Article

Occupational Allergies in Dentistry: A Cross-Sectional Study in a Group of French Dentists

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Abstract: Background: Dentists have a high risk of developing occupational allergies due to their repeated exposure to many professional allergens. The aim of this cross-sectional study was to assess occupation-related allergies in a group of French dentists and to determine the main associated risk factors. Methods: A self-administered questionnaire about allergies, particularly occupational allergies, was published online in a private group dedicated to French dentists. Results: Data from 584 French dentists were collected; 50.3% of the respondents presented allergies and 13.4% presented occupation-related allergies. Regarding professional allergens, natural rubber latex, cleaning products, and resins were the most frequently incriminated substances. Temporary interruption of activity was reported by 10.3% of individuals suffering from occupational allergies. Almost 65% of them used different reliever medications for the management of acute exacerbations, but maintenance treatment was implemented in only 34.6% of cases. Having a general allergy was the first predictor of occupational allergies with an odds ratio of 7.49. Conclusions: The frequency and the impact of occupational allergies were significant among our study population of French dentists, particularly in those with an associated allergic background. Education and prevention programs are key measures to minimize risk.

Keywords: allergy; dentistry; occupational disease

1. Introduction

According to the World Allergy Organization, allergy can be defined as an hypersensitivity reaction initiated by specific immunologic mechanisms [1] in response to an otherwise harmless environmental antigen called an allergen. Dental workers, i.e., dentists, as well as dental assistants, hygienists, and technicians, are daily exposed to a plethora of occupational allergens. They include natural rubber latex (NRL) proteins found in latex gloves and in dental dams, (meth)acrylate in resins, composites, and bonding agents, metals in restorations, prostheses, and orthodontic devices, chemical substances contained in detergents and disinfectants (e.g., quaternary ammonium compounds) and that are added during gloves manufacturing, essential oils (e.g., eugenol), and even lidocaine [2–6]. Dentistry is, therefore, associated with numerous high-risk procedures for the development of occupational allergies.

Two types of occupation-related allergic reactions are mainly encountered in dental workers [5,7]. First, type I reactions (immediate hypersensitivity), which occur rapidly within minutes or hours of the contact with the causative antigen, are predominantly driven by immunoglobulin E (IgE) antibodies. The latter bind to mast cells, inducing
their degranulation with subsequent release of histamine, leukotrienes, and other mediators \[8,9\]. They can either be localized, being responsible for allergic contact urticaria, rhino-conjunctivitis, and asthma, or more generalized and even life-threatening, leading to anaphylaxis \[1,10\]. Secondly, type IV reactions, also called delayed hypersensitivity, typically require 24 to 48 h after exposure to an antigen to develop. This cell-mediated reaction, which depends on a complex interaction of antigen-specific T cells and macrophages with dermal and epidermal cells, is the underlying pathogenesis for allergic contact dermatitis (ACD). Indeed, in contrast to type I hypersensitivity, type IV reactions are usually limited to the area in contact with the allergen \[9\]. In dental workers, occupation-related allergies mainly affect the skin (e.g., ACD, allergic contact urticaria), particularly of the fingers and the hands, as well as the respiratory tract (allergic rhinitis and asthma) and the eyes (allergic conjunctivitis) \[11\].

Occupational allergies affect a significant proportion of dental professionals. In a study assessing occupational health problems among dentists in the Moldavian region of Romania, allergies associated with professional activities were reported by 76.1% of the respondents \[12\]. However, most of the available data on occupation allergies in dentistry are about dermatoses whose prevalence varies from 15% to 46% across studies \[11\]. About 15% of Swedish dentists that participated in a questionnaire study on skin manifestations affecting the hands suffered from eczema, with an allergic etiology confirmed in 28% of the cases \[13\]. In a cross-sectional study investigating occupation-related health problems in 178 dentists in southern Thailand, 22% had an history of ACD, mostly linked to an NRL allergy \[14\]. In New Zealand \[15\] and Australia \[16\], one-third of the dentists reported symptoms of hand dermatitis during the previous year. Lastly, in a more recent Japanese study, almost half of the dental workers had a lifetime history of chronic hand eczema \[17\]. Occupation-related allergic disorders in dentistry, therefore, constitute a major public health problem.

The aim of our cross-sectional study was to assess occupation-related allergies among a group of French dentists, as well as their impact on the daily professional practice, using a self-administered questionnaire.

2. Methods
2.1. Study Design and Recruitment

Data from this cross-sectional study were collected through a self-administrated Google Forms® questionnaire (Google, Mountain View, CA, USA) with closed questions. The questionnaire was published online twice (28 November 2018 and 9 January 2019) on the social media platform Facebook (https://www.facebook.com) in a private group (i.e., with restricted admission) dedicated to French dentists called “Dentistes de France”. It was a voluntary study. Data collection was anonymous, and neither name nor personal information such as email address was collected. Participants were informed of the study’s goal, the anonymous participation, and the absence of consequences in case of nonparticipation in the study. The study was conducted in accordance with the European Regulation on data protection and complied with the Reference Methodology of the French Data Protection Agency (“Commission Nationale de l’Informatique et des Libertés” (CNIL)) for data collection, preservation, and protection. It received approval from the Institutional Review Board (IRB) of the Strasbourg Faculty of Medicine and University Hospital (reference CE-2020-179).

2.2. Questionnaire

The self-administrated questionnaire (Figure S1, Supplementary Materials) was divided into three parts with a total of 13 closed questions. The first part was related to general information (i.e., gender, age, number of years in dental practice.) In the second part, the participants were asked to provide information regarding allergies that were not necessarily associated with occupational dental activities (type of allergens, clinical manifestations, treatment). In this part of the questionnaire, most of the questions were
multi-selection questions i.e., one or more answers could be selected. If the participants answered “no” to the question “are you allergic?”, they did not need to answer the subsequent questions. Only respondents that reported allergies to at least one allergen type other than “professional allergens” were considered as presenting “general allergies”. The last part of the questionnaire was specifically dedicated to occupational pathologies. Before online publication, the questionnaire was first tested on a panel of 11 dental students. Questionnaires with missing data (i.e., with questions without answers) were not included in the analysis.

2.3. Statistical Analysis

Statistical analysis was performed using the BiostaTGV online platform (https://marne.u707.jussieu.fr/biostatgv/; accessed on 6 September 2020) developed by INSERM (“Institut National de la Santé et de la Recherche Médicale”, Paris, France). Chi-square tests were used to compare the proportions between two groups or more. Excel software (Microsoft Office) was used to classify and analyze the data collection. A p-value lower than 0.05 was considered statistically significant.

3. Results

3.1. Demographic and Work Characteristics of the Study Respondents

Among the 20,000 dentists belonging to the private group dedicated to French dentists on the social media platform Facebook (8 January 2019), 584 of them answered the questionnaire. Participating subjects were primarily females (76%; n = 444) with a male-to-female ratio of 1:3.2 (Table 1). The majority of respondents were under the age of 30 (47.9%) and had practiced for less than 10 years (64.4%). Only 12.8% of the participating dentists were older than 50, and 7.4% had practiced for more than 30 years (Table 1).

Table 1. Demographic and work characteristics of the 584 respondents.

| Gender  | n (N = 584) | % of the Total Population |
|---------|------------|--------------------------|
| Men     | 140        | 24                       |
| Women   | 444        | 76                       |
| Age (years) |          |                          |
| <30     | 280        | 47.9                     |
| 30–39   | 160        | 27.4                     |
| 40–49   | 69         | 11.8                     |
| ≥50     | 75         | 12.8                     |
| Time of Practice (years) |          |                          |
| <10     | 376        | 64.4                     |
| 10–19   | 102        | 17.5                     |
| 20–29   | 63         | 10.8                     |

3.2. Allergies

Approximately half of the participating subjects (50.3%; n = 294) suffered from allergies, with several reported allergens. The most common triggering factors were pollens (54.1% of the respondents suffering from allergies), followed by mites (35%), contact allergens such as nickel, cosmetic products, or synthetic resins (mainly acrylates [18], e.g., in artificial nails, contact lenses, adhesives) (33%), animal dander (28.2%), and food (25.5%). Professional allergens strictly speaking were incriminated by 18.7% of the respondents presenting allergies. Combined allergies to two or more allergen types were reported by 69.7% of the allergic respondents. Dermatologic (70.4%) and respiratory (63.3%) manifestations were the more prevalent clinical features, and 58.4% of the respondents with allergies reported the association of at least two types of clinical manifestations. Almost 11% of the allergic individuals had a history of at least one episode of severe allergic reaction, e.g.,
anaphylaxis or angioedema. No specific treatment has been implemented for about 45% of the allergic respondents, and 38.4% of them received treatment only during acute exacerbations to reduce allergy symptoms (i.e., relievers). A maintenance therapy (i.e., medications that are taken regularly to control or potentially treat the disease) was used by 17.7% of the allergic participants, without any additional reliever medication in 6.8% of cases. Both treatment modalities were combined by 10.9% of the allergic individuals (Table 2).

Table 2. Data regarding allergies in general.

| Allergies                      | n (N = 584) | % of Total Population |
|--------------------------------|-------------|-----------------------|
| Yes                            | 294         | 50.3                  |
| No                             | 290         | 49.7                  |

| Triggering Allergens           | n (N = 294) | % of Respondents with Allergies |
|--------------------------------|-------------|---------------------------------|
| Pollens (e.g., flowers, grasses, trees) | 159         | 54.1                            |
| Mites                          | 103         | 35                              |
| Contact allergens (e.g., nickel, cosmetic product, resins) | 97          | 33                              |
| Animal dander                  | 83          | 28.2                            |
| Food                           | 75          | 25.5                            |
| Drugs                          | 70          | 23.8                            |
| Professional allergens         | 55          | 18.7                            |
| Venom                          | 40          | 13.6                            |
| molds                          | 29          | 9.9                             |
| Allergy to 2 different allergens | 81          | 27.6                            |
| Allergy to 3 different allergens | 53          | 18                              |
| Allergy to >3 different allergens | 71          | 24.1                            |

| Clinical Manifestations        | n (N = 294) | % of Respondents with Allergies |
|--------------------------------|-------------|---------------------------------|
| Dermatologic                   | 207         | 70.4                            |
| Respiratory                    | 186         | 63.3                            |
| Ophthalmologic                 | 111         | 37.8                            |
| Digestive                      | 29          | 9.9                             |
| Severe (i.e., angioedema, anaphylaxis) | 32          | 10.9                            |
| 2 different clinical manifestations | 61          | 20.7                            |
| 3 different clinical manifestations | 85          | 28.9                            |
| >3 different clinical manifestations | 26          | 8.8                             |

| Treatment                      | n (N = 294) | % of Respondents with Allergies |
|--------------------------------|-------------|---------------------------------|
| No treatment                   | 135         | 45.9                            |
| Reliever medications only      | 113         | 38.4                            |
| Maintenance treatment only     | 20          | 6.8                             |
| Maintenance treatment and reliever medications | 32          | 10.9                            |

3.3. Occupation-Related Allergies

Occupational allergies were reported by 13.4% of the participants, as shown in Table 3. The most common triggering professional substances were NRL (66.7%) and cleaning products (detergents and/or disinfectants; 30.8%), followed by resins (21.8%), professional medications (12.8%), and metals (11.5%) (Figure 1A and Table 3). Allergy to glove powder (n = 5), to adjuvants added during glove manufacturing (n = 1), and to hydroalcoholic
solution ($n = 1$) were also reported. In 24 cases (30.8% of occupational allergies), two or more types of professional allergens were incriminated (Figure 1B and Table 3). When one considers all the triggers, the dentists suffering from both general and occupational allergies reported a higher number of incriminated allergens ($3.6 \pm 1.7$ types of allergens per individual) compared to those presenting only general allergies ($2.0 \pm 1.2$ types of allergens per individual).

Temporary work cessation was reported by 10.3% of the respondents suffering from occupational allergies, with no definitive work stoppage. Regarding the management, more than one-third of the individuals with occupational allergies required maintenance therapy (i.e., taken regularly to control the disease), which was two times higher compared to the global population of individuals with general allergies (17.4% for general allergies). Antihistamines were the most commonly used medications (23.1% of the cases), followed by homeopathy (9% of the cases). Furthermore, 7.7% of the respondents reported that they underwent allergen-specific immunotherapy. Most of the individuals (64.1%) with occupation-related allergies required treatment (relievers) during acute exacerbations (Figure 2). Oral antihistamine drugs were used in 37.2% of the cases. Other types of medications were reported and varied depending on the clinical manifestations. They included corticosteroids in several galenic forms (topical: 35.9%; oral: 11.5%; nasal: 9%; inhaled: 6.4%), inhaled bronchodilators (9%), and topical antihistamines (7.7%) for ophthalmologic manifestations (Figure 2). A combination of two or more medications was necessary in 37.2% of the cases. Improvement was observed spontaneously in 19.2% of the cases. Remoteness of the work environment without the need for any treatment was reported by 55.1% of the dentists presenting occupational allergies as sufficient to allow improvement. For most of the respondents, improvement was achieved through different ways.
Table 3. Data regarding occupational allergies.

| Occupational Allergies          | n (N = 584) | % of Total Population |
|--------------------------------|-------------|-----------------------|
| Yes                            | 78          | 13.4                  |
| No                             | 506         | 86.6                  |

| Triggering Occupational Allergens | n (N = 78) | % of Respondents with Occupational Allergies |
|----------------------------------|------------|---------------------------------------------|
| Natural rubber latex              | 52         | 66.7                                        |
| Detergents/disinfectants         | 24         | 30.8                                        |
| Resins                           | 17         | 21.8                                        |
| Professional medications (e.g., eugenol, sodium hypochlorite, sodium hydroxide) | 10 | 12.8 |
| Metals                           | 9          | 11.5                                        |
| Others (e.g., gloves powder)     | 8          | 10.3                                        |
| 2 different occupational allergens | 13        | 16.7                                        |
| 3 different occupational allergens | 7         | 9                                           |
| >3 different occupational allergens | 4         | 5.1                                         |

| Work Stoppage Requirement        | n (N = 78) | % of Respondents with Occupational Allergies |
|----------------------------------|------------|---------------------------------------------|
| Not requirement                  | 70         | 89.7                                        |
| Temporary work cessation         | 8          | 10.3                                        |
| Definitive work cessation        | 0          | 0                                           |

| Maintenance Therapy              | n (N = 78) | % of Respondents with Occupational Allergies |
|----------------------------------|------------|---------------------------------------------|
| Yes                              | 27         | 34.6                                        |
| No                               | 51         | 65.4                                        |
| Antihistamines                   | 18         | 23.1                                        |
| Desensitization (i.e., allergen immunotherapy) | 6 | 7.7 |
| Homeopathy                       | 7          | 9.0                                         |
| Corticoids                       | 1          | 1.3                                         |
| >2 treatments                    | 4          | 5.1                                         |

| Reliever Medications             | n (N = 78) | % of Respondents with Occupational Allergies |
|----------------------------------|------------|---------------------------------------------|
| Yes                              | 50         | 64.1                                        |
| No                               | 28         | 35.9                                        |
| Oral antihistamines              | 29         | 37.2                                        |
| Topical antihistamine (e.g., eye drops) | 6 | 7.7 |
| Topical corticosteroids (i.e., cream, ointment) | 28 | 35.9 |
| Oral corticosteroids             | 9          | 11.5                                        |
| Nasal corticosteroids (i.e., spray) | 7        | 9.0                                         |
| Inhaled corticosteroids (i.e., aerosol/spray) | 5 | 6.4 |
| Inhaled bronchodilators (i.e., aerosol/spray) | 7 | 9.0 |
| Combination of 2 medications     | 18         | 23.1                                        |
| Combination of 3 medications     | 8          | 10.3                                        |
| Combination of >3 medications    | 3          | 3.8                                         |

| Improvement                      | n (N = 78) | % of Respondents with Occupational Allergies |
|----------------------------------|------------|---------------------------------------------|
| Spontaneously                    | 15         | 19.2                                        |
| With maintenance therapy         | 31         | 39.7                                        |
| With reliever medications        | 31         | 39.7                                        |
| After remoteness from the work environment, no treatment required | 43 | 55.1 |
| After remoteness from the work environment and with treatment | 17 | 21.8 |
3.4. Factors Associated with the Occurrence of Occupational Allergies

Older age (≥30 years old) was associated with an increased frequency of occupation-related allergies ($p = 0.047$), but not of allergies in general ($p = 0.21$) (Table 4). No statistical effect of gender or time of practice was evidenced (Table 4). Having a general allergy (due to allergens other than “professional allergens”) was the first predictor of occupational allergies (OR: 7.49; 95% CI: 3.90–14.50; $p < 0.001$) (Table 5).
Table 4. Allergies and occupational allergies according to different descriptive factors.

| Descriptive Variables | % of the Respective Groups | OR (95%CI) | p-value | % of the Respective Groups | OR (95%CI) | p-value |
|-----------------------|---------------------------|------------|---------|---------------------------|------------|---------|
| Total population (N = 584) | 50.3 | 294 | | 13.4 | 78 | |
| Gender | | | | | | |
| Men (N = 140) | 47.9 | 67 | | 11.4 | 16 | |
| Female (N = 444) | 51.1 | 227 | 1.14 (0.80–1.67) | NS | 14 | 62 | 1.26 (0.70–2.26) | NS |
| Age (years) | | | | | | |
| <30 (N = 280) | 46.1 | 129 | | 9.3 | 26 | |
| 30–39 (N = 160) | 56.3 | 90 | 1.50 (1.02–2.23) | | 16.9 | 27 | 1.98 (1.11–3.54) | |
| 40–49 (N = 69) | 53.6 | 37 | 1.35 (0.80–2.30) | NS | 18.8 | 13 | 2.27 (1.08–4.69) | |
| ≥50 (N = 75) | 50.7 | 38 | 1.20 (0.72–2.00) | | 16 | 12 | 1.86 (0.89–3.89) | |
| Time of practice (years) | | | | | | |
| <10 (N = 376) | 48.9 | 184 | | 12.2 | 46 | |
| 10–19 (N = 102) | 57.8 | 99 | 1.43 (0.92–2.23) | | 15.7 | 16 | 1.33 (0.72–2.47) | |
| 20–29 (N = 63) | 42.9 | 27 | 0.78 (0.46–1.34) | NS | 17.5 | 11 | 1.52 (0.74–3.12) | NS |
| ≥30 (N = 43) | 55.8 | 24 | 1.31 (0.70–2.49) | | 11.6 | 5 | 0.94 (0.35–2.52) | |

Abbreviations: CI, confidence interval; NS, not significant; OR, odds ratio. NS, p > 0.05; * p ≤ 0.05.

Table 5. Correlation between general and occupational allergies.

| Occupational Allergy (n) | No Occupational Allergy (n) | OR | 95%CI | p-Value |
|-------------------------|-----------------------------|----|-------|---------|
| No general allergy (n) | 11 | 279 | 7.49 | 3.90–14.50 | *** |
| General allergy (n) | 67 | 227 | |

Abbreviations: CI, confidence interval; OR, odds ratio. *** p ≤ 0.001. Note: Only respondents that reported allergies to at least one allergen type other than "professional allergens" strictly speaking were considered as presenting "general allergies".

4. Discussion

The frequency of allergic disorders is constantly increasing [19] with a global prevalence ranging between 10% and 40% depending on the country [20]. Allergies represent the most common chronic disease in Europe and, by 2025, half of the European population may be affected [21].

In our study population, the overall prevalence was high, with 50.3% of the participants reporting allergies and 13.4% reporting occupation-related allergies; however, it is difficult to compare our results to the general population due to this study being selective (i.e., only composed of dentists). Dental workers have a high risk of developing occupa-
tional allergic diseases, particularly dermatoses, due to their daily and repeated exposure to many professional allergens. Although there are more data available on patients’ allergies to dental products, several studies have already addressed occupational allergies affecting dental workers themselves [4,6,12–17,22–31]. However, to the authors’ knowledge, this is the first one exploring such an occupational health problem in this particular population in France. Our results suggest that age may be a predictor of occupational allergy development ($p = 0.047$). Indeed, about 9% of the dentists under the age of 30 presented professional allergies, whereas this proportion was almost double in older dental workers ($\geq 16\%$ over 30 years of age). Aging is associated with functional and structural changes in different tissues/organs (e.g., impaired skin barrier function, skin dryness, airways remodeling) and with a propensity to develop chronic inflammatory reactions including allergies [32]. Sensitization can also increase with age and cumulative exposure to the different allergens. Indeed, dental workers are exposed to an increasingly large number of substances during their working life.

The most common triggering professional allergen was NRL, followed by detergents/disinfectants and resins. Interestingly, individuals suffering from both general and occupational allergies reported a higher number of causative allergens ($3.6 \pm 1.7$ types of allergens per individual), and we showed a strong association between the existence of general allergies (i.e., due to allergens other than “professional allergens” strictly speaking) and occupational allergies ($p < 0.001$). Dentists with general allergies were almost 7.5 times more likely to develop occupation-related allergies. The existence of associated allergies may, therefore, reflect a higher overall susceptibility [5]. Cross-reactions have been reported between certain fruits (e.g., kiwis, bananas) or pollens (e.g., birch tree) and NRL proteins [5]. However, one should also consider that some of the allergens responsible for what we called “general allergies”, particularly contact allergens such as acrylic resins or metals, can also be encountered in the professional environment, and it is sometimes difficult to clearly discriminate professional allergies from general allergies. This can explain why only 55 participants reported allergies to professional allergens strictly speaking for the item “allergies in general” (Table 2), whereas 78 respondents considered that they presented occupational allergies (Table 3).

Considering their burden on daily practice and on quality of life, occupational allergies require adequate management [33,34] that relies on a complete and accurate diagnosis made by a specialist, including skin and laboratory tests [35,36]. Implementation of preventive measures represents a key element. First, it relies on education, not only of dental workers, but also of dental students [33,34]. Second, reducing or avoiding exposure to allergens is of paramount importance and still represents the gold standard treatment [5]. It is even more important for individuals with an allergic background, considering their higher risk of developing occupational allergies. A good example is represented by the type I allergy to NRL proteins that affected almost 20% of the healthcare workers during the 1990s [5,37]. The subsequent changes made to the manufacturing of rubber products, in combination with the development of effective prevention strategies and alternative products, allowed a significant reduction in the prevalence of pathologies related to latex allergy [38]. In our cohort, although NRL was the main occupational allergen, the proportion of individuals reporting an NRL allergy was below 10%. Indeed, it is currently much easier to avoid contact with this substance in daily practice. Dental professionals may, however, be less aware of the allergenic potential of the myriad of other chemicals and substances that they use every day. This may be reflected by the quite high prevalence of allergies to cleaning products and resins in our study. Methacrylate monomers contained in resin used for dental prostheses, bonding agents, and composites are a common cause of occupational allergies, particularly ACD. In the late 1990s, Wrangsjö et al. observed that 22% of the patch-tested dental workers presenting ACD had positive reactions to (meth)acrylates [39]. The latter are particularly allergenic when they are handled directly, but they are also able to permeate different types of gloves (i.e., NRL, vinyl, and nitrile gloves), particularly when they are dissolved in ethanol or acetone, as in the case of bonding agents [40]. The
introduction of so-called non-touch devices and of disposable packaging has been very useful [41] in reducing occupational allergies to this substance. Rubber additives are also important type IV allergens and a common cause of occupational ACD [42]. Indeed, numerous chemicals such as antidegradants and vulcanizing accelerators are added to natural and synthetic (e.g., nitrile) rubbers during glove manufacturing [5,42]. In addition, although vinyl gloves do not contain vulcanization accelerators and antidegradants [5,43], they may contain plasticizers, stabilizers, and colorants, which can also be allergenic [5]. We did not include this allergen type in our questionnaire, but one respondent reported (in the “other” response item) being allergic to those adjuvants. Even if a diagnosis has been made, exposure to the causative allergen(s) frequently persists due to difficulties in modifying work habits, finding alternative procedures, identifying the presence of the causative allergen(s) in the products used [41], and even complying with the preventive measures [44].

In our study, most of the dentists that reported occupational allergies did not receive any maintenance treatment. They often relied on “on-demand” reliever medications used during acute exacerbation to treat allergy symptoms [41] such as topical treatments or oral antihistamines. To date, the only treatment with disease-modifying effects is allergen immunotherapy (AIT), also called allergy desensitization [45]. It consists of the repeated subcutaneous or sublingual administration [46] of low doses of the triggering allergen to patients with IgE-mediated conditions in order to promote immune tolerance and to block specific immune responses to the causative allergen [45]. It is currently recognized as an effective treatment for respiratory allergies (pollen, house dust mites, animal dander), as well as for Hymenoptera venom allergies [20,47]. AIT has, however, been only scarcely used for occupational allergic diseases and only for a few allergens including NRL [48]. The effectiveness and safety of AIT with standardized latex extracts has only been evaluated by small randomized clinical trials with conflicting results. Some authors reported a good clinical efficacy [49–52], whereas others failed to show a significant improvement of allergic symptoms [53,54] and even highlighted a high incidence of systemic reactions [54]. Six participants reported that they underwent AIT as maintenance therapy, but we did not ask in our questionnaire about the allergen extract that was administered. Indeed, all of them also presented general allergies, particularly to pollen [55,56]. Large randomized controlled trials are required before translating the use of latex AIT into clinical practice, and further investigations are needed to extend the use of AIT to other occupational allergens. Therefore, to date, primary prevention, i.e., allergen exposure avoidance, still remains the most effective method to reduce the burden of occupational allergies [52]. Although none of the participating dentists presenting occupational allergies reported permanent work cessation, temporary work interruption was needed in 10% of the cases. However, dentists with occupational allergies leading to long-term health impairment and requiring definitive work stoppage may no longer be members of the private group dedicated to French dentists on Facebook. We might, therefore, not have reached them with our questionnaire and may have even underestimated the burden of occupational allergies [33].

In addition to “true” allergies, various occupational factors and substances used by dental workers can physically, mechanically, or chemically alter the skin, the mucous membranes, or the respiratory tract, leading to sensitivities or irritations. The clinical presentation of “true” allergies and sensitivities/irritations can be similar, particularly when they affect the skin. Their pathophysiological mechanisms are, however, different [57], as irritations/sensitivities are the consequence of nonspecific inflammatory responses due to the activation of the innate immune system by the proinflammatory properties of different substances used in dentistry (e.g., chemicals) [57]. Irritant contact dermatitis (ICD) affecting the hands is particularly prevalent in dental workers, due to frequent hand washing, long wearing of gloves, and the excessive or prolonged exposure to chemicals and irritant products [57]. This overlapping of clinical features may have led to an overestimation of occupation-related allergies in our self-questionnaire-based study without confirmation.
of occupational allergies by skin or laboratory tests. For example, allergies to NRL proteins, glove powder, and chemicals that are added to gloves during manufacturing can be mistaken. Five respondents reported an allergy to cornstarch powder (in the “other” response item), which is added to the inner part of latex powdered gloves to facilitate their insertion/removal. Allergenic NRL proteins are able to bind to the powder and can subsequently be aerosolized through their handling, more easily reaching the respiratory tract [58]. The cornstarch powder itself is not allergenic, but it can exacerbate lung inflammatory responses [59] and cause skin irritations. Skin allergies due to NRL proteins and ICD due to glove powder can, therefore, be confused by the dental worker. Similarly, it is also possible that some of the reported NRL allergies could in fact be type IV allergic reactions due to chemicals that are added during glove manufacturing, and they are responsible for localized ACD [42]. Indeed, in our survey, 42.5% of the respondents reported sensitivities to one or several occupational substances, particularly to cleaning products (data not shown). Considering the similarity of their clinical expression, the distinction between ACD and ICD, and by extension between “true allergies” and irritations, can be difficult to do and requires further medical investigations [5].

Our study, based on a self-administered questionnaire, has limitations. First, the participation may have been prone to self-selection bias, and one can hypothesize that dental workers suffering from occupational allergies were more likely to participate and may, therefore, not precisely represent the entire population of French dentists. Second, our study population was young, with almost half of the respondents being less than 30 years old, likely due to the delivery mode of the questionnaire via an online popular social media platform. We also observed a majority of women (76%) among the participating subjects. Although the global population of French graduated dentists is reported to be older (mean age of 46.2 years old) and more balanced regarding gender (47.4% of females) [60], there is a general tendency toward feminization, with currently more than a half of dental students being female. In future studies, a larger sample size will be required to improve age and gender balance.

5. Conclusions

Occupational allergic diseases represent an important public health issue due to their high prevalence and their socioeconomic burden. In our study population, 13.4% of the dentists reported allergies to substances encountered in their professional environment. The development of occupation-related allergies tended to increase with age, highlighting the importance of an early implementation of preventive measures. We also observed that the existence of an allergic background was the first predictor of occupation-related allergies. Prevention and education programs are, therefore, of key importance.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/oral1020014/s1: Figure S1. Translated version of the Google Forms® questionnaire (Google, Mountain View, California, CA, USA) that was published online twice on the social media platform Facebook.

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