

Study of Latex Glove Associated Dermatoses Among Nurses in a Tertiary Care Hospital

Abstract

Introduction: Natural rubber latex (NRL) is processed from *Hevea brasiliensis* trees. Allergic reactions to certain proteins in the latex manifest as immediate hypersensitivity reactions and allergic reactions to chemicals added to latex during processing manifest as allergic contact dermatitis. Healthcare workers (HCWs) are at increased risk of developing latex allergies. As little data is available from India, this study was directed toward identifying the prevalence of latex glove-related dermatoses among nurses and the factors leading to it. **Methodology:** This cross-sectional study was undertaken among nurses in a private tertiary care hospital. **Results:** A total of 700 nurses were included in the study. Symptoms of latex allergy were present in 74 (10.6%) of study subjects, out of which 69 (9.9%) had features of contact dermatitis. Patch test was done in 50 subjects and was positive in 12 (24%); among them, patch test antigens were positive in 9 (18%) and a positive result to glove piece was seen in 3 subjects. **Conclusions:** Latex allergy in India is a significant problem; though lesser compared to western countries, its prevalence necessitates the development of pre-employment protocols to avoid workplace morbidity.

Keywords: *Glove dermatitis, hand dermatitis, latex, occupational contact dermatitis, rubber allergy*

Introduction

Natural rubber latex (NRL), a cis-1,4-polyisoprene, is processed from *Hevea brasiliensis* trees.^[1] Latex allergy is a reaction to certain proteins present in latex, which manifests as an immediate hypersensitivity reaction or as a result of chemicals added to latex during harvesting, processing, or manufacturing, which then manifests as allergic contact dermatitis. However, the most common reaction to latex products is irritant contact dermatitis caused by irritation from wearing gloves or by glove powder.^[2] Latex glove reactions have been shown to be an important cause of occupational morbidity among HCWs because they use latex gloves multiple times a day and on a daily basis. A review by the National Institute for Occupational Safety and Health states that 8%–12% of HCWs are regularly exposed are sensitized to latex compared to 1%–6% of the general population.^[3] Quality of work life of latex-allergic HCWs improves significantly after their removal from latex exposure^[4] and workability is increased with successful avoidance of NRL at

the workplace.^[5] Primary prevention of occupational NRL allergies, such as early recognition, health education, and switching to powder-free NRL gloves with reduced protein content, has been associated with a decline in the number of these cases. Secondary prevention of NRL allergies is done by supplying the allergic workers with NRL-free gloves^[6] and reduction of exposure, which results in fewer socioeconomic consequences.^[7] According to the World Health Organization's 2011 report, about 13 nurses/10,000 population are working in India.^[8] In a multicentric study done in China, the prevalence of latex allergy among nurses was 8.8%.^[9] Several epidemiological studies have considered these issues in Europe^[10-12] and North America^[13,14] but little data is available from India. Therefore, this study was directed to identify the prevalence of latex glove-related dermatoses among nurses and the factors leading to it.

Methodology

This cross-sectional study was undertaken among nurses in a private tertiary care hospital for a period of 1.5 years. Based on

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a prevalence of 16% by Agrawal *et al.*,^[15] we estimated a sample size of 322 for this study with an absolute precision of 10% and at 95% level of confidence interval. However, it was decided to include all the nurses who were working at the time of the study. Pregnant females were excluded from the study. Prior to beginning the study, a pilot study was conducted with 30 nursing students. The purpose of this exercise was to assess the utility and feasibility of the research instruments and methods proposed. Suitable changes were then incorporated into the final study tools and methodology. Ethical clearance for the study was obtained from the institution's ethical committee. Written informed consent was obtained from the nurses before the interview and patch and prick tests.

Subjects with a history of hand dermatitis characterized by erythema, dryness, cracking, scaling, and/or vesicle formation with patch test results as negative were considered to have irritant contact dermatitis. Subjects with a history of eczematous dermatitis on hands with papular, pruritic rash, vesicles, blisters, and crusts confirmed by positive patch test results by an experienced dermatologist were considered to have allergic contact dermatitis. Immediate hypersensitivity reaction is manifested as itching, redness, and hives in the area of contact, which stay for a few minutes to hours and clear without any skin changes, which can be associated with runny nose, swollen eyes, generalized rash or hives, bronchospasm or anaphylaxis depending upon the severity.

We considered a subject to have fruit allergy if they had a clear history of at least two episodes of attributable mucosal numbness/irritation/urticaria/anaphylaxis and/or angioedema within a few minutes to hours after eating fruits. However, we did not do any tests to confirm this.

The study comprised four parts:

Step 1: The data were collected by face-to-face interview by using a structured questionnaire with all the nurses which are adopted from the American College of Allergy, Asthma, and Immunology (ACCAI).^[16]

Step 2: Patch test was done for nurses with contact dermatitis using allergens specific for latex allergy from the 80 allergens in the NACDG series.^[17] Patch test kit was obtained from Creative Diagnostic Medicare Private Limited, Navi Mumbai, India. We were able to procure only five allergens for the patch test. The allergens used for the patch test were vaseline (control), mercaptobenzothiazole, ethylenediamine, paraphenylenediamine, thiuram mix and black rubber mix, and a piece of moistened glove. Tiny quantities of allergens (approximately 20 mg) in Finn chambers were applied on the lateral aspect of the upper arm in a dermatitis-free area. The reaction to these allergens was read after 48 hours^[18] and reassessed after 96 hours as per International Contact Dermatitis Research Group (ICDRG) guidelines.^[19] Subjects who developed

erythema and/or papules and/or vesicles at the patch test site on days 2 and 4 were considered to have a positive patch test.

Step 3: Prick test was done on those with history or signs of type 1 reaction of milder forms, such as contact urticaria, allergic rhinitis, allergic conjunctivitis, and contact pruritus. It was not done in those suspected to have severe type 1 reactions to latex, such as angioedema or anaphylaxis. Prick test was done for latex allergen along with a positive control (histamine) and a negative control (saline) on the volar aspect of the forearm by using a lancet. The allergens were procured from Creative Diagnostic Medicare Industries (Credisol Skin Prick test allergens), Navi Mumbai. The forearm was coded with a skin marker pen corresponding to the latex allergen, positive control, and negative control. Marks were at least 2.5 cm apart. A drop of allergen solution, histamine, and saline were placed beside corresponding marks. A small prick through the drop was made to the skin by using a sterile lancet. Skin reactions were read after 15–30 min. Skin test reaction equal or larger than positive control was considered as positive, with histamine producing a weal of at least 3 mm in diameter. While measuring, the diameter of the weal with greatest dimension is first measured as (D1) subsequently the diameter perpendicular to D1 is measured and designated as (D2). The results were then expressed as mean $(D1 + D2)/2$ and wheal size was measured in millimeters.^[20]

Step 4: Use test- The subjects were asked to wear the gloves on one hand for 30 min to observe the development of immediate reaction or subjective symptom of contact pruritus.

Statistical Analysis: The collected data were analyzed using standard statistical software version 16. The data were analyzed using descriptive statistics such as percentages, mean, and standard deviation. The various risk factors and their association with latex glove allergy were studied using relevant tests of significance such as Chi-square test (χ^2).

Results

A total of 700 nurses were included in the study. The age of the study subjects ranged from 21 to 49 years. Approximately 414 (60%) were working as staff nurses for ≥ 1 year (median 1 year) with a range of 1 month to 23 years. In our study, 429 (61.3%) subjects washed their hands with soap for ≤ 10 times, and 361 (51.6%) used sanitizer for ≤ 10 times. Both powdered and nonpowdered gloves were used by 373 (53.3%) subjects. Among the study subjects, 348 (49.7%) were using the gloves for more than 3 h and 242 (34.6%) were using more than 10 gloves per day. History of allergic diatheses such as allergic rhinitis, eczema, asthma, urticaria, and dust allergy was present in 93 (13.3%). There were attributable fruit allergies seen in 51 (7.3%) for one of the following fruits:

pineapple, grape, papaya, tomatoes, cherry, jackfruit, peach, fig, carrot, watermelon, mango, and chikoo. History suggestive of type 1 reaction to other rubber items was present in 9 subjects and history of undergoing surgery with catheterization during surgery was present in 8 subjects.

Symptoms of glove dermatoses were present in 74 (10.6%) study subjects (Figure 1: Subject with irritant contact dermatitis; Figure 2: Subject with allergic contact dermatitis). Contact dermatitis (allergic and/or irritant contact dermatitis) was present in 69 (9.9%) subjects, and symptoms of type I hypersensitivity reaction were present in 21 (3%) subjects. Few subjects (16) had both contact dermatitis and type 1 reaction. Both type 1 localized symptoms/rash within 30 min of using gloves were reported in 21 (28.4%) subjects and generalized rash 24 h after using gloves was reported in 1 subject. History of aerosol reaction such as sneezing and stuffy nose or history of breathing difficulty and wheezing was present in 2 (2.7%).

Irritant contact dermatitis increases with the number of times of handwashing with soap ($P = 0.049$) and with the presence of history of allergic diathesis ($P = 0.001$). Allergic contact dermatitis is significantly associated with history of allergic diatheses ($P = 0.001$), fruit allergy ($P = 0.044$), and allergy to other rubber items ($P = 0.001$). The presence of symptoms of type I hypersensitivity reaction was higher among the subjects who were using gloves for more hours (>3 h) ($P = 0.043$), subjects with allergic diatheses ($P = 0.001$), fruit allergy ($P = 0.035$), allergy to rubber items ($P = 0.001$), and history of catheterization ($P = 0.022$).

Factors associated with any form of latex glove dermatoses are represented in [Table 1]. The presence of any form of latex glove-associated dermatoses was higher among the subjects with personal history of allergic diathesis, fruit allergy, which are statistically significant. No significant

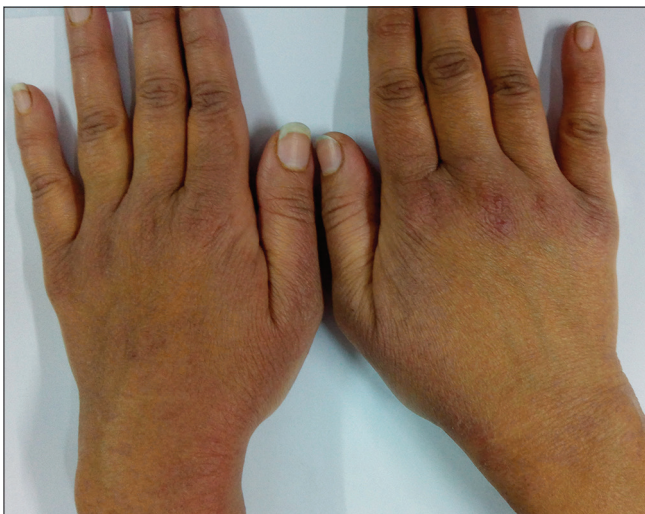


Figure 1: Irritant contact dermatitis

association was found between the number of pairs of gloves used per day and latex glove dermatoses.

On regression analysis, [Table 2], subjects with history of allergic diathesis had 5.4 times, 6.4 times, and 3.9 times more chance of getting irritant contact dermatitis, allergic contact dermatitis, and type I reaction, respectively, compared to those without allergy. Subjects with history of immediate reactions to rubber items had 11.64 times and 21.84 times more chance of getting allergic contact dermatitis and type I reaction, respectively, compared to those without allergy.

Patch test was done among 50 subjects who gave consent for the test and was positive in 12 (24%) study subjects, confirming the diagnosis of allergic contact dermatitis. Among those in whom patch test was done, patch test antigens were positive in 9 (18%) subjects and positive patch test to only glove piece was seen in 3 subjects. To patch test antigen, 7 subjects had grade 2 reaction and two had grade 1 reaction. Among those subjects who were negative with patch test reaction on day 2 remained negative on day 4 of reassessment. No statistically significant association was found between patch test results and other variables such as age, duration of service, work area, washing hands with soap and sanitizer, type of glove used, number of gloves used, hours of gloves used, history of allergic diathesis, fruit allergy, and surgical history. Positive use test was present in 7 (14.0%) subjects:

Table 1: Factors associated with symptoms of latex glove dermatoses

Variables	Any form of latex glove dermatoses		P
	Present (n=74)	Absent (n=626)	
History of allergy			
Present	33 (35.5%)	60 (64.5%)	0.001 ^a
Absent	41 (6.8%)	566 (93.2%)	
Fruit allergy			
Present	15 (29.4%)	36 (70.6%)	0.001 ^a
Absent	59 (9.1%)	590 (90.9%)	
Allergy to other rubber items			
Present	7 (77.8%)	2 (22.2%)	0.001 ^a
Absent	67 (9.7%)	624 (90.3%)	

n=700, ^aChi square value, Significant at $\alpha=0.05$



Figure 2: Allergic contact dermatitis

Table 2: Multivariate logistic regression for latex glove dermatoses

Variables			Adjusted Odds ratio	95% confidence interval		P
				Lower	Upper	
Irritant contact dermatitis	History of allergic diathesis	Present	5.4	2.96	9.45	0.001*
		Absent	1	-	-	
Allergic contact dermatitis	History of allergic diathesis	Present	6.38	3.21	12.69	0.001*
		Absent	1	-	-	
Type I hypersensitivity reaction	History of allergy to other rubber items	Present	11.64	2.55	53.04	0.002*
		Absent	1	-	-	
	History of allergic diathesis	Present	3.86	1.41	10.59	0.009*
		Absent	1	-	-	
History of allergy to other rubber items	Present	21.84	4.63	102.95	0.001*	
	Absent	1	-	-		
Any form of latex glove dermatoses	Catheterisation	Present	8.88	1.46	53.99	0.018*
		Absent	1	-	-	
	History of allergic diathesis	Present	4.81	1.83	12.69	0.001*
		Absent	1	-	-	
History of allergy to other rubber items	Present	17.32	3.75	80.09	0.001*	
	Absent	1	-	-		

*Statistical significance was taken at $\alpha=5\%$

2 had contact pruritus and 5 subjects had contact urticarial reaction. One subject developed generalized urticarial rash with cough following the use test which subsided following supportive and symptomatic treatment. Consent for prick test was given only by 2 subjects who had contact pruritus on use test. The prick test reaction was negative among both of them.

Discussion

Latex is a complex emulsion consisting of resins, tannins, oils, sugars, starches, alkaloids, proteins, and gums that go hard when exposed to air. The International Union of Immunological Societies recognizes 15 latex allergens that bind to human immunoglobulin IgE (Hev b1 to Hev b15).^[21] Depending on the methodology of diagnosis, the prevalence of latex sensitivity among HCWs has been reported to be from 3%^[22] to 17%.^[23] A study done by Agrawal *et al.*^[15] among dental professionals in Rajasthan, India showed a prevalence of symptoms of latex allergy in 16%, which is more compared to our study. Prevalence of symptoms of latex allergy varies in studies outside India, from 16.3% in Sri Lanka^[24] to 26.9% in Malaysia.^[25] This difference in the prevalence of symptoms of latex allergy in our study may be due to low mean age and fewer years of experience among the subjects. The most significant factors that contribute to latex sensitivity are the frequency of exposure^[9] and duration of exposure.^[11]

A study done by Sagi *et al.*^[22] using a similar questionnaire reported symptoms of immediate hypersensitivity reaction in 2.9%, which is comparable to our study. Prevalence of type I hypersensitivity varies with studies, from 1.7% in Malaysia^[25] to 6% in Taiwan.^[26] Latex sensitization varies between different countries and within regions of the same

country, depending on various factors such as protein content of latex in glove, genetic predisposition to latex allergy, prevalence of atopy, and differences in diagnostic tests and criteria used for diagnosis of latex allergy.

The reported prevalence of irritant contact dermatitis was 18.6% in Malaysia^[25] and 4.96%^[24] in Sri Lanka and of allergic contact dermatitis was 6.1%.^[25] in Malaysia and 21.8% in the US.^[27] The development of contact dermatitis may be due to repeated hand washing and increased usage of powdered gloves. The subjects with contact dermatitis may have a higher risk of developing immediate hypersensitivity reaction.^[24] Symptoms of allergic contact dermatitis and irritant contact dermatitis may be overlapping and it is possible to have manifestations of irritant and allergic contact dermatitis in the same person.

Subjects with history of allergic diathesis are more prone to latex-related dermatosis as compared to those without history of significant allergies.^[15,28] Those with history of fruit allergy experienced statistically significant symptoms related to latex glove dermatoses. This increased risk of latex allergy may be due to the cross-reactivity with the latex proteins.^[29,30] Even the presence of preexisting latex allergy can induce food allergies in individuals.^[30] Class I chitinases (Hev b6.02 and Hev7) are the major allergens that cross-react with latex.^[31] In our study, fruit allergy was significantly associated with allergic contact dermatitis, which is similar to the earlier studies.^[11,15,25,32] Subjects with history of immediate reactions to other latex products have more chance of getting glove dermatoses.^[10,24]

Subjects with symptoms of latex allergy were reluctant to take patch test due to the fear of flare of allergy and difficulty to keep the patch for 48 h. Thus, patch test was

done in 50 subjects who gave consent for the test. We were not able to procure some antigens such as carbamix and mercapto mix. This is probably the reason why some are positive to glove pieces but not to the patch test antigen.

Consent for prick test was given only by 2 subjects who had only contact pruritus on use test. The prick test reaction was negative among them. This is probably because of the absence of major antigens Hev3 and Hev5 in some of the prick test kits as these antigens degrade very fast. It could also be because the variable amount of residual extractable proteins available can vary depending on the manufacturing processing.

Limitations

Occlusion, heat, sweating, and sanitizer usage could have contributed to our findings in some of our subjects. In this study, we did not use full set antigens of the NACDG series; thus, there was a possibility of some allergic reactions being missed. We had not taken nitrile glove sensitivity in our study as it was not available in our institution at the time of the study. All the subjects with symptoms of latex glove allergy could not be confirmed by investigations due to their reluctance to participate in patch test and/or prick test. Also, non-probability sampling technique was one limitation of our study.

Conclusions

In our study, symptoms suggestive of latex glove dermatoses among nurses were present in 74 (10.6%) nurses. Those with history of allergy including fruit allergy, already existing allergic diathesis, rubber allergy, etc. had a high chance of developing latex glove dermatoses. Latex allergy in India is a significant problem, though less compared to western countries. The risk factors identified should be included in pre-employment health checks and HCWs should be provided with non-latex gloves.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

References

- Sussman GL, Beezhold DH, Kurup VP. Allergens and natural rubber proteins. *J Allergy Clin Immunology* 2002;110(Suppl 2):S33-9.
- National Institute for Occupational Safety and Health. Latex allergy a prevention guide; 1998. NIOSH Publication No. 98-113. Available from: <https://www.cdc.gov/niosh/docs/98-113>.
- National Institute for Occupational Safety and Health. NIOSH Alert: Preventing allergic reactions to natural rubber latex in the workplace; 1997. NIOSH Publication No. 97-135. Available from: <https://www.cdc.gov/niosh/docs/97-135/pdfs/97-135.pdf?id=10.26616/NIOSH PUB97135>.
- Power S, Gallagher J, Meaney S. Quality of life in health care workers with latex allergy. *Occup Med* 2010;60:62-5.
- Nienhaus A, Kromark K, Raulf-Heimsoth M, van Kampen V, Merget R. Outcome of occupational latex allergy--work ability and quality of life. *PLoS One* 2008;3:e3459.
- Allmers H, Schmengler J, Skudlik C. Primary prevention of natural rubber latex allergy in the German health care system through education and intervention. *J Allergy Clin Immunol* 2002;110:318-23.
- Vandenplas O, Jamart J, Delwiche JP, Evrard G, Larbanos A. Occupational asthma caused by natural rubber latex: Outcome according to cessation or reduction of exposure. *J Allergy Clin Immunol* 2002;109:125-30.
- World Health Organization. *World Health Statistics*; 2011. p. 115-118. Available from: https://www.who.int/gho/publications/world_health_statistics/EN_WHS2011_Full.pdf.
- Liu QL, He XZ, Liang K, Xie R, Fang HP, Zhu KJ, et al. Prevalence and risk factors for latex glove allergy among female clinical nurses: A multicenter questionnaire study in China. *Int J Occup Environ Health* 2013;19:29-34.
- Verna N, Di Giampaolo LD, Renzetti A, Balatsinou L, Stefano FD, Gioacchino GD, et al. Prevalence and risk factors for latex-related diseases among healthcare workers in an Italian general hospital. *Ann Clin Lab Sci* 2003;33:184-91.
- Suli C, Parziale M, Lorini M, De Silva E, Miadonna A, Tedeschi A. Prevalence and risk factors for latex allergy: A cross sectional study on health-care workers of an Italian hospital. *J Investig Allergol Clin Immunol* 2004;14:64-9.
- Filon FL, Radman G. Latex allergy: A follow up study of 1040 healthcare workers. *Occup Environ Med* 2006;63:121-5.
- Tarlo SM, Sussman GL, Holness DL. Latex sensitivity in dental students and staff: A cross-sectional study. *J Allergy Clin Immunol* 1997;99:396-401.
- Liss GM, Sussman GL, Deal K, Brown S, Cividino M, Siu S, et al. Latex allergy: Epidemiological study of 1351 hospital workers. *Occup Environ Med* 1997;54:335-42.
- Agrawal A, Bhatt N, Kk S, Singh K, Chaudhary H, Asawa K. Prevalence of allergy to latex gloves among dental professionals in Udaipur, Rajasthan, India. *Oral Health Prev Dent* 2010;8:345-50.
- Sussman G, Gold M. Guidelines for the management of latex allergies and safe latex use in health care facilities. *American College of Allergy, Asthma and Immunology*; 1996. Available from: <https://www.researchgate.net/publication/242182348>.
- Warshaw EM, Belsito DV, Taylor JS, Sasseville D, DeKoven JG, Zirwas MJ, et al. North American Contact Dermatitis Group patch test results: 2009 to 2010. *Dermatitis* 2013;24:50-9.
- Lazzarini R, Duarte I, Ferreira AL. Patch tests. *An Bras Dermatol* 2013;88:879-88.
- Lachapelle JM, Maibach HI. The international contact dermatitis research group. In: *Patch Testing and Prick Testing: A Practical Guide Official Publication of the ICDRG*. Springer Berlin Heidelberg; 2009. p. 1-3.
- Heinzerling L, Mari A, Bergmann KC, Bresciani M, Burbach G,

- Darsow U, *et al.* The skin prick test-European standards. *Clin Transl Allergy* 2013;3:3.
21. King TP, Hoffman D, Lowenstein H, Marsh DG, Platts-Mills TA, Thomas W. Allergen nomenclature. WHO/IUIS Allergen Nomenclature Subcommittee. *Int Arch Allergy Immunol* 1994;105:224-33.
 22. Sagi TM, Sebastian J, Nair H. Natural rubber latex allergy: Occupational exposure to latex glove among clinical laboratory workers. *Indian J Physiol Pharmacol* 2014;58:187-8.
 23. Yassin MS, Lierl MB, Fischer TJ, O'Brien K, Cross J, Steinmetz C. Latex allergy in hospital employees. *Ann Allergy* 1994;72:245-9.
 24. Amarasekera M, Rathnamalala N, Samaraweera S, Jinadasa M. Prevalence of latex allergy among healthcare workers. *Int J Occup Med Environ Health* 2010;23:391-6.
 25. Yusoff A, Murray SA, Rahman NA, John J, Mohammad D, Tin-Oo MM. Self-Reported latex glove allergy among dental personnel in Kelantan State, Malaysia. *Int Med J* 2013;20:343-5.
 26. Lin C-T, Hung D-Z, Chen D-Y, Wu H-J, Lan J-L, Chen Y-H. A hospital-based screening study of latex allergy and latex sensitization among medical workers in Taiwan. *J Microbiol Immunol Infect* 2008;41:499-506.
 27. Kim KT, Wellmeyer EK, Miller KV. Minimum prevalence of latex hypersensitivity in health care workers. *Allergy Asthma Proc* 1999;20:387-91.
 28. Pherwam A, Kurkal P, Trpathi DM, Bhutani M. The incidence of latex sensitivity amongst operation theatre personnel. *Indian J Allergy Appl Immunol* 2000;14:11-4.
 29. Brehler R, Theissen U, Mohr C, Luger T. "Latex-fruit syndrome": Frequency of cross-reacting IgE antibodies. *Allergy* 1997;52:404-10.
 30. Beezhold DH, Sussman GL, Liss GM, Chang NS. Latex allergy can induce clinical reactions to specific foods. *Clin Exp Allergy* 1996;26:416-22.
 31. Blanco C, Diaz-Perales A, Collada C, Sanchez-Monge R, Aragoncillo C, Castillo R, *et al.* Class I chitinases as potential panallergens involved in the latex-fruit syndrome. *J Allergy Clin Immunol* 1999;103:507-13.
 32. Buss ZS, Kupek E, Frode TS. Screening for latex sensitization by questionnaire: Diagnostic performance in health care workers. *J Investig Allergol Clin Immunol* 2008;18:12-6.