

Prevalence of Latex Glove Hypersensitivity among Dental Personnel in Dental Polyclinic of Universiti Sains Islam Malaysia (A Questionnaire Based)

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Abstract

Introduction: Latex hypersensitivity is one of the problems in healthcare workers. This problem affects the productivity of the workers due to the hypersensitivity symptoms. In Dental Polyclinic USIM, there have been complaints by dental personnel regarding the usage of latex glove. However, there was no data that have been documented.

Aim: The aim of this study is to determine the prevalence of self-reported latex glove hypersensitivity among dental personnel in Dental Polyclinic of Universiti Sains Islam Malaysia.

Methodology: A cross-sectional study was conducted using purposive non-probability sampling technique. 196 dental personnel in Dental Polyclinic USIM who used natural latex gloves in their work were selected. Questionnaire on respondent's information on latex glove hypersensitivity was sent by email to the respondents and data collection was done from August to September 2015. Nevertheless, only 91% response was obtained.

Result: From 175 returned questionnaires, 55 (31.4%) respondents showed to have latex hypersensitivity symptoms. The most type of hypersensitivity symptoms was irritant contact dermatitis in 35 (20.1%) respondents, followed by Type IV response with delayed hypersensitivity in 14 (8.05%) respondents and immediate hypersensitivity Type I reaction in 6 (3.4%) respondents. Data analysis was done using Chi-Square test and there was a significant association between the latex allergy and the hours of exposure ($p < 0.05$).

Conclusion: Approximately one third (31.5%) of the dental personnel in Dental Polyclinic USIM has latex glove hypersensitivity through this questionnaire based study. Further study and further medical assessments need to be done to confirm the latex hypersensitivity among dental personnel, followed by specific measures in order to manage the hypersensitivity symptoms in clinical setting.

Keywords: Latex glove allergy, occupational hazard, oral healthcare workers

I. Introduction

Products of latex have been utilized since the 18th century, and for medical and dental use in particularly latex gloves have become widely used since the 1960s. Largely this has resulted from the increased awareness of the need for cross-infection control measures with acknowledgment of infectious diseases such as HIV and hepatitis C.¹ The rise of usage of latex glove came in 1988 with the AIDS scare and the "Universal Precautions" recommended by the US Centres for Disease Control (CDC) to treat certain body fluids and blood as potentially infectious.² Latex is found in many items in the dental surgery, being the most prominent are gloves.

It is proposed that exposure to medical gloves high in latex protein has sensitized numerous healthcare workers. Body sweat in the latex gloves may make the latex proteins soluble, further allowing absorption through skin and wearer will be sensitized easily.³ Available statistics suggest that 8-12 per cent of health care workers and 1-6 per cent of the general population have a latex allergy.¹ UK Adverse Reaction Reporting Project¹⁴ reported that dentist is the largest group reported with gloves hypersensitivity compared to others, making latex hypersensitivity considered as a major occupational health problem in dental personnel who are using natural rubber latex gloves on a regular basis. Jolanski¹⁷ also reported that dentist is the major group who has been using glove in long duration, which is postulated to have increased the risk to the hypersensitivity symptoms.

In Malaysia, only two studies have been done to find out the prevalence of latex glove hypersensitivity. M Shahnaz et al (1999) found that 3.1% of healthcare workers in Hospital Kuala Lumpur have latex hypersensitivity, while 26.9% latex hypersensitivity was found among dental personnel in Kelantan State (A.Yusoff et al 2013). This limited number of studies on prevalence of latex hypersensitivity urges on more study to be done to find out the current prevalent of latex glove hypersensitivity especially involving the dental personnel.

Particularly in USIM dental polyclinic, gloves supplied for clinical daily basis need are from natural latex origin. There is complaint regarding the symptoms related to glove usage particularly among the dental students, and other dental personnel which is not officially reported. Hence, the prevalence of hypersensitivity to latex gloves in USIM Polyclinic is unknown. The rationale of this study is that there is a need to find out how many of the dental personnel have the latex glove hypersensitivity because the symptoms will affect the productivity of their work in clinic. This study aims to determine the prevalence of hypersensitivity symptoms among dental personnel in Polyclinic USIM, and subsequently identify the most common symptoms reported by the dental personnel. Besides, we would like to investigate any significant relationship between duration of latex glove exposure and latex glove hypersensitivity.

The outcome of this study will be the reference for USIM dental polyclinic in reducing the risk for the dental personnel. At the end of this study, we will discuss about the recommendations for managing latex glove adverse reactions in the clinical dental settings.

II. Literature Review

1.1. The natural rubber latex

Natural rubber latex is an extract of sap which derived from the rubber tree (*Hevea Brasiliensis*)⁴, one of the lactifer plants in worldwide, including *Ponsettia (Euphorbia pulcherrima)* and Castor Bean (*Ricinus communis*)⁵. These lactifer plants species have special cells that secrete milky substance which is the latex, circulating in the branched tubes throughout the plant tissues.⁵

Latex have been used in worldwide where it is manufactured in more than 40 000 industrial products in the United States which includes the dental, medical and consumer products⁶. In dentistry, a review by T. Kean and McNalley⁶ has been done on the potentially latex-containing products in the dental clinic and they are listed in Table 1 below:

Potentially latex containing products in the dental clinic ²	
•	Gloves
•	Rubber dam
•	Amalgam carrier
•	Anesthetic carpules(diaphragm and plunger)
•	Inravenous tubing and bags
•	Syringes (rubber stopper covered with silicone)
•	Bulbs on medicine droppers
•	Bite blocks
•	Oxygen mask
•	Volatile anesthetic mask
•	Operative mask with rubber ties
•	Suction tips and suction tubing
•	Air or water syringer tips and irrigation tubing
•	Impression material
•	Mixing bowls
•	Orthodontic rubber bands and elastics
•	Polishing discs
•	Prophy cups
•	Bandages and tape
•	Stethoscopes
•	Blood pressure cuffs
•	Theoretical cross reactivity
•	Guttapercha

Table 1: Potentially latex containing products in the dental clinic

1.2. Latex manufacturing process

The process of manufacturing latex need to be well understood as it explains the materials and chemicals used in the production of latex gloves. There are several processes that have to be done in producing the latex as explained by Krapp⁷. First, rubber tapping will be done by shaving off the thinnest possible layer from the intact section of rubber tree bark in order to collect the latex lump. In the beginning, the latex is a flowing liquid which will be collected as a lump because it undergone coagulation or clotting process upon exposures to the air. To prevent most of the liquid latex from coagulating before it is collected, pooled and transported, the taper will usually add a stabilizing agent or preservatives such as ammonia or formaldehyde to prevent coagulation of the latex. The collected latex will be processed at the processing station where it is strained and concentrated. If solid latex is required by the manufacturer, the latex will be heated in which this process can destroy many but not all of the proteins. Otherwise, if liquid concentrated latex is required, there will be no heating process and most of the proteins will remains in the latex. After that the latex will be centrifuged to remove some water content and become concentrated latex with roughly 60% solid rubber and 40% protein and water. This is done under quality control where additional centrifuging is done to remove as many of the remaining impurities and proteins as possible, as well as adding some proteolytic enzymes to break down the proteins in centrifugation for improvement of the latex quality. Concentrated latex is the form of latex that is used by the manufacturer to manufacture the latex gloves in the dipping process⁷.

1.3. Gloves manufacturing process

Manufacturing process of gloves are the same for all manufacturers where it involves many chemicals addition, besides its process of reducing the proteins as awareness to reduce sensitivity. For latex gloves manufacturing process⁸, compounding is the next process done on the concentrated latex. Chemicals like accelerators and antioxidants are added to control the vulcanization and deterioration of rubber molecules consecutively. There will be hand shape formers which will be coated with coagulant like calcium nitrate and then dipped into the latex, which will form coagulated latex glove after passage through a warm oven. Then, the glove will undergo a wet gel leaching process to remove excess additives by soaking it into the bath or water pray. Vulcanization or cross linkage of rubber is done next where the latex film is heated with the help of sulphur, accelerator and heat which finally gives strength and elasticity to the film. The workers will remove the glove from the formers where it is called stripping process. Post vulcanization or dry-film leaching will be done again to keep the gloves dry. Lubrication will be done next where hydrolyzed corn starch is added as lubricant to enable easy glove wearing, and it also aims to reduce the slippery of the gloves surface when chlorination is done during the stripping process. All gloves will be checked again and then packaged to be supplied to the consumers.

1.4. History of latex glove in health care workers

The latex surgical gloves are first used in 1870s and 1880 among the healthcare worker from irritating antiseptic solutions². John Hopkins Medical School surgeons started to use gloves during surgery in early 20's in order to protect their patients from bacteria of the hand. In 1952, disposable gloves are introduced² and hence increasing the number of gloves used. Latex glove usage increase tremendously in worldwide following the introduction of Universal Precautions by US Centre for Disease Control (CDC) due to AIDS disease in 1988, followed by Blood borne Pathogen Standard by US Occupational Safety and Health Administration (OSHA) in June 1992². The mandatory use of latex glove in the 80's has shot up the latex glove usage and latex hypersensitivity has started concurrently to be prevalent, where the first one has been reported by FDA in the early 80's².

1.5. Latex allergen

Latex is rich in hydrocarbon cis-1,4polyisoprene which can cross-link to form plug which is a strong, elastic barrier that tends to be impermeable to water and returns to its original shape after multiple forces are applied to it¹⁰. It also contains 256 proteins⁶ which contribute to 2% of weight of the natural rubber latex produced in the lactifer plant. Apparently the polymer of polyisoprene is immunologically inert and does not causing allergic reaction.¹⁰ Allergic reactions are associated with 11 to 13 recognized allergens from the latex proteins and also from the chemicals that are being used in dipping process of manufacturing latex gloves.

The 11⁵ to 13¹¹ recognized allergens are water soluble membrane-bound protein causing clinical reactions. There is also evidence saying that only hev b 2, hev b 6, hev b 13 and possibly hev b 4 are the major allergens causing latex sensitivity in adults¹¹. Hev b 5 apparently exhibit close homology to other plant and fruit allergen such as Kiwi fruit protein in Pkiwi501. This amino acid homology causing the antibody has a cross reactivity between the latex and food antigens. Individuals who have food allergies like banana, avocado, chestnut, apricot, kiwi, papaya, passion fruit, pineapple, peach, nectarine, plum, cherry, melon, fig, grape, potato, tomato and celery may also have a coexisting latex allergy¹². (Kurup et al 1994, DH Beezhold et al 1996). The other cause of allergic reactions are the chemicals used in the dipping process which are accelerators or antioxidants like thiuram, carbamates, and mercaptobenzothiazole which can cause contact dermatitis and also type iv hypersensitivity.¹⁰

1.6. Pathogenesis of hypersensitivity

The pathogenesis of latex hypersensitivity is postulated by the American Latex Allergy Association¹³ to sensitize in several ways. Inhalation of powder particle can absorb the latex allergen particle and cause sensitivity. It can also occur from absorption through the skin from latex product, where body secretions like sweat solubilized the latex allergens or it can pass through a traumatized skin, irritation or contact dermatitis. Absorption through mucous membrane from latex product can also sensitize the individual in contact with the rubber, or it can also enter directly into the body during injections or any procedures when the practitioner is using latex gloves.

1.7. Types of hypersensitivity

There are mainly three conditions in which latex sensitize the individual, which are contact dermatitis, type IV hypersensitivity and type I hypersensitivity¹⁴. Irritant contact dermatitis is a non-allergic, localized inflammation of the skin caused by chemical irritation that does not involve the immune system. The irritation occurs gradually with redness, itching, dryness, scaling, and cracking of the hand that allows the latex allergens entry into the body. It can also be caused by inadequate hand care, friction, perspiration or in extreme humidity and temperature conditions. Type IV hypersensitivity or also known as delayed hypersensitivity is a T-cell mediated caused by direct physical contact with substance containing latex, allowing high access of proteins, rubber accelerators and antioxidants used in manufacturing the gloves to enter the body. It is delayed onset hypersensitivity in 24 to 48 hours with sign and symptoms of erythema, scaling and vesiculation of the skin involved. In repeated exposures to the allergens, delayed hypersensitivity developed type I hypersensitivity which is an IgE mediated reaction toward specific protein allergen in latex. It is also associated with cross reactivity to certain food. Mast cell and basophils will release histamine, leukotriene, prostaglandins and kinins when the immune system responded toward the antigen. This acute onset hypersensitivity occurs within 30 minutes, causing sign and symptoms ranging from rhinitis, urticarial, angioedema, pruritus, asthma and anaphylaxis which can cause death.

A study has been done for UK Adverse Reaction Reporting Project¹⁴, where in 23 months period they received 369 reports on adverse reactions to protective gloves used in dental practices. Dentists were the largest group reported with gloves hypersensitivity where 47% reported with the adverse reactions, followed by dental nurses (25%), patients (22%), hygienists (4%) and technicians (2%). It is also find out that the most occurring hypersensitivity is the type I and type IV hypersensitivity. In contrast to that, a study done among Malaysian dental personnel in Kelantan found that the highest prevalence of allergy reaction was irritant dermatitis (18.5%), type IV hypersensitivity(6.7%) followed by 1.7% type I hypersensitivity.

Dental personnel are highly associated with latex sensitivity and they are at high risk for the sensitization. This is due to the longer duration of exposure to latex glove which associated with latex glove allergy¹⁵. Wrangsjo¹⁶ in his study finds out that 40% of the dentists questioned wore gloves for more than six hours per day, in which he concludes that dentist wears gloves for longer periods of times, as compared with other dental staff. It is synchronized with reports from Jolanskiet al¹⁷ where dentist is reported with higher adverse reactions relating to glove use than the other subject groups of physicians and nurses. Tarlo et al 1997¹⁵ found out that there is increasing number (a 10-fold increase) of dental students became sensitized to latex protein between their first and fourth year of training. A.Yusoff³ also supported that the longer duration of exposure to latex glove significantly associated with the glove allergy.

III. Materials And Methods

A cross-sectional study was conducted using purposive non probability sampling technique among study population of dental personnel in Polyclinic USIM who are using latex glove in their work. 196 respondents were selected comprises of dentists, dental students, dental nurses, dental surgery assistant, dental clinic helper, dental laboratory technician, and dental radiographer.

Questionnaire adapted from Azizah et al and American Association of Latex Allergy was used as the instrument for data collection. It consists of 12 items which are divided into demographic background and respondents' information on latex glove hypersensitivity symptoms. The sociodemographic questions are related to the age, sex, race, job title, types of glove used and duration of using latex glove in dental work. The duration of using latex glove was explicitly asked on the hours, days and years of glove usage. History of atopic illness was asked through questions of history of asthma, allergic rhinitis, atopic dermatitis, hives or angioedema. History of allergy to fruits was also asked whether respondents has allergy to avocado, banana, chestnut, kiwi, ground nuts, papaya, peach and tomato.

The symptoms of latex hypersensitivity was categorised based on the types of reactions to latex products. Respondents were required to answer the polar questions in this section based on their experience when in exposed with latex glove. Categorised symptoms are dry, cracked, irritated skin (irritant contact dermatitis); popular, pruritic rash, vesicles, and blisters after 48 hours of contact (delayed hypersensitivity or allergic contact dermatitis-Type IV reaction); and development of localised or generalised urticarial, vomiting, faintness, rhinitis, conjunctivitis, bronchospasm and anaphylactic shock immediately or within minutes of contact (immediate hypersensitivity type I). Physician diagnosed latex allergy was also asked for type I hypersensitivity reactions. Respondents' history of allergy to other latex product was asked in the lastquestion.

The questionnaire was translated back to back translation into Malay version in order to develop a bilanguage version of questionnaire. It is validated through pre testing on 15 of USIM dental personnel which are excluded in study sample for clarification and to avoid ambiguity in this study.

The self-administered questionnaire was distributed to the respondents in study population for one month duration in August to September 2015. Respondents was briefed and well understood regarding the voluntariness and confidentiality of their data prior to participation in this study and informed consent was obtained.

The collected data were analysed using Statistical Package for the Social Sciences (SPSS) version 22. Descriptive statistics was used in calculation of the frequency, mean and standard deviation. The association between the duration of glove exposureand the hypersensitivity symptoms reported were done using Chi Square test with significant p value of less than 0.5.

IV. Result

Out of 196 study population, 175 respondents answered and returned the completed questionnaire with 91% response rate. The sociodemographic details showed the mean age of respondents was 25.74, where almost all (96%) of respondents were Malay ethnicity. According to gender, respondents are more in females with 70.9% compared to 29.1% male respondents. Majority of the respondents were dental students (77%), 11.4% dentists and the other types of dental personnel background (Figure 1). This is due to the predominant of number of dental students in this dental faculty.

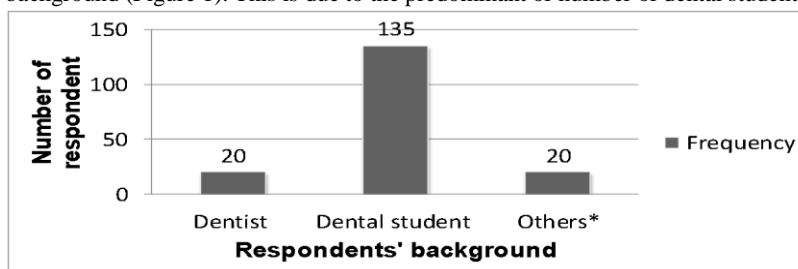


Figure 1: Number of respondents according to respondent's background.

* Dental nurse, dental surgery assistant, dental clinic helper, dental Laboratory technician and dental radiographer.

Figure 2 showed the respondents information on the latex glove usage. It is found that more than half of the respondents (54.3%) are wearing both powdered and non-powdered latex glove in their practice. Duration of the glove usage is mostly less than 5 years (82%), in corresponding to the high number of dental student being the major group of sample population. Almost half (42.9%) of the respondents wear gloves for 5 days in a week, and also for about 3-5 hours in a day (48%). 31.6% of dental personnel in Polyclinic USIM reported to have experience of symptoms of hypersensitivity, being the most common reported symptom was irritant contact dermatitis (20.1%).

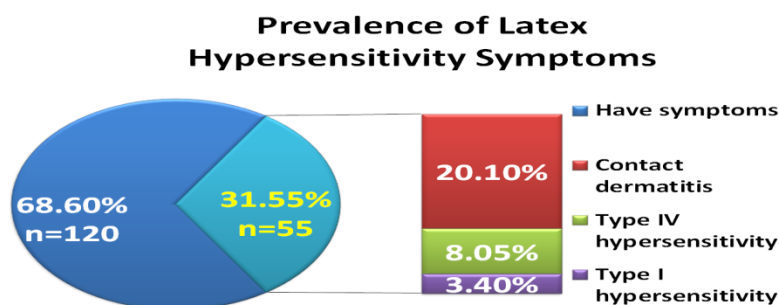


Figure 2: Prevalence of latex hypersensitivity according to symptoms.

The association of duration of exposure to latex and glove hypersensitivity symptoms reported were tabulated in figure 3. Chi square test reveals significant association between days and hours of exposure to latex with the hypersensitivity symptoms. Those who wear latex gloves for more than four days in a week and with longer hour of glove usage were the higher risk to develop symptoms of latex glove hypersensitivity. There was also significant association between the history of atopy to the higher risk of having hypersensitivity.

Durations of Glove Usage	n	Glove Allergy symptoms frequency	No Glove Allergy symptoms frequency	P value (Sig p<0.05)
(Years)				
0-5 years	144	44	100	0.519
6-10 years	6	1	5	
11-15 years	9	2	7	
> 16 years	8	4	4	
(Days / weeks)				
<4 days	52	22	68	0.05
>4 days	116	30	48	
(Hours/day)				
1-3hours	75	16	59	0.041
3-5hours	84	32	52	
>6 hours	16	7	9	

Figure 3: Association between duration of glove usage and glove hypersensitivity

V. Discussion:

Dental personnel are at risk of latex allergy because of their regular use of latex gloves. The prevalence of latex hypersensitivity in the present study is slightly higher than recent study done among dental personnel in Kelantan with 27.6 % reported by Azizah et.al 2013. It is still within the range of most of other questionnaire based studies published from 1992 to 2013 with prevalence of 13% to 33%. (Berky 1992, Rankin 1993, Wrangsjö 1994, Katelaris, 1997, Gholizadeh 2010, Azizah 2013).

Most of dental personnel in USIM reported symptoms of dry, cracked and scaly skin related to symptoms of irritant contact dermatitis, which is similar to the study by Azizah et al. The most common symptoms reported by other studies varies from itching, redness (Berky 1992, Wrangsjö 1994, 2001) Rankin 1993, Katelaris 1997, Walsh 1999, Gholizadeh 2010), followed by pruritus and urticaria (Tarlo 1992, M Shahnaz 1999).

Delay hypersensitivity symptoms (Type IV reactions) and immediate hypersensitivity symptoms (Type I reactions) reported in USIM are 8.05% and 3.4% respectively, which is slightly higher compared to study by Azizah et al. It is comparable to 14% of the reported adverse reactions by dental professionals in UK with Type I (n=19) and Type IV hypersensitivity reactions (n=18) as reported by Scott et.al.

One of the possible risk factors of glove allergy among the dental personnel is duration and frequency of exposure to latex. Inconsistent data findings were noted between different researches. Krasteva et.al 2008 found that there is no statistical correlation between daily, hours and weekly used of latex gloves. Apparently the present study showed significant association only in longer duration of hours of exposure to latex glove in daily used, meanwhile Azizah et al and Chaier et al only showed association with longer years of exposure to latex.

One of the limitations of our study is the use of questionnaire to evaluate the types of hypersensitivity symptoms. Katelaris et.al 2002 compared the use of questionnaire to latex skin testing and found that questionnaire has high specificity but poor sensitivity as a screening tool to latex allergy. There is no well-defined questionnaire for screening recommendation, but it follows guideline from American Latex Allergy Association. The classified hypersensitivity symptoms are not an objective screening and diagnostic tools and the prevalence maybe overestimated.

The results of this study suggested for further investigation to be carried out in order to get a proper diagnosis of hypersensitivity. Due to time, financial and procedural preparations limitation through this study, skin prick testing was not done. We would recommend future study to use more objective diagnostic tools either by skin prick tests, measurement of

latex-specific serum IgE levels, glove provocation tests, or skin patch testing to diagnose and identified the dental personnel with latex hypersensitivity.

As for the prevention, the current dental practitioner and other personnel should follow the guidelines provided to reduce or prevent the incident of latex hypersensitivity in the clinic. US National Institute of Occupational Safety and Health recommendations are as follows:

- A use non latex glove is advisable for activities that are not likely to involve contact with infectious materials.
- Appropriate barrier protection is needed when dealing with infectious materials. If the latex glove is used, powder free gloves, with reduced protein content is preferable.
- Oil based hand creams or lotions is not advisable because it can cause glove deterioration (Except for those who have shown to have reduced the symptoms)
- Work areas need to be frequently cleaned and free from the latex dust.
- The ventilation filters and vacuum bags used in latex contaminated areas need to be changed frequently.
- All personnel must recognise the symptoms of latex allergy; skin rashes, hives, flushing, itchiness, nasal, eye, or sinus symptoms, asthma and shock.
- If there is symptoms of latex allergy, direct contact with the latex glove need to be avoided. An immediate action need to be taken to seek for the physician in treating the latex allergy.

VI. Conclusion

In conclusion, approximately one third (31.5%) of the dental personnel in Dental Polyclinic USIM has latex glove hypersensitivity through this questionnaire based study. Significant association were found between latex glove allergy to the hours and days of exposure to latex glove. Further study and further medical assessment are recommended followed by specific measures to manage the hypersensitivity symptoms in clinical setting.

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