MEDICINE AND MATERIALS

Volume 6, Issue 2, 2026: 145-152 | ISSN: 2784 – 1499 & e-ISSN: 2784 – 1537
DOI: 10.36868/MEDMATER.2026.06.02.06 | www.medicineandmaterials.com |

PROTECTIVE MATERIALS, ENVIRONMENTAL DISINFECTION TECHNOLOGIES, AND OCCUPATIONAL BURDEN IN DENTAL PRACTICE DURING THE COVID-19 PANDEMIC

Souat TSOLAK[1], Mariana PĂCURAR[2,*], Daniela MANUC[3]

[1] Doctoral School, Romanian Academy, 010071 Bucharest, Romania
[2] Department of Orthodontics, George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Târgu Mureș, 38 Ghe. Marinescu Street, 540139 Târgu Mureș, Romania
[3] Public Health Department, Carol Davila University of Medicine and Pharmacy, 050474 Bucharest, Romania

Abstract

The COVID-19 pandemic substantially changed dental practice, increasing occupational exposure concerns and requiring rapid adoption of protective measures, and our study evaluated the use of personal protective materials and environmental disinfection technologies among dental professionals and explored associated occupational and psychological burden. A cross-sectional electronic survey was distributed to 120 dental professionals who were clinically active during the pandemic. Seventy complete responses were analyzed, and data were summarized using frequencies and percentages, while sex-based comparisons were performed with chi-square or Fisher's exact tests. Gloves and face masks were reported by all participants, while protective eyewear or face shields were used by 82.9%. Nebulization and ultraviolet disinfection were adopted less frequently, by 25.7% and 20.0%, respectively. Stress was reported by 51.4% of respondents, fear by 35.7%, anxiety by 7.1%, and physical fatigue by 5.7%. Medication or supplement use was reported by 37.1% of respondents. No significant sex-related differences were identified. Personal protective materials were widely adopted, whereas environmental technologies were implemented less consistently, and future preparedness should integrate protective equipment, environmental controls, training, and psychological support within coordinated dental emergency response frameworks.

Keywords: dental professionals, infection control, personal protective equipment, environmental disinfection, occupational stress, COVID-19.

Introduction

The COVID-19 pandemic profoundly altered dental practice by amplifying concerns related to occupational exposure, aerosol generation, and the safety of both clinicians and patients, and dental professionals were considered particularly vulnerable because routine procedures require close face-to-face contact and frequently involve saliva, blood, droplets, and aerosol-producing instruments. Early evidence showed that fear of infection was accompanied by rapid changes in clinical behavior, including increased use of personal protective equipment, patient triage, and modifications to treatment protocols [1]. At the same time, dentists reported

Corresponding author: mariana.pacurar@umfst.ro

marked psychological reactions, reflecting the combined effects of infection risk, uncertainty, and disruption of routine professional activity [2-4].

The interruption or restriction of elective dental care also produced important organizational and economic consequences, and surveys conducted during lockdown documented reduced patient flow, altered working schedules, and concerns regarding the continuity of dental services [3], and similar findings were reported among dental practitioners in Poland, where professional attitudes and infection-control behavior changed substantially in response to the outbreak [1,4]. In the United Kingdom, the pandemic was associated with considerable psychological distress and a strong perceived impact on professional and personal life [5]. Studies performed in Germany and Norway likewise identified anxiety, stress, and emotional strain among dental personnel, confirming that the psychological burden was not limited to a single healthcare system or geographic region [6,7].

These concerns were closely linked to the biological characteristics of dental care, and a systematic review demonstrated that numerous dental procedures can generate droplets and aerosols, although their quantity and clinical relevance vary according to the instrument and procedure used [8-10]. Consequently, pandemic-era recommendations emphasized layered prevention, including patient screening, personal protective barriers, surface disinfection, ventilation, and reorganization of the dental office [9], and experimental evidence further indicated that natural ventilation and saliva ejectors may reduce aerosol concentrations during clinical procedures, supporting the integration of source-control and environmental measures [10]. Masks and respirators, therefore, became central components of occupational protection, although their filtration characteristics and indications vary by design and clinical context [11].

Beyond immediate infection-control requirements, the pandemic reshaped dentists' perceptions of professional risk, a multicountry survey conducted in Latin America documented substantial changes in clinical practice and widespread concern among dental professionals [6,12]. In the United States, dental care providers also reported broad effects on workflow, preparedness, and delivery of care, while demonstrating an ability to adapt to rapidly changing recommendations [13], and anxiety remained an important outcome in later assessments, suggesting that psychological consequences persisted beyond the initial phase of the crisis [3,14,15]. More recent evidence indicates that several infection-control practices introduced during the pandemic continued to influence dental activity, although their implementation was not uniform across practices [15].

Against this background, we conducted the present study to examine current protective measures, environmental disinfection technologies, and their psychological impact on dental professionals during the COVID-19 pandemic, and in our study, we also evaluated self-reported occupational and psychological burden and explored whether these outcomes differed according to sex, and by analyzing both technical protection and human burden, we aimed to inform future protocol improvements and enhance pandemic preparedness in dental practice.

Materials and Methods

Study design and participants

We conducted this cross-sectional, questionnaire-based our study among practicing dentists and dental practitioners actively involved in clinical work during the COVID-19 pandemic, and the survey targeted professionals who experienced pandemic-related changes in clinical workflow, occupational exposure, infection control requirements, and professional stress, with the aim of gathering insights into infection control and occupational health strategies, and the questionnaire was distributed electronically to 120 eligible professionals through professional communication channels and social media, and seventy complete responses were retained for analysis, corresponding to a response rate of 58.3%, and we included only those who were professionally active during the pandemic who submitted a

complete questionnaire. The participation of doctors in our study was voluntary, and we processed the data collected anonymously.

Questionnaire and variables

Data from collaborating physicians were collected using a de novo electronic questionnaire developed specifically for our study, and the instrument comprised 10 closed-ended questions addressing the professional, behavioral, and psychological effects of the COVID-19 pandemic on dental practice, and for the present analysis, the variables were organized into three main domains.

The first domain included professional characteristics, namely sex and years of clinical experience, and professional experience was classified into three categories: 1–5 years, 5–10 years, and more than 10 years, and in the second direction, we coordinated the use of protective materials and environmental infection control technologies, personal protective measures included gloves, face masks, and goggles or face shields, and additional environmental measures included nebulization and ultraviolet-based disinfection.

The third domain assessed occupational and psychological burden, participants indicated whether they had experienced stress, fear, anxiety, or physical fatigue during the pandemic, and the use of medication or dietary supplements was also recorded, including sleep medication, anti-stress medication, muscle relaxants, and vitamin or mineral supplements.

We exported the answers from the electronic survey platform to a database with spreadsheets, and we checked the dataset for completeness, duplicate entries, and inconsistent responses before statistical analysis, we coded the categorical variables numerically, while we kept the original answer categories for interpretation.

Statistical analysis

Statistical analysis was performed using GraphPad Prism, version 10.2.3 (GraphPad Software, Boston, MA, USA). Categorical variables were summarized as absolute frequencies and percentages.

Comparisons between female and male respondents were performed using the chi-square test, with Fisher's exact test applied for small sample sizes or when assumptions were not met, and this rigorous statistical approach ensures the reliability of our findings, which are primarily descriptive and hypothesis-generating due to the modest sample size and cross-sectional design.

All tests were two-sided, and a p-value below 0.05 was considered statistically significant, and because of the modest sample size, the limited number of observations in several response categories, and the cross-sectional nature of our study, subgroup comparisons were considered exploratory, and accordingly, the findings were interpreted primarily as descriptive and hypothesis-generating rather than confirmatory.

Results

Characteristics of the participants

Of all the dentists invited by us to participate, 70 sent complete questionnaires and were included in the analysis, resulting in a response rate of 58.3%, and the final sample we conducted included 43 women (61.4%) and 27 men (38.6%).

Clinical experience varied within the population we studied. 31 participants (44.3%) practiced dentistry for 1–5 years, representing the largest professional subgroup. Another 22 respondents (31.4%) reported 5-10 years of clinical experience, while 17 of the participants (24.3%) worked in dentistry for more than 10 years. Although professionals were represented at different stages of their careers, about three-quarters of respondents had no more than 10 years of clinical experience. The demographic and occupational characteristics of the population studied are summarized in Table 1.

Table 1. Demographic and professional characteristics of our study participants.

Characteristic	Category	n	%
Sex	Female	43	61.4
	Male	27	38.6
Professional experience	1–5 years	31	44.3
	5–10 years	22	31.4
	>10 years	17	24.3

Uptake of protective materials and environmental technologies

We found that the use of personal protective materials was consistently high among the dental professionals surveyed. Gloves and face masks were used by everyone, with identical application rates in women and men. Goggles or visors were reported by 58 participants (82.9%), including 37 out of 43 women (86.0%), and 21 out of 27 men (77.8%).

Environmental infection control technologies have been adopted less frequently. Nebulization was reported by 18 collaborators (25.7%), and ultraviolet disinfection was used by 14 participants (20.0%). The corresponding proportions were 23.3% and 18.6% among women and 29.6% and 22.2% among men, respectively.

We did not identify statistically significant differences in sex for the use of protective glasses or face protection, nebulization or ultraviolet-based disinfection. Comparative analyses were not applicable for gloves and face masks, as both measures were reported by all respondents. The full distribution of protection measures on the basis of sex is presented in Table 2.

Table 2. Adoption of personal protective materials and environmental infection-control technologies according to sex**.**

Protective measure	Total n/N (%)	Female n/N (%)	Male n/N (%)	p-value
Gloves	70/70 (100.0)	43/43 (100.0)	27/27 (100.0)	—
Face masks	70/70 (100.0)	43/43 (100.0)	27/27 (100.0)	—
Protective eyewear/face shield	58/70 (82.9)	37/43 (86.0)	21/27 (77.8)	0.381
Nebulization	18/70 (25.7)	10/43 (23.3)	8/27 (29.6)	0.555
UV-based disinfection	14/70 (20.0)	8/43 (18.6)	6/27 (22.2)	0.754

Occupational burden and exploratory associations

Psychological burden was common among the surveyed dental professionals during the COVID-19 pandemic. Stress was the most frequently reported response, affecting 36 participants (51.4%), followed by fear, reported by 25 respondents (35.7%). Anxiety and physical fatigue were reported less frequently, accounting for 7.1% and 5.7% of cases, respectively. And 26 participants (37.1%) reported using medications or supplements during the pandemic. Exploratory comparisons did not show significant differences between women and men for the assessed indicators. The distribution of occupational burden indicators and medication/supplement use is illustrated in Figure 1.

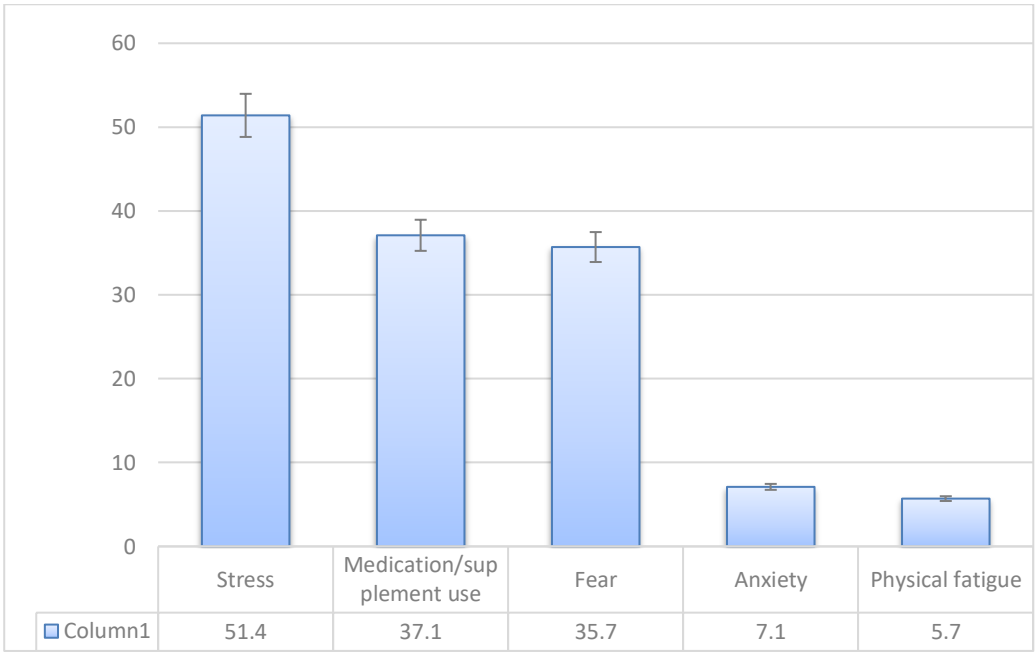

Figure 1. Distribution of occupational burden indicators and medication/supplement use among dental professionals during the COVID-19 pandemic, and bars represent the percentage of respondents reporting stress, fear, anxiety, physical fatigue, and medication/supplement use.

Discussion

In the present study, we examined the adoption of personal protective materials and environmental disinfection technologies among dental professionals during the COVID-19 pandemic, as well as the occupational and psychological burdens reported by participants. Our principal finding was the marked difference between the widespread use of personal protective barriers and the more limited implementation of environmental control technologies, and gloves and face masks were used by all respondents, while protective eyewear or face shields were adopted by more than four-fifths of the sample, and by contrast, nebulization and ultraviolet-based disinfection were reported by only approximately one-quarter and one-fifth of participants, respectively.

The universal use of gloves and masks observed in our study is consistent with the rapid modification of infection-control behavior described among dentists during the early stages of the pandemic [1,3,4]. The extensive use of protective eyewear is also clinically warranted because dental procedures are performed near the patient's oral cavity and may generate droplets and aerosols that can contaminate exposed facial surfaces [8]. Therefore, masks, respirators, eye protection, and gloves represented the most accessible components of a layered prevention strategy [9,11], nevertheless, our questionnaire did not differentiate between surgical masks and filtering respirators or between goggles and face shields, and consequently, the reported prevalence reflects the adoption of broad protective categories rather than the level of protection provided by specific products.

The lower use of nebulization and ultraviolet disinfection suggests that environmental technologies were not incorporated as consistently as personal protective equipment, and this difference may reflect variations in cost, infrastructure, technical knowledge, or confidence in the effectiveness of these methods, and existing evidence indicates that environmental control should not rely on a single intervention, ventilation, high-volume evacuation, saliva ejectors,

source control, and appropriate organization of the clinical space may jointly reduce aerosol dispersion [9,10]. More recent studies have also emphasized engineering and bioengineering approaches to control aerosols and improve infection prevention in dental units [16,17]. However, because our study assessed self-reported use rather than technical performance, we cannot determine whether the selected measures reduced occupational exposure or infection rates.

An important finding of our article was that extensive protective behavior coexisted with a substantial psychological burden, and stress affected 51.4% of respondents, while fear was reported by 35.7%, and these observations are broadly aligned with studies from Italy, the United Kingdom, Germany, Norway, Poland, and Latin America, which documented anxiety, fear, emotional distress, and professional uncertainty among dental personnel [2,5–7,12,14], the psychological impact of the pandemic was likely influenced not only by the perceived risk of infection but also by disrupted clinical activity, changing recommendations, financial uncertainty, and concern about transmitting infection to family members or patients [3,5,13], and in our sample, medication or supplement use was reported by 37.1% of participants, although the questionnaire did not establish whether these products were initiated specifically because of pandemic-related symptoms.

We did not identify statistically significant sex-related differences in protective behavior or occupational burden. These comparisons should not be interpreted as evidence of equivalence between women and men. The limited sample size and the small number of observations in several response categories reduced the statistical power of the subgroup analyses. For this reason, we regarded them as exploratory.

Our study has several additional limitations, the cross-sectional design prevents causal interpretation, and the use of a de novo, self-administered questionnaire introduces the possibility of recall and reporting bias, participants were recruited through electronic professional channels, which may have produced selection bias and limited generalizability, and we also lacked detailed information regarding mask type, frequency of equipment use, technical specifications of ultraviolet devices, nebulization protocols, ventilation, or the characteristics of the clinical setting, and despite these limitations, our article provides an integrated description of technical protection and occupational burden in dental practice. The findings support preparedness models that combine accessible protective materials, evidence-based environmental controls, clear clinical protocols, and structured psychological support rather than treating these components as separate responses to infectious-disease emergencies [15–17].

Conclusions

This study demonstrates that dental professionals adopted personal protective materials more consistently than environmental disinfection technologies during the COVID-19 pandemic, as gloves and face masks were universally used and protective eyewear was widely reported, whereas nebulization and ultraviolet disinfection remained less common; despite these preventive measures, stress, fear, and medication or supplement use were still frequent, suggesting that future preparedness in dental practice should combine accessible protective equipment, effective environmental controls, clear clinical protocols, staff training, and structured psychological support to safeguard both clinical safety and professional resilience during emergencies.

References

1. Ahmed MA, Jouhar R, Ahmed N, Adnan S, Aftab M, Zafar MS, Khurshid Z: *Fear and Practice Modifications among Dentists to Combat Novel Coronavirus Disease (COVID-19)*

Outbreak. **Int J Environ Res Public Health.** 2020. 17,8,2821. doi: 10.3390/ijerph17082821

2. Consolo U, Bellini P, Bencivenni D, Iani C, Checchi V: *Epidemiological Aspects and Psychological Reactions to COVID-19 of Dental Practitioners in the Northern Italy Districts of Modena and Reggio Emilia.* **International Journal of Environmental Research and Public Health.** 2020. 17,10,3459. doi: https://doi.org/10.3390/ijerph17103459
3. Sinjari B, Rexhepi I, Santilli M, D Addazio G, Chiacchiaretta P, Di Carlo P, Caputi S: *The Impact of COVID-19 Related Lockdown on Dental Practice in Central Italy-Outcomes of A Survey.* **Int J Environ Res Public Health.** 2020. 17,16,5780. doi: 10.3390/ijerph17165780.
4. Tysiąc-Miśta M, Dziedzic A: *The Attitudes and Professional Approaches of Dental Practitioners during the COVID-19 Outbreak in Poland: A Cross-Sectional Survey.* **Int J Environ Res Public Health.** 2020. 17,13,4703. doi: 10.3390/ijerph17134703.
5. Collin V, O´Selmo E, Whitehead P: *Psychological distress and the perceived impact of the COVID-19 pandemic on UK dentists during a national lockdown.* **Br Dent J.** 2021. doi: https://doi.org/10.1038/s41415-020-2592-5
6. Mekhemar M, Attia S, Dörfer C, Conrad J: *The Psychological Impact of the COVID-19 Pandemic on Dentists in Germany.* **J Clin Med.** 2021. 10,5,1008. doi: 10.3390/jcm10051008
7. Uhlen MM, Ansteinsson VE, Stangvaltaite-Mouhat L, Korzeniewska L, Skudutyte-Rysstad R, Shabestari M, Mdala I, Hovden EAS: *Psychological impact of the COVID-19 pandemic on dental health personnel in Norway.* **BMC Health Serv Res.** 2021. 21,1,420. doi: 10.1186/s12913-021-06443-y.
8. Innes N, Johnson IG, Al-Yaseen W, Harris R, Jones R, Kc S, McGregor S, Robertson M, Wade WG, Gallagher JE: *A systematic review of droplet and aerosol generation in dentistry.* **J Dent.** 2021. 105,103556. doi: 10.1016/j.jdent.2020.103556.
9. Melo P, Manarte-Monteiro P, Veiga N, de Almeida AB, Mesquita P: *COVID-19 Management in Clinical Dental Care Part III: Patients and the Dental Office.* **Int Dent J.** 2021. 71,3,271-277. doi: 10.1016/j.identj.2020.12.028
10. Rexhepi I, Mangifesta R, Santilli M, Guri S, Di Carlo P, D'Addazio G, Caputi S, Sinjari B: *Effects of Natural Ventilation and Saliva Standard Ejectors during the COVID-19 Pandemic: A Quantitative Analysis of Aerosol Produced during Dental Procedures.* **Int J Environ Res Public Health.** 2021. 18,14,7472. doi: 10.3390/ijerph18147472.
11. Ramírez A, Ochoa D, Llanque G, Trelles B, Watanabe R, Alvitez-Temoche D, Mayta-Tovalino F: *Historical Evolution and Filtering Characteristics of Masks and Respirators in Dentistry in the Context of COVID-19: A Literature Review.* **J Int Soc Prev Community Dent.** 2021. 11,3,248-255. doi: 10.4103/jispcd.JISPCD_22_21.
12. Moraes RR, Cuevas-Suárez CE, Escalante-Otárola WG, Fernández MR, Dávila-Sánchez A, Grau-Grullon P, Fernández E, López TM, Grazioli G, Arana LA, Rondón LF, Torrez WB, Lima GS, Schuch HS, Correa MB, Demarco FF: *A multi-country survey on the impact of COVID-19 on dental practice and dentists' feelings in Latin America.* **BMC Health Serv Res.** 2022. 22,1,393. doi: 10.1186/s12913-022-07792-y.
13. Bsoul EA, Challa SN, Loomer PM: *Multifaceted impact of COVID-19 on dental practice: American dental care professionals prepared and ready during unprecedented challenges.* **J Am Dent Assoc.** 2022. 153,2,132-143. doi: 10.1016/j.adaj.2021.07.023.
14. Rusyan E, Mielczarek A, Bogusławska-Kapała A, Adamczyk K, Piec R, Szykuła-Piec B: *Level of Anxiety Caused by the Coronavirus (COVID-19) Pandemic among Dentists in Poland.* **Medicina (Kaunas).** 2022. 58,3,415. doi: 10.3390/medicina58030415.

15. Caggiano M, Acerra A, Martina S, Galdi M, D'Ambrosio F: *Infection Control in Dental Practice during the COVID-19 Pandemic: What Is Changed?* **Int J Environ Res Public Health.** 2023. 20,5,3903. doi: 10.3390/ijerph20053903.
16. Yu Y, Wu X, Sun Y: *Precise control of digital dental unit to reduce aerosol and splatter production: new challenges for future epidemics.* **BMC Oral Health.** 2024. 24,1,213. doi: 10.1186/s12903-024-03980-w.
17. AlSaiari AKA, Alonazi MS, Alotaibi NM, AlQahtani H, Alotaibi WM, Yhyha ASSA, Aldarorah A, Alaklabi NM, Al-Obayli TAS, Alsaud OAS, Alosaimi LA, Beshi MGA: *Bioengineering Innovations in Global Dental Infection Control: Applications and Adaptations in Clinical Settings.* **Int Dent J.** 2025. 75,3,2222-2238. doi: 10.1016/j.identj.2024.12.011.

Received: March 11, 2026
Accepted: May 26, 2026