Original Article

Latex Sensitisation in Healthcare Workers in Singapore

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Abstract

Introduction: Epidemiological data on latex sensitisation among Asian healthcare workers is lacking. The aim of the study is to determine the rate of latex sensitisation in our healthcare workers. Materials and Methods: We recruited 313 healthcare workers, of which 46.6% were operating theatre staff and 53.4% were non-operating theatre staff. Seventy-one administrative staff served as controls. All participants answered a self-administered questionnaire relating to latex exposure and glove-related symptoms. Latex sensitisation was determined by skin prick testing to latex and latex-specific IgE detection. Results: The prevalence of latex sensitisation among healthcare workers was 9.6%, with no difference between operating theatre and non-operating theatre staff. Glove-related symptoms were reported in 13.7% of all healthcare workers, of which 22.9% were sensitised to latex. Only 26.7% of latex-sensitised healthcare workers had glove-related symptoms while the rest were asymptomatic. The most common symptoms were itch and hand eczema but the most important discriminating symptom was contact urticaria. Personal history of atopy was more common in sensitised healthcare workers (40.0%) compared to non-sensitised workers (31.8%). Only 1 out of 9 (11.2%) symptomatic latex-sensitised subjects had sought previous medical attention for the problem. Conclusions: Latex sensitisation among healthcare workers in Singapore should be considered a significant occupational health risk, as it is in the West. Increased screening and awareness of this problem is essential to identify those at risk.

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Key words: Contact urticaria, Glove allergy, Latex allergy

Introduction

Type I IgE-mediated natural rubber latex (NRL) hypersensitivity constitutes an important, but often undiagnosed, occupational health hazard for healthcare workers (HCWs), especially those with high exposure to latex gloves. Reports on NRL allergy have emerged steadily over the last 2 decades, with reported rates of sensitisation ranging from 3% to 17% of HCWs in the West.[1-4] The most common clinical manifestation is contact urticaria, presenting with pruritus, erythema and urticarial wheals. Other clinical symptoms include eczematous lesions, occupational asthma and rhinitis. Undiagnosed Type I latex allergy is potentially life-threatening, with systemic anaphylactic reactions reported in sensitised patients.[5]

To date, the prevalence of NRL allergy and its clinical significance has not been well studied among Asian healthcare workers. This study aims to determine the prevalence of latex sensitisation among medical, nursing and allied healthcare professionals working at 2 medical institutions in Singapore, namely Tan Tock Seng Hospital (TTSH) and the National Skin Centre (NSC).

Materials and Methods

The study was approved by the local ethics committee at the National Skin Centre, Singapore. Informed consent was obtained from all participants.

Subjects

There were 2 main target populations, namely, HCWs working in an operating theatre (OT) environment and those working in a non-operating theatre (non-OT) environment. The OT group comprised all medical staff from the TTSH Department of Anaesthesia as well as all

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nursing staff working at the main and ambulatory surgical OTs in the same institution. The non-OT group comprised all medical, nursing, laboratory and administrative staff of the NSC, as well as medical and nursing staff from the Communicable Disease Centre, which is part of TTSH. All eligible participants were approached via posters, information sheets and educational talks.

Participants were divided into 3 groups (control, OT and non-OT group) based on their occupational exposure to latex. The control group consisted mainly of administrative staff from the NSC who did not have direct occupational exposure to latex. HCWs in both the OT and non-OT groups were regular users of latex gloves but the OT group was presumed to have a higher occupational exposure to latex compared to the non-OT group.

Questionnaire

All participants answered a self-administered questionnaire, which included information on personal biodata, duration of occupational and non-occupational exposure to latex, frequency of current latex glove use, personal and family history of atopy (self-reported atopic eczema, asthma and allergic rhinitis), latex-related symptomatology (itch, eczematous hand rash, urticaria, glove-related asthma, glove-related rhinitis and anaphylaxis), previous medical attention for latex-related problems and food allergy to bananas, avocados and kiwis.

Skin Prick Testing

Skin prick test (SPT) to NRL was performed using a standardised commercial extract of natural non-ammoniated latex (Stallergenes, Paris, France) which contained latex proteins of 14, 20, 27, 30 and 45 kDa, corresponding to known allergenic NRL proteins included in the US Food and Drug Administration (FDA) E8 non-ammoniated latex reference material. This reagent has a reported diagnostic sensitivity of 93% and a specificity of 100%.[6] Normal saline was used as a negative control while 9% codeine phosphate was used as a positive control. SPTs were performed by the same investigators on the volar aspect of the participant's forearm using the standardised Stallerpoint® device (Stallergenes, Paris, France). Reading was done after 15 minutes and expressed as the mean of the smallest and largest diameters of the wheal obtained. A wheal diameter of greater than half the positive control, and at least 1 mm greater than the negative control, was considered a positive SPT reaction to NRL.

Latex-specific IgE Antibody Testing

Blood was obtained for detection of latex-specific IgE antibodies using FDA-cleared chemiluminesent AlaSTAT enzyme immunoassay (Immunulite® 2000, Diagnostic Products Corporation, Los Angeles, California, USA). This assay has a reported diagnostic sensitivity of 75% and a specificity of 92%, with a positive predictive value of 93%.[7] An IgE assay >0.7 kIU/L was considered positive, while an assay in the range of 0.35 kIU/L to 0.7 kIU/L range was considered equivocal.[8]

Exclusion Criteria

Exclusion criteria included participants less than 18 years of age and those with known anaphylaxis or systemic reactions to NRL exposure. SPT was not performed on participants who were on antihistamines 48 hours prior to testing or those on oral corticosteroid or immunosuppressive medication 2 weeks prior to SPT. Pregnant or nursing female participants did not undergo skin prick testing but were offered latex-specific IgE screening only.

Statistical Analysis

Comparisons of differences between the groups were made using Chi-square or Fisher's exact tests, and *t*-tests. A P value of <0.05 was considered statistically significant.

Results

Sociodemographic Data, Self-reported Atopy and Latex-related Symptoms

A total of 384 participants were recruited (Table 1), representing an overall participation rate of 75.6%. There was a total of 313 HCWs recruited, of which 80 (25.6%) were medical doctors and 233 (74.4%) were nursing or allied healthcare staff. Overall, there were more females (73.1%) than males (26.9%) but this was due to the predominance of females in the nursing profession. Racial distribution was not statistically different between the groups, except for Filipinos, who had a higher representation among the HCWs compared to controls. The mean age of the participants was 38.3 ± 11.2 years, with the control group being slightly older than the HCWs.

There was a significant difference in the occupational use of latex gloves, with 95.8% of the control group having no usage of latex gloves at work, compared to 94.6% of HCWs who used latex gloves in on a daily basis. Duration of exposure to latex gloves was also longer in HCWs compared to the control group, indicating that the cumulative exposure to latex gloves was higher among HCWs.

Self-reported personal and family history of atopy was higher among HCWs compared to the control group, although this was only statistically significant for participants who reported a family history of atopy.

Overall, latex glove-related symptoms were reported in 12.0% of participants. This was highest among the OT HCWs (16.4%), followed by non-OT HCWs (11.4%), compared to only 3 participants (4.2%) in the control group. Dermatological manifestations such as itch and

Table 1. Socio-demographic Data, Atopy and Latex-related Symptoms in 384 Participants

Characteristics	Control	OT HCW	Non-OT HCW
No. of eligible workers	118	201	189
No. of participants, %	71 (60.2%)	146 (72.6%)	167 (88.4%)
Age (mean ± SD), years	41.5 ± 11.7	36.9 ± 9.8	38.1 ± 11.8
Sex			
Female	45 (63.4%)	118 (80.8%)	118 (70.7%)
Male	26 (36.6%)	28 (19.2%)	49 (29.3)
Race			
Chinese	47 (66.2%)	89 (61.0%)	112 (67.0%)
Malay	8 (11.3%)	11 (7.5%)	14 (8.4%)
Indian	13 (18.3%)	29 (19.9%)	19 (11.4%)
Filipino	1 (1.4%)	17 (11.6%)	17 (10.2%)
Others	2 (2.8%)	0	5 (3.0%)
Occupation			
Administrative staff	71 (100%)	0	0
Doctors/Anaesthetists	0	31 (21.2%)	49 (29.3%)
Nursing/Allied HCWs	0	115 (78.8%)	118 (70.7%)
Current occupational use of latex gloves			
Nil	68 (95.8%)	0	0
Daily	0	143 (97.9%)	153 (91.6%)
Weekly	3 (4.2%)	2 (1.4%)	12 (7.2%)
Monthly	0	1 (0.7%)	2 (1.2%)
Non-occupational exposure to latex gloves			
Nil	63 (88.7%)	129 (88.4%)	149 (89.2%)
Daily	1 (1.4%)	6 (4.1%)	5 (3.0%)
Weekly	7 (9.9%)	11 (7.5%)	13 (7.8%)
Monthly	0	0	0
Duration of exposure to latex gloves (mean ± SD), years	8.4 ± 7.5	12.8 ± 8.3	12.6 ± 9.3
Personal history of atopy	17 (23.9%)	42 (28.8%)	60 (35.9%)
Family history of atopy	10 (14.1%)	42 (28.8%)	50 (29.9%)
Latex glove-related symptoms			
No symptoms	68 (95.8%)	122 (83.6%)	148 (88.6%)
At least one symptom	3 (4.2%)	24 (16.4%)	19 (11.4%)
Itch/Rash	3/3	22 (15.1%)	18(10.8%)
Urticaria	1/3	3 (2.1%)	5 (3.0%)
Asthma	0/3	1 (0.7%)	0
Rhinitis	0/3	0	3 (1.8%)
Previous medical attention	1/3	2 (1.4%)	2 (1.2%)

HCW: healthcare worker; OT: operating theatre

hand eczema were the commonest symptoms reported, while glove-related urticaria, asthma or rhinitis were uncommon.

None of the participants reported any allergic reactions to fruits such as bananas, kiwis or avocados.

Result of SPTs and Ig E Test

All 384 participants had latex-specific IgE blood testing performed, while 381(99.2%) had skin prick testing done (Table 2). A total of 32 (8.3%) participants were found to be latex-sensitised; 5 participants were both SPT- and IgE-positive, 26 were SPT-positive only and 1 was IgE-positive only. There was no adverse effect noted during skin prick testing.

Of the 32 latex-sensitised participants, 2 (2.8%) were from the control group, 14 (9.6%) were OT HCWs (3 doctors, 11 nurses) and 16 (9.6%) were non-OT HCWs (3 doctors, 11 nurses, 2 laboratory technicians).

When correlated with glove-related symptoms, 4 out of 5 with both SPT and IgE tests positive were symptomatic, compared to 4 out of 26 who were SPT-positive only. The only subject with positive IgE detected was also

Table 2. Results of Skin Prick Test and Latex-specific IgE Test

Test	Control (n = 71)	OT HCW (n = 146)	Non-OT HCW (n = 167)	Total (n = 384)
Total no. of SPT done	71	144	166	381 (99.2%)
Total no. of IgE test done	71	146	167	384 (100%)
Total no. sensitised to latex (Either test positive)	2 (2.8%)	14 (9.6%)	16 (9.6%)	32 (8.3%)
SPT to latex				
Positive	2 (2.8%)	14 (9.6%)	15 (9.0%)	31 (8.1%)
Negative	69 (97.2%)	130 (89.0%)	151 (90.4%)	350 (91.1%)
Not performed*	0	2 (1.4%)	1 (0.6%)	3 (0.8%)
IgE to latex (kIU/L)				
Positive (>0.7)	1 (1.4%)	1 (0.7%)	4 (2.4%)	6 (1.6%)
Negative (<0.35)	70 (98.6%)	145 (99.3%)	161 (96.4%)	376 (97.9%)
Equivocal (0.35 to 0.7)	0	0	2 (1.2%)	2 (0.5%)
SPT and IgE tests				
Both tests positive	1 (1.4%)	1 (0.7%)	3 (2.4%)	5 (1.3%)
SPT +ve /IgE –ve	1 (1.4%)	13 (8.9%)	12 (6.6%)	26 (6.8%)
SPT -ve /IgE +ve	0	0	1 (0.6%)	1 (0.3%)

*pregnant females
HCW: healthcare worker; OT: operating theatre; SPT: skin prick test

symptomatic, but did not undergo SPT because she was pregnant. The mean diameter for SPT to latex among sensitised participants was 4.6 mm [95% confidence interval (CI); range, 4.2 to 5.0]. The mean titre of latex-specific IgE antibodies among the 6 subjects who tested positive was 5.23 kIU/mL (range, 0.78 to 14.5).

Comparison of Sensitised and Non-sensitised HCWs

All 30 sensitised HCW were compared to 283 non-sensitised HCWs. Comparison between both groups did not reveal any statistical difference with regard to age, sex, race, occupation, frequency and duration of latex glove use (Table 3). However, there was a higher proportion of Filipino HCWs that was sensitised (26.7%) compared to non-sensitised Filipino HCWs (9.2%). There were also more sensitised HCWs who had a positive personal (40.0%) and family history (36.7%) of atopy, compared to non-sensitised HCWs (31.8% and 28.6% respectively), but this difference did not reach statistical significance.

Non-parametric correlation showed that the size of the SPT to latex was positively correlated with the presence of glove-related symptoms (Spearman's r = 0.51, $P = 0.01$).

Only 26.7% of sensitised HCWs reported latex glove-related symptoms. The commonest symptoms were hand rash or itch (7/8) and urticaria (6/8). Urticaria was reported in 20% of sensitised HCWs compared to only 0.7% of non-sensitised HCWs ($P = 0.000$). Rhinitis was reported by 2 sensitised HCWs and none reported asthmatic symptoms. Only 1 sensitised HCW had sought previous medical attention for glove-related symptoms and only 6 had reported using measures to avoid or minimise contact with latex gloves.

Discussion

Type I latex hypersensitivity has emerged as one of the most important occupational health risks for HCWs. With the heightened emphasis on infection control due to the advent of the HIV pandemic and the recent Severe Acute Respiratory Syndrome (SARS) outbreak in Asia, the widespread use of latex-containing personal protective equipment such as gloves will certainly increase and constitute an ongoing risk for HCWs.

While there has been much public health interest in NRL allergy in the West, the prevalence of this problem is relatively unknown in Asia. There are currently no national occupational safety guidelines for the use of latex-containing medical equipment and latex gloves in Singapore.

We found an overall prevalence rate of latex sensitisation of 8.3% among all tested participants. The prevalence among HCWs was 9.6%, with no difference found between the OT HCWs and non-OT HCWs. This is in agreement with previous epidemiological studies in the West, including a rate of 5.6% and 10.7% among OT nurses from studies in Finland and France respectively.[1,2] In contrast, we found a prevalence of 2.8% in the control group, who did not have occupational exposure to latex. Previous studies have estimated the prevalence of latex sensitisation to be less than 1% to 2% in the general population.[9]

Although we did not find a higher prevalence rate among OT HCWs, a study by Turjanmaa[1] found that working in an

Table 3. Comparison of Sensitised HCWs Compared to Non-sensitised HCWs

Characteristics	Sensitised HCW (n = 30)	Non-sensitised HCW (n = 283)	*P* value
Age (mean ± SD), years	36.1 ± 11.6	37.7 ±10.9	0.435
Sex			
Female	25 (83.3%)	211 (74.6%)	0.375
Male	5 (16.7%)	72 (25.4%)	
Race			
Chinese	16 (53.3%)	185 (65.4%)	0.063
Malay	2 (6.7%)	23 (8.1%)	
Indian	4 (13.3%)	44 (15.5%)	
Filipino	8 (26.7%)	26 (9.2%)	
Others	0	5 (1.8%)	
Occupation			
Doctors/Anaesthetists	6 (20.0%)	74 (26.1%)	0.660
Nursing/Allied HCWs	24 (80.0%)	209 (73.9%)	
Current occupational use of latex gloves			
Nil	0	0	0.265
Daily	27 (90.0%)	269 (95.0%)	
Weekly	3 (10.0%)	11 (3.9%)	
Monthly	0	3 (1.1%)	
Non-occupational exposure to latex gloves			
Nil	25 (83.4%)	253 (89.4%)	0.618
Daily	1 (3.3%)	10 (3.5%)	
Weekly	4 (13.3%)	20 (7.1%)	
Monthly	0	0	
Duration of exposure to latex gloves (mean ± SD), years	12.1 ± 8.7	12.7 ± 8.9	0.725
Mean SPT to latex (mm)	4.6 ± 1.2	2.0 ± 0.8	0.000*
Personal history of atopy	12 (40.0%)	90 (31.8%)	0.414
Family history of atopy	11 (36.7%)	81 (28.6%)	0.400
Latex glove-related symptoms			
No symptoms	22 (73.3%)	248 (87.6%)	0.046
At least one symptom	8 (26.7%)	35 (12.4%)	
Itch/Rash	7/8	33/35	0.083
Urticaria	6/8	2/35	0.000*
Asthma	0/8	1/35	1.0
Rhinitis	2/8	1/35	0.025*
Previous medical attention	1/8	3/35	0.333
Avoidance/Barrier cream use	6/30	17/283	0.015*

*statistically significant
HCW: healthcare worker; SPT: skin prick test

OT environment was associated with a higher risk of sensitisation compared to non-OT HCWs. A possible explanation for this may be survivor bias, where affected OT HCWs may have been transferred to non-OT positions, where exposure to powdered sterile latex gloves is perceived to be lower.

Of the 32 latex-sensitised participants, only 9 (28.1%) reported symptoms associated with latex glove use, indicating clinically relevant NRL allergy. The most common reported symptoms were hand rash and itch but the most important discriminating symptom was contact urticaria (P = 0.000). Latex-induced asthma has been reported as an important cause of occupational asthma among HCWs, but this was not reported by any of the latex allergic participants in this study. Two of the latex-allergic participants reported latex-induced rhinitis; one of whom did not have a personal or family history of atopy or allergic rhinitis.

The remaining 23 (71.9%) latex-sensitised participants did not report symptoms associated with latex glove use, indicating subclinical latex sensitisation. All 23 had positive SPT to latex, including 1 participant who had positive latex-specific IgE antibodies as well. This is similar to a previous study, which found that among the 12.5% of

anaesthetists who were latex-sensitised, 10.1% were asymptomatic, compared to 2.4% who were symptomatic.[10] The lack of symptoms may be due to a lack of perception, especially for those with mild dermatological or allergic symptoms. Another possibility is that the magnitude of latex exposure at the workplace was insufficient to produce symptoms in this group. In order to clarify the situation further and establish the true clinical relevance of such participants, latex challenge or provocation use tests should be performed, especially for those with discordant SPT and IgE results.[11] Nonetheless, it may still be important to identify such HCWs as prolonged latex exposure can exacerbate the hypersensitivity reaction, leading to an increased risk of anaphylaxis. This is evidenced by anaphylactic intraoperative reactions that have been reported in latex SPT-positive but IgE-negative patients, as a consequence of high-risk mucosal or visceral latex exposure during surgery.[12]

Sensitised HCWs in this study had a mean SPT to latex of 4.6 mm; with symptomatic HCWs having a larger mean SPT result (5.5 mm) compared to sensitised but asymptomatic HCWs (4.2 mm). In contrast, non-sensitised HCWs had a mean SPT result of 2.0 mm. This concurs with a study that showed a positive association between the size of the SPT response and clinical severity of latex-induced symptoms.[13] Compared with skin prick testing, this study also showed that IgE detection was considerably less sensitive, with only 18.8% of all sensitised HCWs having a positive IgE test result. However, if only symptomatic latex-sensitised HCWs were considered, IgE test was positive in 5 out of 9 (55.6%) subjects.

Glove-related dermatological symptoms were reported in 12.4% of non-latex-sensitised HCWs, suggesting that irritant contact dermatitis of the hands or a Type IV reaction to the latex gloves may be responsible. Further evaluation, including patch testing to rubber chemicals, should be considered in this group as part of the diagnostic work-up for occupational hand eczema.[14]

Previous studies have also indicated that atopy was an important determinant of latex sensitivity.[1,2,4,10] Similarly, this study found that more sensitised HCWs had a personal and family history of atopy compared to non-sensitised HCWs. There also appears to be no racial predilection to latex sensitisation, although there was a greater proportion of sensitised Filipino HCWs compared to non-sensitised Filipino HCWs. We postulate that this may be related to past occupational and non-occupational latex exposure. The frequency and total duration of occupational latex glove exposure was similar in both the sensitised and non-sensitised HCWs, which concurs with previous studies that did not show a clear association between cumulative exposure to latex gloves and the likelihood of latex sensitisation.[1,4]

Cross-reactions with fruits and nuts have been reported, but none of our participants reported allergy to bananas, kiwis and avocados, indicating that fruit allergy is not helpful in identifying latex allergy in our study population.[15]

In conclusion, latex sensitisation among HCWs in Singapore should be considered a significant occupational health risk, as it is in the West. The need for increased awareness, regular education and screening measures cannot be overemphasised, especially when only 1 out of 9 (11.1%) symptomatic latex-allergic participants in this study had received medical attention for their problem. Sensitised HCWs should be provided with latex-free alternatives, like vinyl gloves, at work and measures should be implemented to minimise latex exposure.

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