy within 9000 h of total latex exposure. However, the cumulative sensitization rates of medical workers increase continuously with increasing time of exposure to latex gloves and NRL products. The trend of increasing numbers of positive latex skin prick testing with increasing total duration of latex exposure implies that the longer the use of latex gloves, the more likely the immune systems is to be sensitized.

The results of this study demonstrate that latex allergy continues to be an important occupational hazard among medical workers in Taiwan. Early identification of cases can prevent severe life-threatening anaphylactic reaction in both work and treatment situations [25,26]. Inclusion of latex skin prick tests or latex-specific IgE blood testing at the routine health check-up for medical workers would be helpful for early identification of sensitized medical workers. There is evidence that changing from traditional high-powder latex gloves to powder-free latex gloves in the hospital situation is a rapid and low cost means of reducing the incidence of latex allergy and lowering markers of sensitization to NRL quickly among healthcare workers [11,27,28]. However, powder-free latex gloves are not safe for use for workers who have already developed immediate latex allergy.

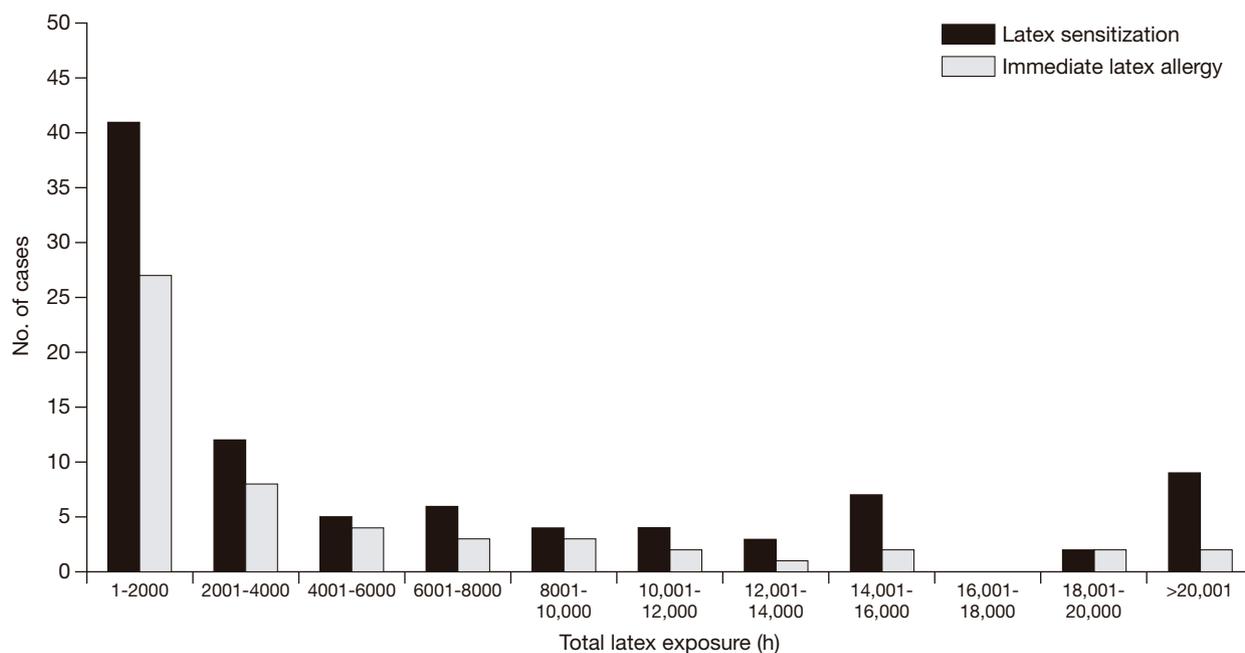


Fig. 5. Frequencies of latex sensitization and immediate latex allergy according to category of latex exposure duration.

We suggested that staff working in high-risk hospital departments, such as the ICU and medical laboratory department, should change to non-latex gloves [29], and a non-latex practice environment should be established to protect staff with immediate latex allergy [22,24,29,30]. We also propose that all hospitals establish a protocol for assessing the quality of latex gloves, involving determination of the quantity of soluble latex allergens [31]. Hev b1 is a suitable candidate allergen for this purpose, because it is the major latex allergen in Taiwan [18] and is the allergenic protein least likely to be removed during routine glove manufacturing process [32].

In conclusion, latex allergy continues to be an important occupational allergy among medical workers in Taiwan. The addition of a routine screening examination during medical employees' health check-ups will help the early identification of sensitized cases and facilitate preventive strategies.

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