

## ORIGINAL ARTICLE

# Skin reactions among Bulgarian dental students: A self-report questionnaire survey

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## Abstract

**Background:** Dental students are at high risk of developing adverse skin reactions following practical work during the dentistry degree program. They encounter multiple irritants and allergens that may cause skin reactions on exposed parts of the body, notably the hands.

**Objectives:** To estimate the prevalence of skin reactions related to the pre-clinical and clinical training courses of the dentistry program and associated risk factors in Bulgarian dental students.

**Method:** A cross-sectional study was performed using a self-report questionnaire.

**Results:** A total of 467 dental students completed the questionnaire (response 51.8%). The prevalence of self-reported skin symptoms was 21.2%. According to logistic regression analysis, the most important risk factors for work-related skin symptoms were a personal history of atopic dermatitis (odds ratio [OR] 3.92, 95% confidence interval [CI]: 1.99-7.72), allergic rhinoconjunctivitis and/or asthma (OR 1.94, 95%CI: 1.03-3.68), personal history of contact allergy (OR 2.19, 95%CI: 1.06-4.55), and hand washing >16 times a day (OR 2.42, 95%CI: 1.06-5.52).

**Conclusions:** The results of this study suggest that work-related skin symptoms are frequent among dental students and indicate the need to establish effective primary preventive programs for occupational skin disorders at a national level.

## KEYWORDS

atopy, dental students, hand washing, skin complaints

## 1 | BACKGROUND

Occupational dermatological problems are common among dental health personnel.<sup>1-3</sup> Contact with dental materials and disinfectants, wearing of protective gloves, and frequent hand washing cause damage to the skin barrier that can result in dry skin and hand eczema. In most cases, work-related skin lesions in dental staff manifest as contact reactions in terms of irritant contact dermatitis, allergic contact dermatitis, or contact urticaria, commonly on the hands but also on other body parts (eg, forearms, face, and neck).<sup>4-9</sup> Studies on the prevalence of hand eczema in dental personnel have been conducted in Sweden,<sup>10-12</sup> Denmark,<sup>13</sup> Finland,<sup>6</sup> the United States,<sup>14</sup> and Poland.<sup>15</sup>

These skin problems may begin during student training and education.<sup>16,17</sup> Dental students are exposed to multiple irritants and allergens during the pre-clinical and clinical training courses of the dentistry program. Studies concerning work-related skin symptoms among dental students are mainly focused on reactions caused by exposure to latex gloves and do not consider other chemical agents with irritant or sensitizing potential in the dental medical environment. This study was conducted to determine the prevalence of self-reported skin symptoms related to the laboratory and clinical work which is part of the dental education program and possible risk factors in Bulgarian dental students based on a self-administered questionnaire.

## 2 | METHODS

A cross-sectional survey was conducted among dental students at Plovdiv Medical University and Sofia Medical University, Bulgaria. The survey used a self-administered online questionnaire that was created using Google Drive. Students were invited by the professors involved in the study to complete the questionnaire during their practical course. In addition, the questionnaire was shared as a Facebook link by the moderator of the dental students' closed Facebook group. Only second-, third-, fourth-, fifth- and sixth-year dental students were invited to participate. First-year students were excluded, because contact with occupational chemical hazards at that point in the training program is minimal.

Participants were requested to document current skin symptoms related to the pre-clinical and clinical work. In case of a positive reply the questionnaire included questions on localization and characteristics of skin symptoms and suspected etiologic factors. The type of gloves used, daily contact with protective gloves, number of pairs of gloves used per day, and frequency of hand washing were also recorded for all participants. One section of the questionnaire sought information about any allergic disorders such as asthma, hay fever, eczema, contact allergy (including to metal objects), food allergy, or drug allergy. The history of atopic dermatitis in terms of infant eczema or eczema on knee and elbow flexures, hay fever, or asthma were regarded as signs of atopy. Ethical approval for this study was granted by the Ethics Committee of the Medical University, Plovdiv, Bulgaria.

The information from the digital questionnaire was exported to a database file. Statistical analysis was carried out with SPSS, version 18.0. Descriptive statistics were used to evaluate the prevalence of various exposures and symptoms. Differences between students with or without self-reported work-related skin symptoms were evaluated by chi-square test. The level of significance was set at  $\alpha = 0.05$ .

Multiple logistic regression analysis was conducted in order to investigate the relationship between sex, frequency of hand washing, hours of glove use per day, pairs of gloves worn per day, atopic dermatitis, allergic rhinoconjunctivitis or asthma, and contact allergy (included as independent variables in the model) with work-related skin symptoms (included as dependent variables).

## 3 | RESULTS

In total, 467 Bulgarian dental students participated in the survey (27.8% men and 72.2% women). Their ages ranged from 20 to 35 years with an average  $\pm$  standard deviation (SD) of  $22.8 \pm 2.1$ . The sample included 62 (13.3%) second-year students, 106 (22.7%) third-year students, 151 (32.3%) fourth-year students, 108 (23.1%) fifth-year students, and 40 (8.6%) sixth-year students.

Altogether, 99 (21.2%) participants reported current skin reactions related to the pre-clinical or clinical work. The prevalence of skin reactions was higher among women (83, 24.6%) than men (16, 12.3%), with statistically significant difference ( $P = 0.004$ ). There was no significant difference in prevalence of skin symptoms between the students of

different classes (Table 1). The onset of skin symptoms was predominantly noted in the second year of education ( $n = 47$ , 47.5%), while 24 (24.2%) students developed symptoms in the third and in the fourth year, and 4 (4.0%) students in the fifth year.

The most frequently reported work-related skin symptoms are listed in Table 2. The hands were affected in 94 (94.9%) dental students reporting work-related skin symptoms. The backs of the hands were affected most frequently (63.6%), followed by fingers (62.6%), finger webs (38.4%), and palms (30.3%). The symptoms were localized predominantly on both hands (83.8%), and rarely on the right or left hand only (9.1% and 2.0%, respectively). Detailed localization of hand symptoms is presented in Figure 1

In 43 (43.4%) dental students, the hand skin symptoms were associated with symptoms at other anatomical sites. Five (5.1%) dental students reported skin symptoms at other sites, without any skin

**TABLE 1** Prevalence of skin symptoms in students of different classes

| Year of education | Number | Percentage | P-value |
|-------------------|--------|------------|---------|
| II y              | 13     | 21.0       | 0.89    |
| III y             | 26     | 24.5       |         |
| IV y              | 29     | 19.2       |         |
| V y               | 22     | 20.4       |         |
| VI y              | 9      | 22.5       |         |

**TABLE 2** Work-related skin symptoms reported by dental students ( $n = 99$ , multiple answers)

| Symptoms             | n  | %    |
|----------------------|----|------|
| Redness              | 70 | 70.7 |
| Dry skin             | 65 | 65.7 |
| Pruritus             | 57 | 57.6 |
| Rash                 | 39 | 39.4 |
| Chapping or cracking | 29 | 29.3 |
| Edema                | 14 | 14.1 |
| Pain                 | 8  | 8.1  |

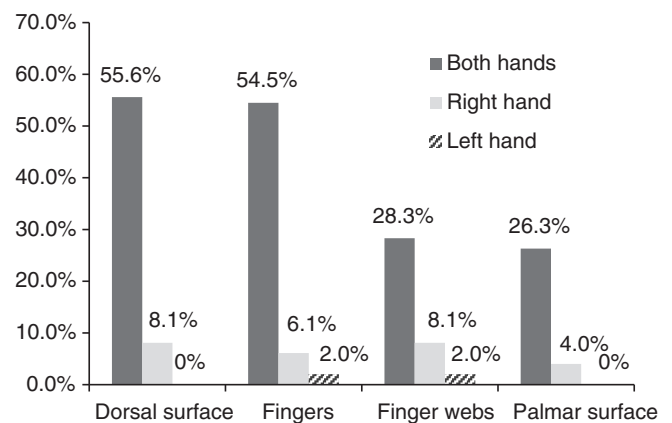


**FIGURE 1** Localization of hand symptoms

reactions on the hands. The other sites included the face (69.8%), neck (37.2%), forearms (14.0%), and legs (2.2%). The most common causes of skin reactions were attributed to protective gloves, frequent hand washing, plastics, and gypsum (Figure 2).

Forty-seven (10.1%) respondents reported that they did not wear protective gloves at all, predominantly second-year students (Table 3). Similar percentages of skin symptoms were found in students who did wear protective gloves and those who did not wear them (21.2% and 21.3%, respectively). Of 420 students wearing protective gloves, 317 (75.5%) used latex gloves, 146 (34.8%) used nitrile rubber gloves, 15 (3.6%) used polyvinyl chloride gloves, 2 (0.5%) used neoprene gloves, and 10 (2.6%) did not know the material of their gloves (multiple answers were possible). Of the respondents, 246 used only latex gloves and 82 only nitrile rubber gloves. Of the students who used only latex gloves, 21.5% had skin symptoms, while 20.7% of the students who used only nitrile rubber gloves reported skin problems.

A history of atopy defined by presence of childhood dermatitis, allergic rhinitis, and/or asthma was present in 143 (30.6%) of the respondents. Dental students with a history of atopic dermatitis or allergic rhinoconjunctivitis and/or asthma were more affected by work-related skin reactions than those without a history of atopic dermatitis or allergic rhinoconjunctivitis and/or asthma (26.3% vs 8.4%;  $P < 0.001$  and 44.4% vs 18.2%;  $P < 0.001$ , respectively). In the group of students with work-related skin symptoms, no statistically significant difference was found between students reporting symptoms elsewhere than the hands and those without such symptoms regarding history of atopic dermatitis (27.1% vs 25.5%,  $P > 0.05$ ).

The prevalences of drug allergy, food allergy, and contact allergy (including metal allergy) were 14.6%, 9.6%, and 11.3%, respectively. Higher percentages of work-related skin reactions were found in

dental students with history of contact allergy than in students with no history of contact allergy (21.2% vs 8.7%;  $P = 0.001$ ). No statistically significant differences between the two groups were found regarding a history of food or drug allergy.

According to logistic regression analysis, atopic disease history was the most significant risk factor for work-related skin symptoms. Atopic dermatitis (odds ratio [OR] 3.92, 95% confidence interval [CI]: 1.99-7.72;  $P < 0.001$ ) was more strongly associated with work-related skin symptoms than only allergic rhinoconjunctivitis and/or asthma (OR 1.94, 95%CI: 1.03-3.68;  $P = 0.041$ ). In addition, significant risk factors included a personal history of contact allergy (OR 2.19, 95%CI: 1.06-4.55) and hand washing >16 times a day (OR 2.42, 95%CI: 1.06-5.52) (Table 4).

## 4 | DISCUSSION

This survey appears to be the first study in the literature concerning self-reported skin reactions in dental students attributed not only to protective gloves but also to hand washing and various chemicals that students encounter during the pre-clinical and clinical training courses. The study was conducted in two of the three Faculties of Dental Medicine in Bulgaria with a response rate of 51.8%. First-year students were not included in the study because of the lack of contact with chemicals from the dental environment; their contact is limited to dental waxes. The self-reported prevalence data indicate that one out of five dental students suffers from current work-related skin symptoms. Female dental students were statistically more likely to develop self-reported skin reactions than male students. The higher prevalence of hand dermatitis among women has been reported by other authors and might be related to a lower threshold for reporting adverse reactions in women.<sup>18,19</sup> Similar to the findings of other studies, most of the skin lesions (95%) occurred on the hands.<sup>20</sup> A surprisingly high percentage (48.5%) of skin reactions were reported at other sites, especially the face and neck. Some symptoms could be attributed to atopy, but no association with history of atopic dermatitis was found. One possible explanation is airborne exposure to volatile irritants and allergens such as acrylic monomers, disinfectants, and gypsum. Airborne occupational dermatitis caused by acrylates has been reported in dental staff.<sup>21-23</sup>

Among students with skin symptoms, 65.7% attributed these to wearing protective gloves, with no difference between use of nitrile rubber and latex gloves. There was an increase in Type I latex allergy in healthcare workers in the late 1980s and early 1990s, due to the increased demand for latex protective gloves and poor manufacturing control. The introduction of low-protein powder-free latex gloves over recent years has resulted in reduced exposure in healthcare workers to latex antigens, and served to prevent sensitization to NRL (natural rubber latex).<sup>24-26</sup> Nitrile rubber gloves do not cause immediate-type allergy but may contain important contact allergens such as carbamates, thiurams, or mercaptobenzothiazoles, which may cause allergic contact dermatitis.<sup>27</sup> In our study, immediate and delayed skin reactions were not differentiated based on the questionnaire. Another reason for glove-related skin symptoms is a cumulative occlusive effect disturbing the skin barrier and

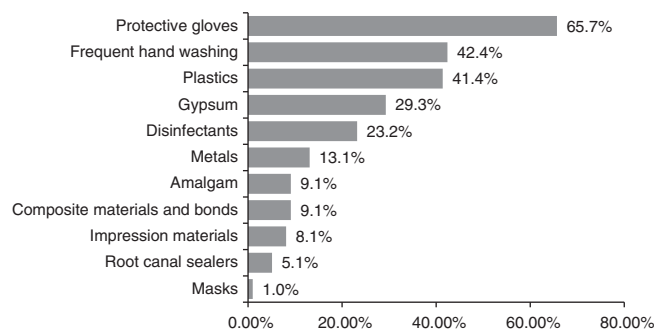


**FIGURE 2** Self-reported suspected causes for work-related skin symptoms in dental students ( $n = 99$ )

**TABLE 3** Students not wearing gloves ( $n = 47$ )

| Year of education | Number | Percentage |
|-------------------|--------|------------|
| II y              | 38     | 61.3       |
| III y             | 4      | 3.8        |
| IV y              | 0      | 0.0        |
| V y               | 4      | 3.7        |
| VI y              | 1      | 2.5        |

**TABLE 4** Association between work-related skin symptoms and potential risk factors

| Risk factor                               | Total N (%) | Skin symptoms N (%) | OR (95%CI) crude         | P-value           | OR (95%) adjusted        | P-value           |
|-------------------------------------------|-------------|---------------------|--------------------------|-------------------|--------------------------|-------------------|
| Sex                                       |             |                     |                          |                   |                          |                   |
| Male                                      | 130 (27.8)  | 16 (16.2)           | 1                        |                   | 1                        |                   |
| Female                                    | 337 (72.2)  | 83 (83.8)           | <b>2.33*</b> (1.31-4.15) | <b>0.004*</b>     | 1.75 (0.93-3.29)         | 0.081             |
| Frequency of hand washing/day             |             |                     |                          |                   |                          |                   |
| <8                                        | 122 (26.1)  | 18 (18.2)           | 1                        |                   | 1                        |                   |
| 8-16                                      | 271 (58.0)  | 55 (55.6)           | 1.47 (0.82-2.63)         | 0.19              | 1.44 (0.72-2.88)         | 0.30              |
| >16                                       | 74 (15.8)   | 26 (26.3)           | <b>3.13*</b> (1.57-6.25) | <b>0.001*</b>     | <b>2.42*</b> (1.06-5.52) | <b>0.036*</b>     |
| Wearing protective gloves (h/d)           |             |                     |                          |                   |                          |                   |
| 1-3                                       | 204 (48.6)  | 38 (42.7)           | 1                        |                   | 1                        |                   |
| 4-6                                       | 191 (45.5)  | 40 (44.9)           | 1.16 (0.71-1.90)         | 0.56              | 0.94 (0.51-1.72)         | 0.84              |
| >6                                        | 25 (6.0)    | 11 (12.4)           | <b>3.43*</b> (1.45-8.15) | <b>0.005*</b>     | 2.41 (0.83-6.97)         | 0.11              |
| Pairs of gloves/day                       |             |                     |                          |                   |                          |                   |
| 1-3                                       | 229 (54.5)  | 40 (44.9)           | 1                        |                   | 1                        |                   |
| 4-6                                       | 146 (34.8)  | 30 (33.7)           | 1.22 (0.72-2.07)         | 0.46              | 0.93 (0.49-1.75)         | 0.81              |
| >6                                        | 45 (10.7)   | 19 (21.3)           | <b>3.45*</b> (1.74-6.84) | <b>&lt;0.001*</b> | 1.76 (0.75-4.14)         | 0.20              |
| Atopic disease                            |             |                     |                          |                   |                          |                   |
| No                                        | 324 (69.4)  | 48 (48.5)           | 1                        |                   | 1                        |                   |
| AD                                        | 57 (12.2)   | 26 (26.3)           | <b>4.82*</b> (2.63-8.83) | <b>&lt;0.001*</b> | <b>3.92*</b> (1.99-7.72) | <b>&lt;0.001*</b> |
| ARC and/or A                              | 86 (18.4)   | 25 (25.3)           | <b>2.36*</b> (1.35-4.11) | <b>0.003*</b>     | <b>1.94*</b> (1.03-3.68) | <b>0.041*</b>     |
| Contact allergy (including metal allergy) |             |                     |                          |                   |                          |                   |
| No                                        | 414 (88.7)  | 78 (78.8)           | 1                        |                   | 1                        |                   |
| Yes                                       | 53 (11.3)   | 21 (21.2)           | <b>2.83*</b> (1.55-5.17) | <b>0.001*</b>     | <b>2.19*</b> (1.06-4.55) | <b>0.035*</b>     |

Abbreviations: AD, history of atopic dermatitis with or without allergic rhinoconjunctivitis and/or asthma; ARC and/or A, history of allergic rhinoconjunctivitis and/or asthma only; CI, confidence interval; OR, odds ratio. \* $P < .005$ .

causing irritant contact dermatitis. In our study a significant association was found between wearing gloves for >6 hours a day and skin symptoms. The contact with protective gloves continues 15 consecutive weeks per term according to the study program of the two medical universities. Summarized data from Tiedemann et al suggest that glove occlusion of normal skin without combination with exposure to irritants causes an impairment of skin barrier function when the occlusion is extensive (6 h daily for >10 days).<sup>28</sup>

Our study demonstrated that the appearance of skin symptoms in almost half of the students (47.5%) occurred during the second year at university; this is the first year with intensive contact with dental materials used in prosthetic dentistry, such as gypsum and plastics. Dental students perform denture laboratory work during which they come into contact with unpolymerized plastic materials, denture powder during finishing and polishing the dentures, and gypsum models that all may cause adverse skin reactions.<sup>29</sup> Twenty-nine per cent of the students associated their skin symptoms with exposure to dental gypsum. Prolonged or repeated skin contact with gypsum may cause skin irritation. In the beginning of their pre-clinical training courses most of the students do not have advanced skills and are thus obliged to repeat several laboratory procedures, which leads to prolonged and repeated contact with dental gypsum. In addition, the results of the study demonstrated that second-year students used protective gloves more rarely compared with

students from the upper-level classes (Table 3). This is a possible explanation for the similar prevalence of work-related skin symptoms as in those students wearing protective gloves. However, even when wearing gloves, protection against low-molecular acrylic monomers is challenging, as they penetrate gloves within minutes.<sup>30</sup>

Logistic regression analysis demonstrated a history of atopic disease to be a strong predictor of work-related skin symptoms among dental students, with a much stronger association with atopic dermatitis than with only respiratory atopy. It has been shown that a history of atopic dermatitis in dentists is the most important predictor of adult hand eczema, with a prevalence ratio of 2.4 compared to dentists without childhood eczema after adjustment for age and sex.<sup>13</sup> Atopic dermatitis is considered to be a risk factor for irritant contact dermatitis, which is the most frequent cause of occupational contact dermatitis.<sup>31</sup>

In our study another risk factor for work-related skin symptoms among dental students was a history of contact allergy (including metal allergy). Several studies have identified an association between a history of contact allergy and hand eczema. According to the univariate analysis of Minamoto et al, a history of metal allergy has been identified as a risk factor for the lifetime prevalence and 1-year prevalence of self-reported hand eczema among dental workers.<sup>32</sup> In a Danish population-based twin sample study, contact allergy was confirmed as a significant risk factor for hand eczema, and the risk was related to strength of contact

allergy.<sup>33</sup> A possible explanation for the association between self-reported contact allergy and skin symptoms could be that some dental students have a contact allergy to a relevant substance in the workplace such as rubber additives, methacrylic monomers, or disinfectants.

Hand washing >16/day was a significant risk factor for work-related skin symptoms among dental students. A cross-sectional study among Japanese dental workers showed that washing hands >10 times/day was an important risk factor for the 1-year prevalence of chronic hand eczema (OR 1.6, 95%CI: 1.0–2.5).<sup>32</sup> The frequency of hand washing has been identified as the strongest risk factor associated with the development of hand dermatitis among the non-atopic nursing staff.<sup>34</sup> Frequent hand washing causes damage to the skin barrier that can result in dry skin and hand eczema.<sup>35,36</sup>

Our study has some limitations. Immediate-type allergy to latex was not investigated by the questionnaire, although a significant portion (75.5%) of the students used latex gloves. In addition, no skin tests were conducted to differentiate delayed-type from immediate-type hypersensitivity in dental students with work-related skin symptoms. A large share of the students with work-related skin symptoms reported a history of contact allergy, but the lack of patch testing did not allow identification of actual sensitizers. We were not able to determine if the reactions were due to haptens from the dental medical environment or were not occupationally related. Factors causing skin reactions were only based on subjective assessments of dental students without objective evaluation regarding the link between symptoms and exposures.

## 5 | CONCLUSIONS

The results of this study suggest that work-related skin symptoms are common in dental students and that these should be particularly cautious, as skin reactions can occur on starting pre-clinical dental work. These adverse reactions may later lead to chronic occupational skin disease. A history of atopic dermatitis, allergic rhinoconjunctivitis and/or asthma, and contact allergy as well as frequent hand washing were significantly associated with such reactions. This indicates the need to establish effective primary preventive programs for occupational skin disorders in dental students at a national level.

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## CONFLICTS OF INTEREST

The authors declare no conflicts of interests.

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