Hypersensitivity to Latex Gloves among Dental Students: Is the Pre-Matriculation Evaluation and Periodic Health Surveillance Necessary?

Research Article

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Abstract

Latex allergy is a common occupational disease among healthcare workers who use latex gloves. Self-administrated questionnaires, physical examination and diverse allergic tests are largely used to assess data about natural history, risk factors, type of allergic reaction, etc. The aim of the present study was to determine the prevalence of allergy to latex gloves among dental students.

In this prospective study, a total of 240 students separated as non-exposed, shortly-exposed and longer-exposed during school practice completed a self-administrated questionnaire that comprised of a total of different items and gave information about the participants and their glove use, working habits and glove use, signs and symptoms related to glove use, precautions taken to minimize it, etc. Challenge and patch tests were performed through latex gloves, skin prick test with commercial extracts.

Questionnaire items and diagnostic tests revealed that one-fourth of subjects were suspicious for latex gloves hypersensitivity. Their mean value for skin reactions like contact urticaria, irritant or allergic dermatitis was between 10% and 14%, while for other symptoms the mean value was under 5%. In general, students who experienced latex exposure over 2 years during their school practice have shown about a two-fold positive response for statements or diagnostic tests about latex gloves hypersensitivity. Also the Kendall tau coefficient progressed from non-exposed group to longer-exposed one for the majority of items.

Because of relationship between allergic reactions to latex gloves and some medical histories, it seems to be necessary for pre-matriculation evaluation and periodic health surveillance of dental students.

Introduction

Latex allergy is a common occupational disease among healthcare workers who use latex gloves, whose prevalence has reached epidemic proportions in highly exposed populations [1-3]. The use of latex gloves by healthcare workers can lead to multiple symptoms: eczema, contact urticaria, rhinitis, conjunctivitis, asthma, and anaphylaxis [4, 5]. Diagnosis of latex allergy is based on personal history, physical examination, skin prick tests, specific IgE, patch test and challenge test, while self-administrated questionnaires are largely used to assess the respective data about natural history, risk factors, etc [6-9].

Today, gloves are worn routinely by many dental practitioners while treating patients, with natural rubber latex being the most commonly used glove material worldwide [10]. There is lack of

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data on the prevalence of latex allergy in the dental care setting in Albania. The aim of the present study was to determine the prevalence of allergy to latex gloves among dental students in the Albanian University of Tirana, Albania, and its correlation to different factors (obtained by questionnaire and diagnostic tests).

Method

In this prospective study, a total of 240 students (42% males and 58% females, mean age 22.8 ± 3.4 years) were first surveyed using a self-administered questionnaire during academic years 2012-2013 and 2013-2014. The questionnaire was comprised of different items and gave information about the participants in regard to working habits, their glove use, concentration on the work, previous chiralurgical interventions, signs and symptoms related to latex gloves usage, any other type of allergy, symptoms associated with toy balloons, familiar atopy and tobacco smoking, as well as precautions taken to minimize it. According to latex gloves exposure during school practice, population was classified in three groups: as non-exposed (n=33), exposed for a few months (shortly exposed, n=136), and exposed for a longer period than two years (longer exposed, n=71). Apart from questionnaire (completed by all subjects), prevalence of latex-related symptoms and sensitization was determined in a randomized sample of students by commercial skin prick tests (Stallergenes), patch tests with natural rubber glove (including latex-free glove as control), as well as through challenge test with dermal and airborne exposure to natural rubber latex and latex-free gloves. Similarly to self-administered questionnaire, the challenge test has been performed by all students.

The suspected cases for adverse reactions during latex exposure were further classified as irritant skin reactions (dried skin, localized erythema, adverse reactions to detergents or disinfectants - mentioned on disease history questionnaire items and confirmed during challenge test, but lack of positive or relevant results for the latex allergy tests), allergic skin reactions (diverse allergy skin reactions like erythema, eczema/cracked hands, hives, angioedema, associated with positive results for latex allergy tests), and internal organs allergic reactions (breathlessness attacks, cough, rhinitis and/or conjunctivitis symptoms, arterial hypotension, associated by positive tests for latex allergy).

Comparisons were made between the different variables by Fisher's exact test and Kendall’s tau correlation coefficient.

Results

A natural rubber latex allergy was reported by 10% of subjects, reaching about 20% in students who were longer exposed (p < 0.003). Ninety-five percent of students were regular users of natural rubber gloves, and 60% of subjects used latex-free gloves when possible. Hand erythema along work procedures was observed in about 10% of cases and a short-term one developed (immediately after gloves wearing) in more than 12% of cases showing a progressive trend up to 21% (p < 0.03).

About 14% of subjects reported for irritant dermatitis after hand wash or washout procedures, reaching a value over 22% in the longer exposed group (p < 0.02). About 10% of subjects complained for irritant symptoms after application of disinfectants. Hand eczema within two days after natural rubber latex gloves use is reported by 14% of subjects, reaching a value of 28% in the longer exposed subpopulation (p < 0.0003).

Immediate facial allergic symptoms, rhino-conjunctival symptoms, lower respiratory symptoms, and visit of emergency services after latex exposure were reported by 5%, 5.4%, 2.5% and 7.1% of subjects respectively.

More than 20% of subjects were exposed to chirurgical procedures (like dental extractions). Dyspnea after toy balloon blowing is reported in about 2% of cases. Concentration disorders or oscillations are reported by 10%-20% of subjects. About one-quarter of subjects were tobacco smokers. Only 2 subjects complained for adverse reactions from latex-free gloves, while more than 40% of all subjects reported for attenuation of them during their regular use. At least 11% of subjects reported for allergic reactions independent to the latex exposure on workplace. Additional allergic pathologies and familiar history for such diseases reported about 17% and 26% of subjects respectively. In addition, 15% of subjects reported for food allergies. One-third of latex-independent allergic pathologies (5.4%) were confirmed by allergy tests. These findings are summarized on Table 1.

With regards to diagnostic procedures, the patch test to latex resulted positive in about 15% of subjects. More than 12% of subjects showed a positive reaction to adhesive of patch test (one subject with parallel sensitivity to latex-free glove, and one other to latex). Commercial skin prick test to latex revealed a sensitization to latex on 20% and atopy (a positive result to airborne and/or food allergens) on 34% of subjects. Airborne challenge with natural rubber latex gloves confirmed the allergic sensitization on 7.5% of subjects, which was reinforced by parallel negative results to challenge with latex-free gloves. An additional population showed irrelevant or irritant skin symptoms (like itching, erythema or dried skin), while respiratory allergic symptoms are shown in a few cases. For more information see Table 2.

In total, 25% of subjects (60 cases) were suspected for adverse reactions during natural rubber latex exposure. According to school practice grouping, in the non-exposed group were suspected 6 cases (18.2%), in the shortly-exposed group 26 cases (19.1%), and in longer exposed group were suspected 28 cases (39.4%, p < 0.002). With respect to irritant contact reactions, these values were 15.2%, 11.8% and 35.2% respectively (p < 0.0002). Regarding allergic reactions on the skin, the respective values were 3%, 11% and 26.8% (p < 0.002). With respect to allergic symptoms manifested on internal organs, these values were 3%, 2.9% and 5.6% (ns) (see also Table 3, and Figures 1, 2, 3, 4).

With regards to correlation between studied variables and the suspicion of natural rubber latex allergy, our findings revealed consistent to strong links to confirmed allergy, self-reporting of latex allergy, hand erythema or eczema, changes in concentration level, occurrence of skin allergic symptoms after latex exposure, attenuation of symptoms during regular use of latex-free gloves, occurrence of allergic skin symptoms during challenge test or positive result for latex skin prick and patch tests. A less consistent but significant correlation is observed between the suspicion of latex allergy and some variables like self-observation of respiratory symptoms after latex exposure, observation of the same symptoms during challenge test, attenuation of symptoms during...
regular use of latex-free gloves, or history for food allergy (see also Table 4).

The majority of mentioned correlations were observed according to student practice grouping. A progressive trend on these correlations is observed with regards to diagnosed skin allergy (including skin prick and patch tests), occurrence of concentration’s disorders, the attenuated symptoms after regular use of latex-free gloves, and history for food allergy (see also Table 5).

The correlation between occurrence of irritant reactions to latex and studied variables revealed a progressive trend for association with diagnosed skin allergy (including eczema, facial allergy symptoms, positive skin prick test and of course occurrence of irritant dermatitis symptoms during challenge test), allergic eye or nasal symptoms, occurrence of concentration disorders/oscillations, occurrence of allergic or irritating symptoms to latex, hand wash or washout substances, and female sex. For more information see Table 6.

The correlation between occurrence of allergy skin reactions to latex and studied variables revealed a progressive trend with respect to additional irritant dermatitis (including respective symptoms during/after disinfectant or wash/washout procedures), immediate or long-term erythema after gloves wearing, development of eczema or other allergy skin symptoms after latex exposure, concentration’s disorders, visit of emergency services after latex exposure, history for additional allergic pathologies including food allergies, attenuation of symptoms during regular use of latex-free gloves, reports for latex-independent allergic reactions. Diagnostic tests were helpful, but correlation level did not show any progressive trend (for more information, see Table 7).

The correlation between occurrence of allergy reactions to latex on inner organs and studied variables revealed a progressive trend with respect to diverse reported symptoms on eye, nose and lower respiratory airways (confirmed by challenge test), facial allergy symptoms, and food allergies (for more information, see Table 8).

**Discussion**

Latex allergy is a major occupational health problem in health care workers, affecting according various studies 0.5 to 18% of subgroups at risk [1, 2, 11-15]. Above-mentioned epidemiologic findings agree with some items in our self-administrated questionnaire, which reports for natural rubber latex allergy among dental students on 10% of cases, hand erythema especially after latex glove wearing in more than 12%, or hand eczema in 14%. A similar frequency is reported among our subjects about concentration disorders or oscillations during the work, which is not mentioned in the literature.

The trend of various questionnaire items shows a progression in concordance with latex exposure along school practice, over-

| Latex Exposure                                              | Total n = 240 (%) | Non-exposed n = 33 (%) | Shortly-exposed n=136 (%) | Longer-exposed n=71 (%) |
|------------------------------------------------------------|-------------------|------------------------|---------------------------|-------------------------|
| Previous reports for latex allergy                         | 24 (10.0)         | 4 (12.1)               | 6 (4.4)                   | 14 (19.7)               |
| Regular use of latex gloves                                | 227 (94.6)        | 32 (97.0)              | 124 (91.2)                | 71 (100)                |
| Assisting colleagues that use latex gloves                 | 195 (81.3)        | 23 (69.7)              | 103 (75.7)                | 69 (97.2)               |
| Hand erythema during work                                  | 23 (9.6)          | 5 (15.2)               | 9 (6.6)                   | 9 (12.7)                |
| Previous chirurgical interventions                         | 57 (23.8)         | 10 (30.3)              | 35 (25.7)                 | 12 (16.9)               |
| Hypotension shock after chirurgical interventions          | 0                 | 0                      | 0                         | 0                       |
| Irritant dermatitis after hand wash/washout procedures     | 33 (13.8)         | 5 (15.2)               | 12 (8.8)                  | 16 (22.5)               |
| Irritant disorders after hand disinfection procedures      | 26 (10.8)         | 6 (18.2)               | 9 (6.6)                   | 11 (15.5)               |
| History for additional allergic pathologies               | 42 (17.5)         | 7 (21.2)               | 17 (12.5)                 | 18 (25.4)               |
| Familiar history for allergic diseases                     | 63 (26.3)         | 9 (27.3)               | 39 (28.7)                 | 15 (21.1)               |
| Smoking                                                   | 65 (27.1)         | 3 (9.1)                | 37 (27.2)                 | 25 (35.2)               |
| Immediate erythema after use of latex gloves              | 31 (12.9)         | 5 (15.2)               | 11 (8.1)                  | 15 (21.1)               |
| Eczema or cracked skin within 2 days after use of latex gloves | 34 (14.2)     | 4 (12.1)               | 10 (7.4)                  | 20 (28.2)               |
| Concentration disorders after use of latex gloves         | 46 (19.2)         | 9 (27.3)               | 20 (14.7)                 | 17 (23.9)               |
| Changes in the concentration level after use of latex gloves | 27 (11.3)     | 4 (12.1)               | 12 (8.8)                  | 11 (15.5)               |
| Regular use of latex-free gloves                          | 146 (60.8)        | 23 (69.7)              | 82 (60.5)                 | 41 (57.7)               |
| Adverse reactions after use of latex-free gloves          | 2 (0.4)           | 1 (3.0)                | 1 (0.7)                   | 0                       |
| Attenuation of adverse symptoms after use of latex-free gloves | 102 (42.5)    | 21 (63.6)              | 50 (36.8)                 | 31 (43.7)               |
| Sneezing, eye itching, nasal congestion after latex exposure | 13 (5.4)       | 3 (9.1)                | 5 (3.7)                   | 5 (7.0)                 |
| Breathlessness attack after latex exposure                 | 6 (2.5)           | 3 (9.1)                | 2 (1.5)                   | 3 (4.2)                 |
| Facial itching, angioedema, or erythema after latex exposure | 12 (5.0)       | 3 (9.1)                | 7 (5.1)                   | 4 (5.6)                 |
| Breathlessness attack after toy balloon blowing            | 5 (2.1)           | 3 (9.1)                | 2 (1.5)                   | 2 (2.8)                 |
| Additional allergic reactions non-related to latex         | 28 (11.7)         | 3 (9.1)                | 20 (14.7)                 | 5 (7.0)                 |
| Visit in emergency services after latex exposure           | 17 (7.1)          | 1 (3.0)                | 12 (8.8)                  | 4 (5.6)                 |
| Previous positive allergy tests                           | 13 (5.4)          | 1 (3.0)                | 8 (5.9)                   | 4 (5.6)                 |
| Previous food allergies                                   | 37 (15.4)         | 4 (12.1)               | 24 (17.6)                 | 9 (12.7)                |
Table 2. Summary of Diagnostic Test Results.

| Exposure to latex | Total n=240 (%) | Non-exposed n=33 (%) | Shortly-exposed n=136 (%) | Longer-exposed n=71 (%) |
|-------------------|----------------|----------------------|--------------------------|------------------------|
| Positive patch test to latex | 7/48 (14.6) | 1/7 (14.3) | 3/24 (12.5) | 3/19 (15.8) |
| Positive patch test to latex-free glove | 1/48 (2.1) | 0/7 | 0/24 | 1/19 (5.3) |
| Positive patch test to adhesive | 6/48 (12.5) | 0/7 | 3/24 (12.5) | 3/19 (15.8) |
| Latex wheal | 10/50 (20.0) | 2/6 (33.3) | 3/26 (11.5) | 5/18 (27.8) |
| Latex flare | 11/50 (22.0) | 2/6 (33.3) | 3/26 (11.5) | 6/18 (33.3) |
| Presence of atopy | 17/50 (34.0) | 4/6 (66.7) | 7/26 (26.9) | 6/30 (33.3) |
| Positive latex challenge test | 18 (7.5) | 4 (12.1) | 9 (6.6) | 5 (7.0) |
| - Erythema | 20 (8.3) | 4 (12.1) | 9 (6.6) | 7 (9.9) |
| - Dry skin | 6 (2.5) | 0 | 3 (2.2) | 3 (4.2) |
| - Itching | 24 (10.0) | 4 (12.1) | 11 (8.1) | 9 (12.7) |
| - Hives | 1 (0.4%) | 0 | 1 (0.7) | 0 |
| - Breathlessness | 3 (1.3) | 0 | 2 (1.5) | 1 (1.4) |
| - Cough | 2 (0.8) | 0 | 1 (0.7) | 1 (1.4) |
| Positive provocation test to latex-free glove | 0 | 0 | 0 | 0 |

Table 3. Reactions to Latex Exposure.

| Type of reaction to latex exposure | Non-exposed (33) | Shortly-exposed (136) | Longer-exposed (71) | Total (240) | P |
|-----------------------------------|-----------------|----------------------|---------------------|--------------|---|
| Suspected adverse reactions | 6 (18.2%) | 26 (19.1%) | 28 (39.4%) | 60 (25%) | .002 |
| Irritant skin reactions | 5 (15.2%) | 16 (11.8%) | 25 (38.2%) | 46 (19.2%) | .0002 |
| Allergic skin reactions | 1 (3%) | 15 (11%) | 19 (26.8%) | 35 (14.6%) | .002 |
| Internal organ allergic reactions | 1 (3%) | 4 (2.9%) | 4 (5.6%) | 9 (3.8%) | .5 |

Figure 1. The Trend of Suspected Adverse Reactions.

Figure 2. The Trend of Irritant Reactions.
Figure 3. The Trend of Allergic Skin Reactions.

![Graph showing the trend of allergic skin reactions.](image)

Figure 4. The Trend of Internal Allergic Reaction.

![Graph showing the trend of internal allergic reactions.](image)

Table 4. Correlation between Suspected Latex Allergies and Variables among Dental Students.

| Variables                                             | r   | p       | n   |
|-------------------------------------------------------|-----|---------|-----|
| Diagnosed allergic reaction on internal organs to latex | .342| <0.001  | 240 |
| Diagnosed allergic skin reactions to latex             | .716| <0.001  | 240 |
| Previous reports for latex allergy                     | .577| <0.001  | 240 |
| Immediate erythema after use of latex gloves           | .581| <0.001  | 240 |
| Eczema or cracked skin within 2 days after use of latex gloves | .676| <0.001  | 240 |
| Concentration disorders after use of latex gloves      | .281| <0.001  | 240 |
| Changes in the concentration level after use of latex gloves | .464| <0.001  | 240 |
| Regular use of latex-free gloves                       | .069| .286    | 240 |
| Adverse reactions after use of latex-free gloves       | .053| .413    | 240 |
| Attenuating of adverse symptoms after use of latex-free gloves | .185| .004    | 240 |
| Sneezing, eye itching, nasal congestion after latex exposure | .202| .002    | 240 |
| Breathlessness attack after latex exposure             | .216| .001    | 240 |
| Facial itching, angioedema, or erythema after latex exposure | .353| <0.001  | 240 |
| Breathlessness attack after toy balloon blowing        | .253| <0.001  | 240 |
| Additional allergic reactions non-related to latex      | .041| .528    | 239 |
| Visit in emergency services after latex exposure       | .103| .111    | 240 |
| Previous positive allergy tests                        | -.053| .411 | 240 |
| Previous food allergies                                | .230| <0.001  | 240 |
| Positive patch test to latex                           | .380| .009    | 48  |
| Positive patch test to latex-free glove                 | .134| .358    | 48  |
| Positive patch test to adhesive                        | .095| .516    | 48  |
| Erythema after latex provocation test                  | .522| <0.001  | 240 |
| Itching after latex provocation test                   | .331| <0.001  | 240 |
| Breathlessness after latex provocation test            | .195| .003    | 240 |
| Hives after latex provocation test                     | .112| .083    | 240 |
| Histamine wheal                                        | .278| .045    | 50  |
| Histamine flare                                        | .052| .684    | 50  |
| Latex wheal                                            | .428| .002    | 50  |
| Latex flare                                            | 0.368| 0.007  | 50  |
Table 5. Correlation’s Trend of Different Variables with Suspicion for Adverse Reactions to Latex Exposure Among Dental Students.

| Variables                                                                 | Non exposed (n=33) | Shortly-exposed (n=136) | Longer-exposed (n=71) |
|---------------------------------------------------------------------------|--------------------|-------------------------|-----------------------|
| Diagnosed allergic reaction to latex on internal organs                   | 0.375 .034         | 0.358 <0.001            | 0.303 .011            |
| Diagnosed allergic skin reactions to latex                                | 0.375 .034         | 0.724 <0.001            | 0.749 <0.001          |
| Previous reports for latex allergy                                        | 0.788 .000         | 0.442 <0.001            | 0.612 <0.001          |
| Immediate erythema after use of latex gloves                              | 0.896421 <0.001    | 0.473 <0.001            | 0.571 <0.001          |
| Eczema or cracked skin within 2 days after use of latex gloves            | 0.788 <0.001       | 0.579 <0.001            | 0.712 <0.001          |
| Concentration disorders after use of latex gloves                         | 0.417 .018         | 0.115 .182              | 0.425 <0.001          |
| Changes in the concentration level after use of latex gloves              | 0.306382 .083      | 0.442 <0.001            | 0.531 <0.001          |
| Regular use of latex-free gloves                                          | 0.139876 .429      | 0.127 .140              | -0.010 .934           |
| Adverse reactions after use of latex-free gloves                          | 0.375 .034         | -0.042 .627             | . .                   |
| Attenuation of adverse symptoms after use of latex-free gloves            | -0.13363 .450      | 0.172 .045              | 0.33552 .005          |
| Sneezing, eye itching, nasal congestion after latex exposure              | 0.124226 .482      | 0.104 .228              | 0.341 .004            |
| Breathlessness attack after latex exposure                                 | 0.375 .034         | 0.251 .004              | 0.117 .328            |
| Breathlessness attack after toy balloon blowing                            | 0.375 .034         | 0.251 .004              | 0.211 .078            |
| Additional allergic reactions non-related to latex                         | -0.14907 .399      | 0.062 .470              | 0.184 .126            |
| Visit in emergency services after latex exposure                           | -0.08333 .637      | 0.112 .191              | 0.178 .137            |
| Previous positive allergy tests                                           | -0.08333 .637      | -0.042 .625             | -0.072 .546           |
| Previous food allergies                                                   | -0.17072 .323      | 0.325 <0.001            | 0.249 .032            |
| Positive patch test to latex                                              | 0.258199 .527      | 0.447 .138              | 0.386 .041            |
| Positive patch test to latex-free glove                                    | . . .              | . . .                   | 0.183 .334            |
| Positive patch test to adhesive                                           | . . .              | 0.000 .1000             | 0.186 .324            |
| Erythema after latex provocation test                                     | 0.787839 <0.001    | 0.548 <0.001            | 0.410 .001            |
| Itching after latex provocation test                                      | 0.67082 <0.001     | 0.542 <0.001            | 0.472 <0.001          |
| Breathlessness after latex provocation test                               | . . .              | 0.251 .004              | 0.148 .215            |
| Hives after latex provocation test                                        | . . .              | 0.177 .040              | . .                   |
| Histamine wheal                                                           | 1 . .              | 0.325 .218              | 0.180 .324            |
| Histamine flare                                                           | 0.942809 .028      | 0.035 .890              | -0.088 .595           |
| Latex wheal                                                               | 0.471405 .273      | .                      | 0.539 .003            |
| Latex flare                                                               | 0.471405 .273      | .                      | 0.539 .003            |

Whelming the prevalence value of 20% significantly. This includes self-reporting of latex allergy, occurrence of allergic and irritant contact dermatitis, whereas respiratory symptoms were reported in a smaller subjects’ proportion. A similar prevalence progression for allergic and irritant skin symptoms is observed in an additional study among dental students, showing a significant difference between students of first to third year and them of fourth to sixth year [2]. This trend is demonstrated also in a survey among dental workers in military dental centers [16]. The increased prevalence of latex allergy and rubber additives as well as between allergic and irritant dermatitis in hyper-sensitized subjects to latex gloves [13, 20]. In our study, the potential role of mentioned factors above is reflected on the lower proportion of positive response to diagnostic tests for the latex hypersensitivity, and on the consistent proportion of self-reported to detergents, disinfectants and cases of allergic reactions in workplace that are independent to latex exposure. Thus, the positive response for skin prick test is shown in 20%, for patch test in 15% and for challenge test in 7.5% of cases. The prevalence’s variation between diverse allergic pathologies has been noted in a recent survey, which reported for glove-related cutaneous and non-cutaneous symptoms in 11.3% and 5.9% of the respondents [4]. This finding also suggests that respiratory exposure plays an important role, in addition to dermal exposure [5, 21].
Table 6. Correlation’s Trend of Different Variables with Presence of Irritant Reactions to Latex Exposure Among Dental Students.

| Variables                                                                 | Non-exposed (n=33) | Shortly-exposed (n=136) | Longer exposed (n=71) |
|---------------------------------------------------------------------------|--------------------|-------------------------|----------------------|
|                                                                           | r      | p       | r      | p       | r      | p       |
| Diagnosed allergic skin reactions to latex                                | -0.75  | .073    | 0.309  | <0.001 | 0.620  | <0.001 |
| Immediate erythema after latex exposure                                   | 0.529  | .003    | 0.310  | <0.001 | 0.485  | <0.001 |
| Eczema or cracked skin within 2 days after use of latex gloves            | 0.361  | .041    | 0.684  | <0.001 | 0.718  | <0.001 |
| Concentration disorders after use of latex gloves                        | 0.121  | .495    | 0.106  | .218    | 0.346  | .004   |
| Changes in the concentration level after use of latex gloves              | 0.102  | .564    | 0.369  | <0.001 | 0.499  | <0.001 |
| Regular use of latex-free gloves                                         | -0.089 | .614    | 0.016  | .848    | 0.034  | .778   |
| Sex (male vs. female)                                                     | -0.199 | .260    | -0.176 | .040    | -0.238 | .047   |
| Previous allergic reactions to latex exposure                             | 0.361  | .041    | 0.477  | <0.001 | 0.524  | <0.001 |
| Regular use of latex gloves                                               | 0.075  | .673    | 0.033  | .700    |        | .     |
| Assisting colleagues that use latex gloves                                | 0.279  | .115    | 0.047  | .585    | -0.053 | .659   |
| Hand erythema during work                                                 | 0.293  | .098    | 0.178  | .038    | 0.340  | .004   |
| Previous chirurgical interventions                                        | -0.279 | .115    | 0.046  | .593    | -0.196 | .420   |
| Irritant dermatitis after hand wash / washout procedures                  | 0.057  | .747    | 0.289  | .001    | 0.732  | <0.001 |
| Irritant disorders after hand disinfection procedures                     | 0.239  | .176    | 0.362  | <0.001 | 0.581  | <0.001 |
| History for additional allergic pathologies                               | -0.013 | .943    | -0.069 | .423    | 0.316  | .008   |
| Familiar history for allergic pathologies                                 | -0.069 | .696    | 0.021  | .809    | 0.196  | .100   |
| Smoking                                                                   | -0.134 | .450    | 0.084  | .326    | 0.136  | .256   |
| Adverse reactions after use of latex-free gloves                          | 0.418  | .018    | -0.031 | .715    |        | .     |
| Attenuation of adverse symptoms after use of latex-free gloves            | -0.383 | .030    | 0.053  | .539    | 0.302  | .011   |
| Sneezing, eye itching, nasal congestion after latex exposure              | -0.134 | .450    | 0.050  | .562    | 0.258  | .031   |
| Breathlessness after latex exposure                                       | -0.075 | .673    | 0.145  | .092    | -0.008 | .945   |
| Facial itching, angioedema, or erythema after latex exposure              | -0.075 | .673    | 0.328  | <0.001 | 0.204  | .089   |
| Breathlessness attack after balloon blowing                               | -0.075 | .673    | 0.335  | <0.001 | 0.053  | .659   |
| Additional allergies non-related to latex-exposure                        | -0.134 | .450    | 0.042  | .628    | 0.082  | .498   |
| Visit in emergency services after latex exposure                          | -0.075 | .673    | 0.128  | .138    | -0.052 | .662   |
| Previous positive allergy tests                                          | -0.075 | .673    | 0.006  | .947    | -0.052 | .662   |
| Previous food allergies                                                   | 0.122  | .479    | 0.270  | .001    | 0.206  | .075   |
| Positive patch test to latex-free glove                                   | .      | .       | .      | .       | 0.196  | .301   |
| Positive patch test to adhesive                                           | .      | .       | -0.158 | .600    | 0.214  | .258   |
| Erythema after latex provocation test                                     | 0.361  | .041    | 0.362  | <0.001 | 0.449  | <0.001 |
| Dry skin after latex provocation test                                     | .      | .       | 0.411  | <0.001 | 0.285  | .017   |
| Itching after latex provocation test                                      | -0.454 | .010    | -0.394 | <0.001 | 0.517  | <0.001 |
| Breathlessness after latex provocation test                               | .      | .       | -0.045 | .604    | 0.162  | .175   |
| Cough after latex provocation test                                        | .      | .       | -0.031 | .715    | 0.162  | .175   |
| Hives after latex provocation test                                        | .      | .       | -0.236 | .006    |        | .     |
| Histamine wheal                                                           | 0.667  | .121    | 0.210  | .407    | -0.070 | .671   |
| Histamine flare                                                           | 0.667  | .121    | 0.210  | .407    | -0.070 | .671   |
| Latex wheal                                                               | -0.111 | .796    |        | .       | 0.446  | .013   |
| Latex flare                                                               | -0.111 | .796    |        | .       | 0.348  | .048   |

More than one-third of subjects reported for symptoms improvement after systematical avoiding of latex gloves, showing an effective prevention measure against latex allergy especially among subjects with longer study period experience or work practice [21, 22]. This indicates that simple measures such as the use of non-powdered latex gloves and use of latex-free gloves by sensitized subjects can stop the progression of latex symptoms and can avoid new cases of sensitization [23]. Being often an IgE-mediated disease, the latex allergy among our subjects is associated with other IgE-mediated pathologies like food allergy, and positive skin prick tests to various atopens in a large proportion. Similarly to this study, previous surveys have noted that family history of allergy, history of personal food allergy, or symptoms associated with toy balloons are frequent among individuals with latex allergy [2-4, 7, 8, 11]. Apart from the frequency trend, the majority of mentioned questionnaire and allergy tests items demonstrated also a progressive correlation trend from the latex non-exposed group to the longer exposed one. This can suggest that questionnaire statements in concert with diagnostic tests are more convincing and conclusive when the pathologic processes and disease’s installment reach an advanced stage due to latex exposure along years of dental practice [24]. This is reinforced by the finding that quantity of gloves use should be considered a risk factor for latex allergy, and the recent confirmation that some commercial tests Bakiri A, Skenderaj S, Kraja D, Petrela E, Mingomataj EÇ, et al., (2017) Hypersensitivity to Latex Gloves among Dental Students: Is the Pre-Matriculation Evaluation and Periodic Health Surveillance Necessary?. Int J Clin Med Allergy. 5(1), 55-64.
are useful diagnostic tools only for patients with a history of latex allergy and not for screening the population with a low prevalence of latex sensitization [4, 24].

This study reinforces the conclusion that it is essential to recognize which professionals are sensitized to latex in order to provide appropriate treatment and to establish adequate prevention [3]. A positive history for allergic and irritant symptoms, as determined by questionnaire was significant predictor of a positive response to latex antigens. Healthcare enterprise-wide interventions requiring use of low-allergen gloves, changing gloves to non-latex ones, or even using low-allergen latex gloves, in the affected individuals appears to confer adequate secondary prevention [5, 25]. Because of relationship between allergic reactions to latex gloves and some medical histories, it seems to be necessary the pre-matriculation and pre-employment evaluation, as well as periodic health surveillance of dental students/workers [16].

Table 7. Correlation’s Trend of Different Variables with Presence of Allergic Skin Reactions to Latex Exposure Among Dental Students.

| Variables                                      | Non-exposed (n=33) | Shorty-exposed (n=136) | Longer-exposed (n=71) |
|------------------------------------------------|--------------------|------------------------|-----------------------|
| Diagnosed irritant reactions to latex          | r = -0.75, p = 0.673 | r = 0.309, p < 0.001   | r = 0.620, p < 0.001  |
| Immediate erythema after use of latex gloves | r = 0.418, p = 0.018 | r = 0.584, p < 0.001   | r = 0.778, p < 0.001  |
| Eczema or cracked skin within 2 days after use of latex gloves | r = 0.476, p = 0.007 | r = 0.261, p = 0.002 | r = 0.541, p < 0.001 |
| Concentration disorders after use of latex gloves | r = 0.289, p = 0.102 | r = 0.185, p = 0.031 | r = 0.332, p = 0.006 |
| Changes in the concentration level after use of latex gloves | r = -0.066, p = 0.710 | r = 0.387, p < 0.001 | r = 0.532, p < 0.001 |
| Regular use of latex-free gloves              | r = 0.117, p = 0.510 | r = 0.142, p = 0.099   | r = 0.002, p = 0.988  |
| Sex (female vs. male)                          | r = -0.083, p = 0.637 | r = -0.161, p = 0.061 | r = -0.057, p = 0.631 |
| Previous allergic reactions to latex exposure  | r = 0.476, p = 0.007 | r = 0.382, p < 0.001   | r = 0.820, p < 0.001  |
| Regular use of latex gloves                   | r = 0.031, p = 0.860 | r = 0.110, p = 0.203   | -         |
| Assisting colleagues that use latex gloves   | r = 0.117, p = 0.510 | r = 0.035, p = 0.684   | r = -0.089, p = 0.455 |
| Hand erythema during work                     | r = 0.418, p = 0.018 | r = 0.473, p < 0.001   | r = 0.630, p < 0.001  |
| Previous chirurgical interventions            | r = 0.268, p = 0.129 | r = -0.046, p = 0.591  | r = -0.103, p = 0.390 |
| Irritant dermatitis after hand wash / washout procedures | r = -0.075, p = 0.673 | r = 0.056, p = 0.515 | r = 0.435, p < 0.001 |
| Irritant disorders after hand disinfection procedures | r = -0.083, p = 0.637 | r = 0.190, p = 0.028 | r = 0.445, p < 0.001 |
| History for additional allergic pathologies   | r = -0.092, p = 0.604 | r = 0.222, p = 0.010   | r = 0.452, p < 0.001  |
| Familiar history for allergic pathologies     | r = -0.108, p = 0.540 | r = 0.244, p = 0.005   | r = 0.155, p = 0.195  |
| Smoking                                       | r = -0.056, p = 0.752 | r = -0.004, p = 0.960  | r = 0.154, p = 0.198  |
| Adverse reactions after use of latex-free gloves | r = -0.031, p = 0.860 | r = -0.030, p = 0.725  | -         |
| Attenuation of adverse symptoms after use of latex-free gloves | r = 0.134, p = 0.450 | r = 0.218, p = 0.011   | r = 0.302, p = 0.012  |
| Sneezing, eye itching, nasal congestion after latex exposure | r = 0.559, p = 0.002 | r = 0.181, p = 0.036   | r = 0.455, p < 0.001  |
| Breathlessness after latex exposure           | r = 1.000, p = 0.000 | r = 0.347, p < 0.001   | r = 0.189, p = 0.113  |
| Facial itching, angioedema, or erythema after latex exposure | r = 1.000, p = 0.000 | r = 0.449, p < 0.001   | r = 0.404, p = 0.001  |
| Breathlessness attack after toy balloon blowing | r = 1.000, p = 0.000 | r = 0.347, p < 0.001   | r = 0.089, p = 0.455  |
| Additional allergies non-related to latex-exposure | r = -0.056, p = 0.752 | r = 0.053, p = 0.541   | r = 0.278, p = 0.021  |
| Visit in emergency services after latex exposure | r = -0.031, p = 0.860 | r = -0.056, p = 0.515  | r = 0.266, p = 0.026  |
| Previous positive allergy tests               | r = -0.031, p = 0.860 | r = -0.012, p = 0.892  | r = -0.010, p = 0.935 |
| Previous food allergies                       | r = -0.064, p = 0.711 | r = 0.262, p = 0.002   | r = 0.387, p = 0.001  |
| Positive patch test to latex-free gloves      | -                     | -                     | -                     |
| Positive patch test to adhesive               | -                     | -                     | -                     |
| Erythema after latex provocation test         | r = 0.476, p = 0.007 | r = 0.756, p < 0.001   | r = 0.547, p < 0.001  |
| Dry skin after latex provocation test         | -                     | r = 0.107, p = 0.214   | r = 0.031, p = 0.794  |
| Itching after latex provocation test          | r = 0.559, p = 0.002 | r = -0.670, p < 0.001  | r = 0.535, p < 0.001  |
| Breathlessness after latex provocation test   | -                     | r = 0.152, p = 0.077   | r = 0.198, p = 0.098  |
| Cough after latex provocation test            | -                     | r = 0.244, p = 0.005   | r = 0.198, p = 0.098  |
| Hives after latex provocation test            | -                     | r = 0.244, p = 0.005   | -                     |
| Histamine wheal                               | r = 0.298, p = 0.488  | r = 0.199, p = 0.432   | r = -0.015, p = 0.930 |
| Histamine flare                               | r = 0.298, p = 0.488  | r = 0.199, p = 0.432   | r = -0.015, p = 0.930 |
| Latex wheal                                   | r = 0.745, p = 0.083  | -                     | r = 0.488, p = 0.007  |
| Latex flare                                   | r = 0.745, p = 0.083  | -                     | r = 0.427, p = 0.016  |
Table 8. Correlation's Trend of Different Variables with Presence of Internal Organ Allergic Reactions to Latex Exposure Among Dental Students.

| Variables | Non-exposed (n=33) | Shortly-exposed (n=136) | Longer-exposed (n=71) |
|-----------|----------------------|-------------------------|-----------------------|
|           | r   | p    | r   | p    | r   | p    |
| Suspected allergic reactions to latex | .375 | .034 | .358 | <.0001 | .303 | .011 |
| Diagnosed allergic reactions to latex | 1.000 | . | .355 | <.0001 | .404 | .001 |
| Immediate erythema after use of latex gloves | .418 | .018 | .268 | .002 | .322 | .007 |
| Eczema or cracked skin within 2 days after use of latex gloves | .476 | .007 | .284 | .001 | .390 | .001 |
| Concentration disorders after use of latex gloves | .289 | .102 | .173 | .044 | .149 | .212 |
| Changes in the concentration level after use of latex gloves | -.066 | .710 | .253 | .003 | .064 | .591 |
| Regular use of latex-free gloves | .117 | .510 | .052 | .543 | -.162 | .175 |
| Adverse reactions after use of latex-free gloves | -.031 | .860 | -.015 | .862 | . | . |
| Attenuation of adverse symptoms after use of latex-free gloves | .134 | .450 | .138 | .109 | .154 | .196 |
| Sneezing, eye itching, nasal congestion after latex exposure | .559 | .002 | .197 | .022 | .888 | <.0001 |
| Breathlessness after latex exposure | .1000 | . | .702 | <.0001 | .556 | <.0001 |
| Facial itching, angioedema, or erythema after latex exposure | 1.000 | . | .353 | <.0001 | .735 | <.0001 |
| Breathlessness attack after toy balloon blowing | 1.000 | . | .702 | <.0001 | .328 | .006 |
| Additional allergies non-related to latex-exposure | -.056 | .752 | -.072 | .401 | -.061 | .615 |
| Visit of emergency services after latex exposure | -.031 | .860 | -.054 | .529 | -.060 | .617 |
| Previous positive allergy tests | -.031 | .860 | -.044 | .613 | -.060 | .617 |
| Previous food allergies | -.064 | .711 | .246 | .003 | .268 | .021 |
| Positive patch test to latex | 1.000 | . | . | . | .521 | .006 |
| Positive patch test to latex-free glove | . | . | . | . | -.064 | .734 |
| Positive patch test to adhesive | . | . | . | . | -.136 | .472 |
| Erythema after latex provocation test | .476 | .007 | .304 | <.0001 | .329 | .006 |
| Dry skin after latex provocation test | .559 | .002 | .427 | <.0001 | .274 | .022 |
| Breathlessness after latex provocation test | . | . | .702 | <.0001 | .489 | <.0001 |
| Hives after latex provocation test | . | . | .-015 | .862 | . | . |
| Histamine wheal | .316 | .480 | .147 | .578 | -.299 | .101 |
| Histamine flare | .298 | .488 | .235 | .353 | .070 | .671 |
| Latex wheal | .745 | .083 | . | . | .384 | .032 |
| Latex flare | .745 | .083 | . | . | .384 | .032 |

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