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Prevalence of latex allergy in dental professionals - A systematic review and meta-analysis

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Background: Despite concerns such as allergic dermatitis and bans recommended by health authorities, latex gloves are used by dental professionals in many countries. There are published reports of the prevalence of latex allergy in health professionals including dental professionals; however, no systematic review and meta-analysis is available. ***Objectives***: To determine the prevalence of latex allergy in dental professionals. ***Method***: Two researchers independently searched articles using appropriate keyword combinations in three search engines; PubMed, Cochrane Library, and Google Scholar for observational studies on latex allergy in dental professionals reported in English or where complete translations in English were included. Percentage prevalence of latex allergy was the variable of interest. The risk of bias was assessed using the Hoy et al. (2012) tool and publication bias using a funnel plot. ***Results***: From 435 possible sources, a total of 14 studies were included in the review and meta-analysis. The prevalence of latex allergy, based on 6302 participants was 10.37% (95% CI: 7.31 to 13.88). Heterogeneity (I2) was high (94.13%); hence, REM was used. There was moderate risk of bias across studies and minimal publication bias. GRADE analysis indicated that the evidence was uncertain. ***Conclusions***: The prevalence of latex allergy in dental professionals is about 10.37%. Evidence is of low quality due to high heterogeneity.

Keywords*: dermatitis, allergy, prevalence, cross-sectional, dental, latex gloves*

Introduction

Latex allergy can be caused by the presence of latex, a rubber polymer, in gloves. Latex is produced from *Hevea brasiliensis,* a rubber tree (Venkatachalam *et al*., 2013) and composed of rubber hydrocarbon (35%), protein (1.5%), hydrocarbon (1.5%), lipids (1.3%), organic solutes (0.5%), inorganic substances (0.5%) (Vaysse *et al*., 2012). The properties of natural rubber are high viscosity, natural storage hardening, high structural regularity and high elasticity (Kurian *et al*., 2011). Alternatives to natural rubber latex are synthetic rubbers (such as elastane, neoprene, nitrile) and products made from guayule natural rubber which also do not contain the proteins from the *Hevea* rubber tree. (Anderson & Daniels, 2003). Other healthcare products produced from latex include catheters and balloons.

Direct skin or mucous membrane contact and inhalation of powder from latex gloves can cause allergic reaction. Several allergens present in rubber can cause Type I hypersensitivity reactions (Nguyen *et al*., 2023). Type IV hypersensitivity can also be caused by chemical antioxidants added during processing of the latex. Risk factors for natural rubber latex allergy include hand dermatitis, medical history, atopic disposition and environmental factors (Hamann *et al*., 1998). Systemic symptoms of type I hypersensitivity can vary from skin (itching, redness, contact dermatitis, hay fever, eczema) to respiratory system (respiratory depression, rhinitis) and tachycardia, hypotension (Hamann *et al*., 2005; Safadi *et al*., 1996; Amin *et al*., 1998; Katelaris *et al*., 2002; Rankin *et al*., 1993; Nucera *et al*., 2020). Type IV (delayed) reactions are dose-dependent and can be caused due to addition of chemicals during processing of rubber gloves and cause eczematous dermatitis at the site where latex touches skin (Nguyen *et al*., 2024). Powdered latex gloves can cause airborne exposure of latex proteins in the dental environment, though powder is a rare sensitizer (Hamann *et al*., 1998). Latex gloves with low allergen content (low powder and powder free) were introduced as hypoallergenic latex gloves. These eliminated only the cornstarch powder (carrier) and not the latex content (source). Hence, the healthcare workers exposed to hypoallergenic gloves are still at a risk of developing latex sensitization (Phaswana *et al*., 2013). Excess latex can be removed during glove manufacturing by leaching (washing) them in hot regulated water to remove biological and chemical residues (Huda *et al*., 2014).

Diagnosis of latex allergy requires a detailed history of previous reactions, a health history and clinical tests (skin prick test or blood tests).

The United States Food and Drug Administration (U.S. FDA) banned the use of powdered gloves after identifying risks of severe airway inflammation and hypersensitivity reactions in patients and health care workers (Federal Register, 2016). Some countries still use latex gloves as they are economical, more stretchable, less slippery, and have a better grip than nitrile gloves (Eckert 2023). Some studies conclude that the decrease in the use of powered gloves is directly proportional to the decrease in the number of cases of allergic dermatitis. In contrast, one study concluded that 16.1% participants who wore powdered gloves and 20.7% who wore powder-free gloves were allergic to latex gloves (Agrawal *et al*., 2010).

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There are reported cases of allergic reactions to latex during surgery, which were recognised in time and the patients' lives were saved (Lee *et al*., 2011). The importance of gaining a detailed history of previous allergies may help prevent such reactions (Sampathi *et al*., 2011).

Latex allergy has been reported in dental professionals, however, no systematic review has considered the global prevalence of the condition or any variations pertaining to gender, ethnicity, etc. Therefore, the aim of this study was to determine the prevalence of latex allergy in dental professionals.

Method

This systematic review with meta-analysis of observational studies used the PEOS acronym to specify the Participants/population (P) as dental professionals (dentists, dental specialists, and dental auxiliaries), the Exposure (E) as Latex allergy, the Outcome (O) as the prevalence of latex allergy in dental professionals and the Study-type (S) as observational studies.

Two researchers independently searched for articles using appropriate keyword combinations in three search engines; PubMed, Cochrane Library, and Google Scholar and conflicts, if any, were resolved by a third investigator. The period of search was from 01/08/2023 to 01/12/2023. All articles till 01/12/2023 were searched. Keywords and terms used in combination were: latex, dent, survey, prevalence, cross-sectional, gloves, allergy. Details of the search strategy are available at https://drive.google.com/file/d/169owL01IQPsV2VQ_D1yx85oALpCt7PL1/view?usp=sharing.

Articles published in the English language or translated to English with full texts available were selected. The search was extended for physical copies, using cross references in the bibliographies of included articles and by contacting authors and researchers in the field. Cross-sectional and prevalence studies were included. Articles in which allergies were determined using questionnaires or skin-prick tests were included. Participants eligibility criteria included any dental professionals including dentists, dental specialists, dental auxiliaries (dental hygienists, dental therapist, dental nurses).

Data were extracted by two authors using the parameters for inclusion. Risk of bias was assessed using the Hoy et al. (2012) tool for observational studies (Table 1).

Summary statistics (percent prevalence and confidence intervals) were derived from the included studies. Meta-analysis was performed using a forest plot. Heterogeneity was assessed using I^2 statistics and a Random Effects Model was employed. Funnel plot analysis assessed publication bias. Additional analyses were carried out for gender, allergy measures (self-reported vs skin prick), and across settings (continents). Grading of Recommendations, Assessment, Development and Evaluation (GRADE) analysis determined the certainty of evidence. GRADE analysis is based on eight criteria. To downgrade the evidence quality (1. Risk of Bias 2. Inconsistency 3. Indirectness 4. Imprecision 5. Publication Bias) and to upgrade the evidence quality (6. Large Magnitude of Effect 7. Dose Response 8. Effect of all plausible confounding factors) (Guyatt *et al*., 2011).

Forest and funnel plots with relevant tables were generated using MedCalc software (Schoonjans, 2024). The Meta-analyses Of Observational Studies in Epidemiology (MOOSE) guidelines were used for reporting.

Results

After the initial search, 435 titles were identified and after eliminating duplicates and screening titles and abstracts, 15 articles were identified for full reading. (Figure 1). One source was not available as a full text, therefore, 14 articles with a total of 6302 participants were included for the systematic review and meta-analysis.

Table 2 summarises the characteristics of the included reports. Five studies (Hamann *et al*., 2005; Hamann *et al*., 1998; Hill *et al*., 1998; Safadi *et al*., 1996; Katelaris *et al*., 2002) used skin prick tests while whilst the remainder used self-assessment. Dentists were the most studied professional group. Most studies were conducted in United States. More detailed data are available at https://docs.google.com/document/d/1dZE2s3opeh9CzRUFaU32Ngd37c449BF0/edit?usp=sharing&ouid=110724577721022941641&rtpof=true&sd=true

The pooled prevalence was 10.37% (95% CI: 7.316 to 13.886) (Table 3). A REM was used because heterogeneity was high (I^2=94.13%).

(Data available at https://docs.google.com/document/d/1dZE2s3opeh9CzRUFaU32Ngd37c449BF0/edit?usp=sharing&ouid=110724577721022941641&rtpof=true&sd=true)

Table 1. Criteria for assessing risk of bias (Hoy *et al*., 2012).

Criterion 1	Was the study's target population a close representation of the national population in relation to relevant variables, e.g. age, sex, occupation?
Criterion 2	Was the sampling frame a true or close representation of the target population?
Criterion 3	Was some form of random selection used to select the sample, OR, was a census undertaken?
Criterion 4	Was the likelihood of non-response bias minimal?
Criterion 5	Were data collected directly from the subjects (as opposed to a proxy)?
Criterion 6	Was an acceptable case definition used in the study?
Criterion 7	Was the study instrument that measured the parameter of interest (e.g. prevalence of low back pain) shown to have reliability and validity (if necessary)?
Criterion 8	Was the same mode of data collection used for all subjects
Criterion 9	Were the numerator(s) and denominator(s) for the parameter of interest appropriate

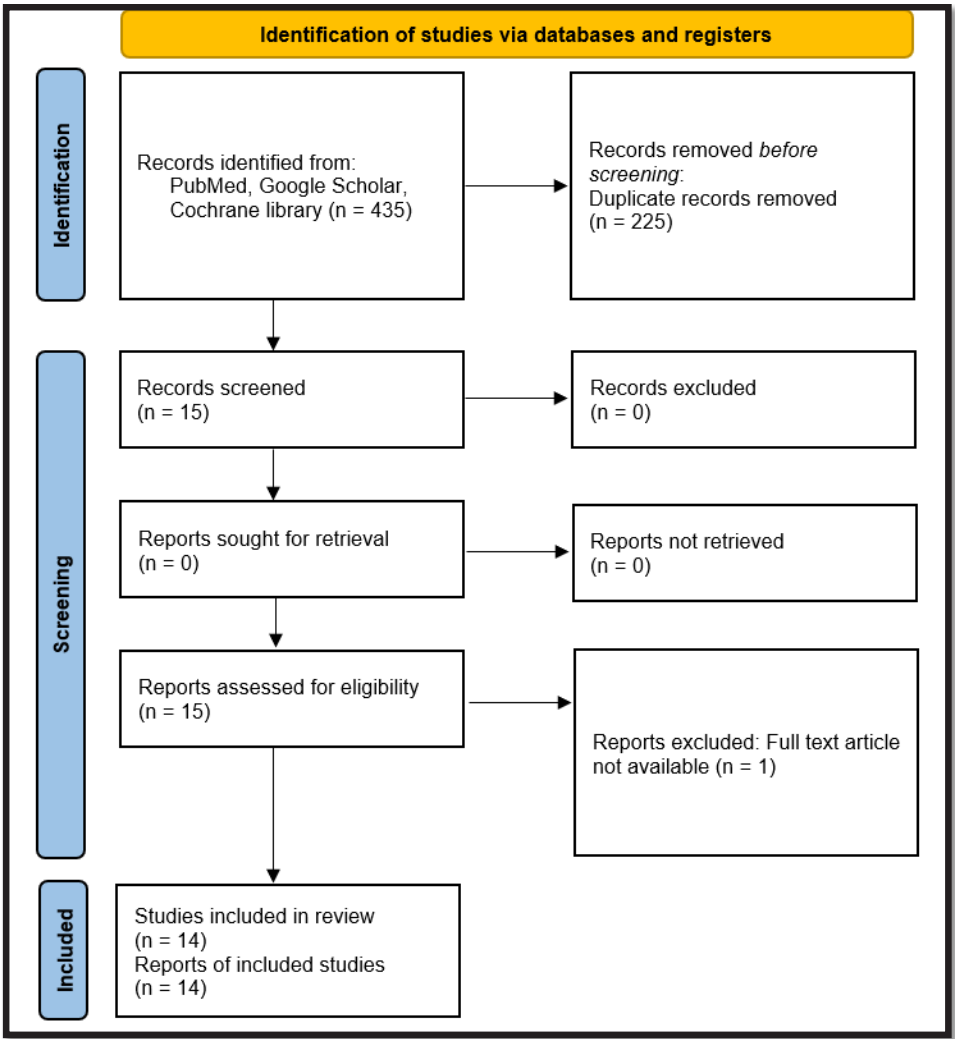

Figure 1. *PRISMA flow diagram.*

One study was found to have high risk of bias, 11 had moderate risk and 2 had low risk (Table 4). The major sources of risk of bias were the selection of the target population and the lack of random sampling resulting in concerns about sampling bias.

Certainty of evidence was assessed as per the GRADE analysis. Based on the eight assessment criteria, viz. risk of bias, inconsistency, indirectness, imprecision, publication, magnitude of effect, dose response and the effect of all plausible confounding factors, the evidence was judged to be of very low grade.

Discussion

This systematic review and meta-analysis of observational studies determined the prevalence of latex allergy among dental professionals. Additional sub-analyses also determined the prevalence of allergy by gender, continents, and type of test.

A previous review found the worldwide prevalence of latex allergy among healthcare workers, susceptible patients and general population to be 9.7%, 7.2% and 4.3% respectively (Wu *et al*., 2016). A recent cross-sectional study found latex allergy present in 9.1% in South Indian healthcare workers (Sakkaravarthi *et al*., 2022). The prevalence in these two studies is similar to that of 10.37% found in this meta-analysis. The higher prevalence in healthcare workers may reflect the dose-dependency of Type 4 hypersensitivity. Dentists and dental auxiliaries wear gloves daily for up to 10 hours and 5-6 days a week. The role of exposure is also indicated by two studies where restricted handwashing (not washing hands before and after using gloves, using only water instead of antimicrobial soap and too short a duration) was associated with allergy (Agrawal *et al*., 2010), In another study, no correlation was seen between time taken to wash hands and skin irritation. The same study showed that dental students washed hands longer than dental practitioners, the difference being significant (Amin *et al*., 1998). This shows that after removing the gloves, the presence of allergens remaining on hands, and time taken to wash the hands may be significant.

The high prevalence of latex allergy noted among healthcare workers makes them suitable participants for research of the condition (Al-Ali *et al*., 2012).

Allergy to latex gloves was more common in those who had a history of allergies to pollen grains, hay fever, foods, rubber dam as well as those who had asthma and with family history of allergies (Agrawal *et al*., 2010; Hamann *et al*., 2012; Amin *et al*., 1998).

Latex allergy appeared to be more common in females and in Asia and North America (16.89% and 15.55%, respectively). However, this could be because men are less likely to report problems, or in general, people in

Table 2. Summary of included studies.

Author/Year	*Sample* *N* *% male / female where available*	*Professional groups*	*Latex assessment*	*Prevalence %*
Agrawal et al. (2010), India	163 73 / 27 Age: 24-68 years	Dental professionals	Questionnaire	16.0
Ohlson et al. (2001), Sweden	686	Dentists Dental nurses Dental hygienists	Questionnaire	3.7
Osazuwa-Peters et al. (2012), Nigeria	90 54.4 / 45.6	Dental surgeon 71.1% Dental nurse: 16.7% Dental therapist: 3.3% Dental technologist: 8.9%	Questionnaire	17.8
Hamaan et al. (2005)	631 2 / 98	Dental hygienists	Skin-prick test	4.8
Jacobsen et al. (1995), Norway	189 (Age 23-65 years)	Dental hygienists	Questionnaire	13.2
Al-Ali and Hashim (2012), UAE.	733 61 / 39 Age: 22-70 years	Dentists	Questionnaire	18.0
Hamann et al. (1998), USA.	1701 69 / 31	Dentists: 80.7% Hygienists & assistants: 19.3%	Skin-prick and Questionnaire based	6.2
Chowanadisai et al. (2000) Southern Thailand	178 46.6 / 53.4 Age: 22-54 years	Dentists	Questionnaire	13.5
Hill et al. (1998), US	390 65.9 / 34.1 Age: 19-66 years	Dentists: 33.6% Dental assistants: 54.3% Dental hygienists: 3.3% Dental technicians: 8.7%	Questionnaire and patch test	3.8
Safadi et al. (1996), US	Total: 34 29.4 / 70.6 Age: 20-59 years	Dental assistants: 29.4% Dental hygienists: 11.8% Staff dentists: 20.6% Lab technicians: 2% Dental residents: 9% Support staff: 26.5%	Skin-prick and questionnaire	38.0
Amin et al. (1998), UK	281 70 / 30	Dental students: 42.3% Dental practitioners: 57.6 %	Questionnaire	9.96
Katelaris et al. (2002), Australia	464	Dentists	Skin-prick and questionnaire	8.6
Rankin et al. (1993), US	526 45.8 / 54.2	Clinical personnel: 48.3% Non-clinical: 51.7%	Questionnaire	15.0
Leggat and Smith (2006) Australia	285 73.3 / 26.7	General dentists: 89.1% Specialists: 10.9%	Questionnaire	2.1

less well-developed regions are more likely to tolerate problems or no adequate studies are conducted in the same regard.

This systematic review had several strengths. Data were collected and compiled in adherence to a strict protocol to create a large dataset and precise estimate of the prevalence of latex allergy. The funnel plot revealed that the studies were symmetrically dispersed, indicating low publication bias. However, there were some limitations. Allergy was ascertained by different methods. Five studies (Hamann *et al*., 2005; Hamann *et al*., 1998; Hill *et al*., 1998; Safadi *et al*., 1996; Katelaris *et al*., 2002) used skin prick tests while whilst the remainder used self-assessment. Risk of bias was found to be moderate, largely due to the representativeness of samples in the source studies. The GRADE analysis found the certainty of evidence to be low as the studies included were observational studies. The grading for the SRMA of observational studies was judged in response to only the last three of the eight criteria as suggested by Guyatt et al. (2011).

We could not include many recent studies from the United States and Europe, possibly because latex gloves

Table 3. Prevalence of latex allergy in 14 included studies.

Study	*n*	*Allergy %*	*95% CI*	*Weight (%)*	
				Fixed	*Random*
Agarwal et al. 2010	163	15.95	10.692 to 22.492	2.60	6.90
Ohlson et al. 2001	686	3.64	2.372 to 5.333	10.88	7.71
Osazuwa-Peters et al. 2012	90	17.78	10.517 to 27.258	1.44	6.21
Hanman et al. 2005	582	4.81	3.220 to 6.878	9.23	7.66
Jacobson et al. 1995	189	13.23	8.746 to 18.904	3.01	7.03
Al-Ali & Hashim 2012	733	18.01	15.292 to 20.985	11.62	7.73
Hamann et al. 1998	1701	6.173	5.076 to 7.424	26.95	7.88
Chowanadisa et al. 2000	178	13.48	8.834 to 19.395	2.83	6.98
Hill et al. 1998	390	3.85	2.168 to 6.264	6.19	7.50
Safadi et al. 1996	34	38.23	22.167 to 56.436	0.55	4.56
Amin et al. 1998	281	9.96	6.724 to 14.079	4.46	7.32
Katelaris et al. 2002	464	8.62	6.230 to 11.554	7.36	7.58
Ranki et al. 1993	526	15.02	12.075 to 18.363	8.34	7.62
Leggat and Smith 2006	285	2.10	0.776 to 4.526	4.53	7.33
Total (random effects)	6302	10.37	7.316 to 13.886	100.00	100.00

Table 4. Risk of bias in 14 included studies.

	Hoy (2012) Criterion										
Author, Year	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*Score*	*Risk*
Agarwal 2010	*	*	*						*	4	Moderate
Ohlson 2001	*	*	*			*	*		*	6	Moderate
Osazuwa-Peters 2012	*	*	*			*	*		*	6	Moderate
Hanman 2005	*		*							2	Low
Jacobson 1995	*	*	*	*		*	*		*	7	High
Al-Ali & Hashim 2012	*	*					*		*	4	Moderate
Hamann 1998	*	*	*	*					*	5	Moderate
Chowanadisa 2000	*		*				*		*	4	Moderate
Hill 1998	*	*	*				*		*	4	Moderate
Safadi 1996	*	*	*							3	Low
Amin 1998	*	*		*			*		*	5	Moderate
Katelaris 2002	*	*	*	*			*		*	6	Moderate
Ranki 1993	*		*	*			*		*	5	Moderate
Leggat and Smith 2006	*	*	*	*			*		*	6	Moderate

are no longer used in these countries (Pagani, 2024), which may restrict the generalisability of the results. However, the inclusion of 14 studies with 6302 participants should make these findings applicable to settings where latex gloves are still used.

Dental professionals in many countries such as India are still using powdered latex gloves. They should be aware of exposure to themselves and their patients to latex to address any adverse skin reactions promptly. Hand hygiene may also protect against allergy. Barrier protection guidelines should be developed and implemented by health authorities for the use of nitrile rather than latex gloves.

In conclusion, this meta-analysis of 14 studies (6302 subjects) determined the global prevalence of latex allergy in dental professionals to be 10.37%. Evidence is of low quality due to the low representativeness of samples and high heterogeneity between observational studies.

Conflict of interest

None.

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