

Well-being of dental professionals and workplace challenges

Edited by

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Well-being of dental professionals and workplace challenges

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Editorial: Well-being of dental professionals and workplace challenges

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KEYWORDS

harassment and bullying, workplace, stress, anxiety, dental

Editorial on the Research Topic

Well-being of dental professionals and workplace challenges

The well-being of dental professionals and their teams is not only a matter of personal health but also a cornerstone of the sustainability of the entire profession. Dentistry, like other healthcare disciplines, exposes its workforce to a spectrum of stressors ranging from clinical pressures and job insecurity to systemic inequities and the threat of harassment or violence (1). Such factors, if unaddressed, may lead to burnout, professional disillusionment, and compromised patient care (2, 3). This research topic, focused on “Well-Being of Dental Professionals and Workplace Challenges,” brings together nine studies (Riad et al.; Zhu et al.; Fux-Noy et al.; Queirolo et al.; Queirolo et al.; Javed et al.; Queirolo et al.; Al-Almer et al.; Foláyan et al.) that explore such issues.

A core message of this editorial is the need to transition from merely identifying stressors to offering structured recommendations for action. Dental schools, institutions, and policy makers must implement protective protocols that prioritize occupational safety, including reliable reporting systems for harassment and aggression. Equally critical are structured mental health support schemes, ranging from counseling access to simple stress-management interventions like hypnosis-based techniques that have shown promise for reducing physiological stress responses. Organizational mechanisms must be introduced to combat inequities such as gender discrimination, while academic bodies should create transparent frameworks to prevent editorial bullying and abuse of power. Without such practical measures, editorials risk becoming only descriptive rather than prescriptive, failing to provide the leadership expected of them. Furthermore, it is essential to identify research gaps, for instance, longitudinal studies on the long-term psychological outcomes of workplace aggression, global data on editorial misconduct, and evidence-based models for preventive institutional policies are still scarce and demand urgent attention in the coming years. Equally important is the choice of references that substantiate the argument with depth and relevance. Some cited studies, such as those addressing mask-wearing behaviors among patients, reflect more on societal compliance than on the lived reality of dental professionals (Zhu et al.). For instance, Braquehais et al. (4) provide a nuanced account of acute stress, anxiety, and depression among healthcare workers in Spain during the first COVID-19 wave, emphasizing urgent support needs. The study by Gasparro et al. (5) focused on dentists from Italy, linking fear of infection with job insecurity and depression, underscoring the profession's vulnerability. Likewise,

Sarapultseva et al. (6) shed light on psychological distress and post-traumatic stress in Russian dental staff, revealing the enduring mental health risks within the profession.

Another aspect that contributes to the novelty of this editorial lies in its emphasis on overlooked and emerging challenges, particularly those tied to the digital era. The study by Javed et al. highlighted the concept of “editorial bullying” focuses on a previously underrecognized occupational hazard that threatens academic integrity, undermines professional well-being, and exacerbates burnout. By framing scholarly publishing as part of the broader “workplace,” this perspective expands the discourse on professional hazards beyond the operatory or institution to the digital realm. Moreover, by connecting structural inequities, harassment, and digital exploitation, this editorial proposes a comprehensive framework for understanding occupational stress in dentistry. Explicitly stating this contribution, our effort to reconceptualize dental well-being in both physical and digital domains ensure clarity for readers and sets a standard for future discourse.

In conclusion, safeguarding the well-being of dental professionals requires decisive, multi-level interventions. Institutions and policy makers must move beyond rhetoric and implement enforceable protective policies against workplace violence and harassment. Dental schools should embed structured support systems for students and faculty, cultivating resilience early in training. Professional organizations must invest in transparent editorial processes and global monitoring systems to combat bullying and abuse in academic publishing. At the same time, researchers should prioritize filling critical evidence gaps, especially longitudinal and cross-cultural investigations of stress trajectories and recovery patterns. Ultimately, protecting the well-being of dental professionals is both an ethical imperative and a prerequisite for sustaining a resilient and effective oral healthcare workforce. By taking a critical stance, using stronger evidence, and proposing novel frameworks, this editorial aspires not only to summarize existing knowledge but to lead the profession toward solutions.

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The impact of a pandemic on dental professionals' work and personal lives: A qualitative study with implications for primary healthcare workers

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During a pandemic, dentists face enormous challenges due to restrictions placed on their practice and the need to comply with biosafety measures. This study aimed to explore the impact of the COVID-19 pandemic and infection control measures on dentists and their practice in Jordan and the global implications for other primary healthcare workers. A qualitative exploratory study employing face-to-face or telephone interviews, was conducted with ten dentists from the 9th May to 20th September 2020. An inductive thematic approach to analysis was used identifying three themes, each with two accompanying subthemes: (1) Response to COVID-19 pandemic: (1a) Government response and (1b) People's response; (2) The effects of the pandemic and response measures: (2a) Impact on work and practice and (2b) Impact on personal and social life; (3) The unanticipated gains: (3a) Altruism and (3b) Leadership and change. Stringent infection control measures were implemented to slow the spread of the virus, however limited government support made implementation unsustainable and caused financial hardship. Lack of clear guidelines, changes in practice, social distancing measures, and altered social interactions, adversely impacted daily life, triggering mental distress. Misinformation influenced response to COVID safety measures. Despite the negatives, working during the pandemic reaffirmed dental professionals' roles and purpose, with strong leadership boosting morale. Education, adequate biosafety resources and clear guidelines or policies to support and sustain stringent infection control procedures are crucial in ensuring that measures are implemented to meet the safety requirements of the pandemic response. Promoting the well-being of

the healthcare workforce is equally important. Finally, altruism and strong leadership among healthcare workers can contribute to a meaningful and humane pandemic response.

KEYWORDS

biosafety, dentists, epidemic, corona virus, SARS-CoV-2, COVID-19, primary health care, healthcare personnel

Introduction

Since the first case of novel coronavirus infection (COVID-19) in December 2019, the causative virus has rapidly spread, wreaking havoc worldwide straining public health resources (1). With an incubation period of 1 to 14 days, the virus, SARS-CoV-2, mainly affects the upper respiratory tract and is transmitted through saliva, droplets or aerosols at close personal contact, and through fomites (2). Of concern is that mutations that the virus undergo over time make the pandemic harder to track and control (3). This is exemplified by the emergence of new variants, the *Delta* variant and lately, the *Omicron* variant which has higher transmissibility, resistance to COVID-19 vaccine and higher immune escape potential, reducing population immunity (4). Consequently, the COVID 19 epidemic continues to be a public health concern almost 2 years since its first appearance.

Undoubtedly, healthcare workers are at a higher risk of contracting SARS-CoV-2 than the average population due to their proximity to individuals infected with the disease (5). Therefore, WHO has initiated a wide range of additional preventive measures, including the use of personal protective equipment (PPE), to protect them from contracting the disease (6). However, some healthcare workers have been identified as being at a higher risk than their counterparts, particularly those who work at the frontline of healthcare like nurses and doctors, and those who work with aerosol-generating procedures, such as dentists. Dentists work at very close proximity to patient's oral cavity where the viral load is highest and are also exposed to droplets, saliva and blood during dental care treatment. In addition, their work involves aerosol-generating procedures as part of daily professional practice. Considering that SARS-CoV-2 particles are able to survive in a small droplet in the air which could last for several hours, dentists are at a higher risk of being infected with SARS-CoV-2 and transmitting the infection across patients in the dental setting (7). Hence, they have been required to take more stringent measures to ensure protection and prevention of cross-infection by using filtering face-piece respirator masks in addition to other protective gears (6). These measures had a profound impact on their clinical practice.

The few studies undertaken in this area have highlighted the enormous challenge dentists and other healthcare professionals are facing due to restrictions in scheduling elective cases,

treating only emergencies, booking fewer appointments, and having less revenue (7–9). For example, medical personnel are required to be fully equipped with PPEs, which are expensive and uncomfortable, leading to an increase in expenditures that will, undeniably, affect patients, and increase the treatment cost burden on healthcare systems (10). Notwithstanding scholarly reports stating that the potential risk of transmission to family members, relatives, and other patients has led to a wide range of psychological reactions among many healthcare workers including fear, stress, anxiety, burnout and depression (11).

In Jordan, case zero of SARS-CoV-2 was confirmed on the 2nd of March 2020. Since then, there have been 806,501 infections and 10,542 coronavirus-related deaths reported in the country (12). The government implemented drastic measures early to contain the virus, such as complete lockdown including closure of clinical practices, activation of emergency laws, and shifting of the whole education system online. Dentists received strict measures that are in line with the international recommendations, such as restriction of dental treatment only to emergency cases and use of PPEs. The infectivity and pervasiveness of the infection, coupled with these draconian pandemic control measures impacted on the mental health of many healthcare professionals in Jordan causing high levels of fear, stress, anxiety and depression (13). However, few studies have explored their perceptions being in the frontline of the pandemic health response. To address this gap, this study was undertaken to explore the challenges faced by primary healthcare workers in the face of the COVID-19 pandemic and the impact on their professional as well as their personal lives in Jordan. As frontline healthcare workers such as nurses and doctors were under immense pressure, this study approached dental healthcare professionals for interview who had also been severely affected by the restrictions and whose practices had been closed or limited during the pandemic. Highlighting the impact of the pandemic on healthcare professionals through the lens of dentists will provide valuable insights to inform policies and practices governing the healthcare workforce in the primary healthcare sector. There is a need to explore how dental professionals view the pandemic and the government's response, how they comply with biosafety measures and the impact of restrictions on their practice and personal life, as well as their preparedness to transition to the "new normal" post-COVID.

Methods

Design

A qualitative exploratory approach (14) using semi-structured interviews was adopted for this study. Qualitative studies that utilize an inductive approach do not lend themselves to a priori theorizing or expanding upon the existing body of knowledge (15). To illustrate, the paucity of empirical research regarding the impact of COVID-19 on dental practices necessitated an exploration of the issue through a qualitative approach. Reporting of this paper followed the 32-item checklist of the consolidated criteria for reporting qualitative research (COREQ) (16).

Setting

This study targeted dental healthcare professionals working in the private, military and government sectors. All interviews were conducted between May 9, 2020 and September 20, 2020. During this period, the number of COVID-19 positive cases increased from 672 (9 deaths) to 4779 (30 deaths). Many primary healthcare professionals including community nurses and physicians were seconded to support the frontline workers in response to the pandemic. Dental practices were closed or had limited operation which provided the researchers an opportunity to invite dental professionals to an interview for this study.

Sampling and recruitment method

Using a snowball sampling technique, Jordanian dentists practicing in the capital city of Amman were invited. Following approval from the University ethics committee, information about the study was posted on the University's websites and social media platforms to recruit eligible participants for the study. Inclusion criteria were practicing dentists who: (a) completed a bachelor's degree in dentistry; (b) were registered with the Jordanian Dentists Association (JDA); (c) were working in a clinical setting in Jordan; and (d) consented to be interviewed for the study. Dental students and dental assistants and those not working in the clinics during the pandemic were excluded from the study. Those who indicated an interest were then requested to provide written consent and their contact details.

Ethical considerations

Ethics approval was granted by the Isra University Human Research Ethics Committee (JS/BA/94), Jordan.

During the interview process, in addition to obtaining written consent, participants were also informed verbally that their participation was voluntary, and they could stop the interview or withdraw from the study at any time without penalty. Permission was sought to audio-record, and all participants approved the recording of the interview.

Data collection

The interview was conducted face-to-face or by telephone, depending on participant preference. Face-to-face interviews, lasting approximately 30 to 45 min, were conducted while adhering to the recommended infection control precautions (social distancing, handwashing and sanitizing, and wearing a mask when social distancing was not possible). Two native Arabic-speaking researchers (RA, & OA), who were also proficient in the English language conducted all the interviews. The first researcher has nursing and doctoral qualifications, while the second is a dental specialist, both are current practicing health professionals in their field and experienced in conducting interviews for research studies. Having a culturally and linguistically congruent female and male interviewers in the research team enhanced the interview and data collection process. Using the semi-structured interview guide developed by the team, data collection was initially piloted with two participants. Modifications were then made to the interview guide, following discussion with a dental practitioner on the team, as both participants discussed a number of technical issues related to dental practice (Table 1—Interview Guide). During the data collection period, both researchers kept field notes reflecting on the interview process and the challenges encountered and scheduled ongoing meetings to discuss if modification of the interview process was needed.

No third party was present during the interview between the researcher and participant. The interview usually began by asking each participant to recount their experiences of the restricted movement order issued by the Jordanian governmental authority at the beginning of 2020, and how this order affected their dental practice. During the interview, participants were encouraged to share their feelings and thoughts about the impact of COVID-19 on them personally. Theoretical data saturation was deemed to have been reached after 10 interviews as no new information was identified.

Every participant was sent their interview transcript for member-checking and were asked to provide a pseudonym to replace their name. During this process, two participants requested that some details be removed, which were confidential.

TABLE 1 Interview guide.

1. In relation to Jordan, what do you think of the country's response to the pandemic?
 2. What do you think of the current movement restrictions?
 3. How do you feel about the restrictions on dentists and on your service?
 4. What has been the impact of this restriction on your dental practice, professional and personal life? Give examples.
 5. During this restricted movement period:
 - a. How did this affect your work practices and workload?
 - b. What were the challenges and how did you overcome these challenges?
 6. Are you receiving support from the health service or from your professional association? If so, please elaborate
- Transitioning back to the "new normal" dental practice*
7. If the restrictions are lifted in the next month and a vaccine is still not available, what do you think is required to practice safely? Discuss personal safety for yourself and for your staff.
 8. What alternate ways do you have to mitigate any emerging risks if there is a shortage of available equipment?
 9. Based on your current experiences, how can you influence policy development for dental practice in Jordan, to be better prepared for a pandemic response in the future?

Translation

As all interviews were conducted in the Arabic language, audio-transcripts were transcribed and translated to the target language, English. During the translation process specific attention was given to maintaining textual and content equivalence, as well as semantic equivalence in the English language (17). All transcript translations were performed by two research team members (RA and OA), who are proficient in both Arabic and the English language and experienced in undertaking interview transcription and translation. To maintain contextual and cultural integrity as recommended (18), the translated transcripts were then reviewed by two English-speaking researchers (YS and DM) for data cleaning and readability, with the first author (RA).

Data analysis

Following transcription of audio-recordings and translation, textual data were analyzed thematically, using the inductive approach as outlined by Braun and Clark (19). To preserve anonymity of participants, pseudonyms were assigned by a researcher (RA). Four researchers independently read all transcripts to familiarize themselves with the data. Data analysis was primarily performed by three researchers independently. This was conducted using an exploratory approach to summarize the data into different themes to

provide a representative description of participants' perceptions and experiences. Each researcher familiarized themselves with the data, generated initial codes, developed and reviewed themes and sub-themes before regrouping to compare and discuss their analysis to reach consensus in the classification and naming of themes and subthemes. Researchers used Microsoft Excel Windows 10 for textual data management and documented the audit trail of their data analysis.

Results

Ten dentists practicing in Jordan, registered with the Jordanian Dental Association consented to participate in this study. Dentists working in the private, public and military sectors were represented. Practice sizes varied from small practices of 11 to 20 patients to large practices serving more than 40 patients. Table 2 shows the demographic characteristics of study participants.

Three themes and accompanying sub-themes were generated from the data which related to dentists' perceptions and response to COVID-19, the impact on work practices and personal life and the unexpected benefits.

Theme 1: Response to COVID-19 pandemic—"Just right or an overkill of power?"

Participants had mixed feelings about how the government managed and responded to the COVID-19 pandemic. Initially, most of the participants felt that the early response to contain the spread of the virus was swift and appropriate. As time passed, some felt ambivalent expressing that it might have been an overreaction rather than well-considered however they justified the actions: "*It was an overkill of power a bit but maybe if we hadn't started like this we would've ended up like other countries in a big mess*" (Leen). Some participants were also perplexed by the restrictions and measures imposed on their practices, which surfaced in narratives as a lack of trust in the dental health authorities' management of the crisis. People within the community were also confused by the changes imposed on their daily life, citing COVID-19 as a worldwide conspiracy.

Subtheme 1:1 government response to the COVID-19 pandemic—"It was an overkill of power a bit"

Some participants believed the measures and the strict lockdown processes were timely and warranted. They felt that the initial response was crucial to containing the spread of the virus and reducing the number of cases in Jordan as illustrated by the following quote:

TABLE 2 Demographic characteristics of participants.

Demographic characteristics	N = 10
Age (years), mean (range)	35.8 (28–56)
Gender	
○ Male	6
○ Female	4
Marital status	
○ Single	4
○ Married	6
Years of practice, mean (range)	11.7 (3–30)
Holds position in the Jordanian Dental Association or Medical Syndicate	3
Specialization	
○ General dentistry	2
○ Periodontist	2
○ Orthodontist	2
○ Prosthodontist	1
○ Endodontist	2
○ Maxillofacial	1
Type of practice	
○ Private	2
○ Public	1
○ Both private and public	2
○ Military	2
○ Both private and military	1
○ Not stated	2
Number of patients seen in a week	
○ 11–20	1
○ 21–30	2
○ 31–40	1
○ 41 and above	6
Health status	
○ Very good to excellent health	9
○ Being treated for high blood pressure	3
○ Type 1 diabetes	1
Feeling vulnerable to COVID 19 infection	
○ No	7
○ Yes	3

“They did the right procedures in the right time; we were earlier than other countries around us but that is what made us have lesser number of cases” (Mousa.)

However, some participants felt the lockdown procedures were not practical nor logical. For instance, some felt that the timings of curfews were unnecessary. Further they explained that it was near impossible to expect people living in refugee camps (high density areas) to adhere to the

restrictions and COVID-safe practices and therefore restrictions were unjustified.

“I don’t think there was a need for the restrictions in general, there were places where people didn’t even stay home even at curfew times... especially in places like refugee camps because of the high population density there, I mean these areas are overcrowded. I have been told that no one at these camps was able to follow the instructions of the curfew yet no cases of Covid-19 were reported from these places” (Leen).
“And the curfew from 12am till 7am was a joke. I think it has nothing to do with the Corona[virus], it was made on a political basis, and the people knew it... We shouldn’t forget that there were many non-Covid-19 patients, who needed treatment too” (Ruby).

Participants were often seeking guidance from the Jordanian Dentistry Association. Some reported when *“we were allowed to resume our practice, I was psychologically ready, and I literally followed the protocol”* (Ruby). These participants felt that they were prepared to open their practices because they had new protocols to support best practices for their own and their patients’ safety. These practices included: patients making appointments by phone, treating emergency cases, ventilating rooms between cases, signing in and measuring temperatures on arrival, and donning full Personal Protective Equipment (PPE): *“I used to wear a facemask, gloves, gown and a face shield”* (Ruby).

“I am well-prepared, and I have a set of new protocols and my clinic follows the guidelines provided by the Jordanian Dental Association” (Haytham).

Subtheme 1.2: People’s response to the COVID-19 – “it’s a lie and conspiracy”

Most of the participants reported that the quarantine measures negatively impacted on the economy and the people’s mental and physical health. The curfews often caused a sense of panic with people rushing to buy food and groceries, causing traffic congestion and lengthy queues for medicines. People were often unable to maintain social distancing in queues because of the high density and disorganization.

“I think it should be more thoughtful because it causes heavy traffic on the day before [curfew] and the day after. For example, on Thursday, people rush to the bakeries, to the market to buy things” (Moath).

Often the public and even some of the participants themselves, did not understand the severity of the COVID-19 virus and/or the reason for the strict measures. Therefore, the measures and restrictions were not always followed

as they had “no scientific proof” and simple logic did not explain the rationale behind these stringent measures. They felt the restrictions should be limited to vulnerable segments of the population like older adults or the medically compromised.

“...if the virus is that strong, it won’t be easily transmitted because the carrier of the virus will die before it can get transmitted” (Dalida).

Misunderstandings surrounding COVID-19 led some people in the community to view being COVID-19 positive as shameful. Others felt it was a conspiracy and believed that the number of reported cases were inaccurate as well as the number of tests that were being completed each day. The participants were also concerned about the eruption of violence in the community, if people were refused treatment due to a lack of PPE: “...it is a tribal community and they will not accept telling them we can’t treat you because of the Corona[virus], they might get violent...” (Bashar).

“To many people, corona[virus] wasn’t a disease, it was like something wrong they did and they were ashamed of it, that’s not right” (Dalida).

“...now we don’t know what’s right and what’s wrong, also the Secretary of Health is overestimating the procedures, he says that we did 5,000 random tests in a day! No one can do that...” (Bashar).

“...they say that it’s a lie and conspiracy, and they didn’t also care about distancing at all...our community is aggressive if someone came and didn’t find a ventilator, his family would go violent and do a mess” (Leen).

Theme 2: The effects of the COVID-19 pandemic and response measures – “I’m afraid of being infected, for sure, but I need to live my life too”

Participants felt the impact of the pandemic and the response of the dental association to control it on their work procedures and processes as well as their personal and social life. Fear of being infected and fear of transmitting the infection to their family were grave concerns for many. As a consequence, there was increased awareness of and adherence to infection control measures in their clinical practice and reduced social contact with family and friends. However, as the pandemic continued, some participants felt that the fear of being infected cannot take over their lives.

Subtheme 2.1: Impact on work and practice – “I closed my clinic according to government’s orders. I was afraid, to be honest”

At the beginning of the pandemic, the government responded strongly by closing many of the dental practices and restricting treatment to emergency procedures only, as dentistry was considered a high-risk practice. They also issued requirements particularly in the use of personal protective equipment and restricting procedures to the use of low-speed instruments. While many participants felt this was necessary, they also noted that there was no clear demarcation between emergency and urgent cases. Fear for their own safety inevitably was an important consideration that influenced their practice.

“Look this is a very gray zone. A couple of days ago a doctor called asking me if this was an emergency case, she had a patient whose temporary filling fell off. He’s in pain but this is not an emergency what should she do? The thing is we define emergencies as if it is any case with pain or the pain can’t be managed by medicine” (Sarah).

“In the protocol that we should follow, we were ordered not to use high speed hand piece, but the doctors were afraid of using the low speed hand piece too, we would give the patient an antibiotic if his case can be handled this way” (Nadeem).

Many of the participants were conflicted between providing just emergency palliative treatment in obedience to COVID-19 restriction guidelines and providing full treatment as dictated by professional ethics and best practice.

“Yes, there were a lot of them [repeat visits], and this increases the risk that’s why I thought that we should’ve treated them fully the first time they came. Many of my colleagues were afraid of contracting it during the curfew, so they just prescribed antibiotics and analgesics for them, even though they knew it won’t help them. It was an unethical practice and those same patients would come again with worse pain or even dental abscess or swelling”. (Dalida).

In addition, participants felt that the dental association seemed to be formulating rules without adequate support or resources. Participants were confused about what was safest to follow for themselves and for patients.

“There is a lot of exceptions on working and prescribing medicines, there are more exceptions than laws, therefore there is no law” (Bashar).

“You can’t work with high speed, you can’t use the three-way syringe, you have to wear a face mask and you can’t use the dental spittoon and it should be wrapped [talking about the restrictions imposed on dental practices]” (Moath).

The closure and restrictions on cases that can be treated severely reduced the number of patients in practice which

in consequence, radically affected their incomes. Furthermore, elective procedures were canceled or postponed and the costs of the required PPE were not sustainable in practice particularly when patients were also financially burdened. Cosmetic dentistry was a thing of the past as no patient came for treatment.

"Some of the doctors were offered 50% percent of their salaries. . . .and those who refused to accept the 50% were fired, because they cannot give them full salaries, but most of them accepted the 50%" (Bashar).

- *"The patients' dental concerns changed too, most of my patients would do regular check-ups, whitening, scaling, or composite facing. None of these patients contacted me, even when we had near zero cases of corona[virus]. It's like no one cares about 'Hollywood smile' anymore" (Ruby).*

Participants felt that the changes instigated as a response to the pandemic, although beneficial to maintain best sanitary practice, were not sustainable in the long term. These included complicated, time consuming and expensive sterilization procedures and the use of Personal Protective Equipment.

"The general area of the clinic is sterilized by water and detergent. The transfer area we clean it, first with water and soap, then you check it if there is anything visible to the eye, if not, you disinfect it by 1% sodium hypo chloride if it's not metallic. If it is, you use aldehyde containing disinfectant, after this you get it out of the dirty zone and put it in the clean zone or autoclave. And the last zone, which is the surfaces where you treat the patient, you sterilize it by 1% sodium hypo chloride and use hard wipes to clean all the surfaces, then you wrap all the touching surfaces and when the patient finishes you unwrap them, disinfect them again, then you wrap them again with new wrapping paper, and every tool you use on a patient should be fully disinfected" (Sarah).

As the pandemic continued, moving forward, participants felt that acknowledging the existence of the virus and adjusting to its presence seemed to be the only logical response to continue with life as it was known prior to the pandemic. However, obtaining adequate training to deal with the virus and its possible consequences and taking the right precautions, where feasible, were seen as necessary elements of a pandemic response.

"I will take the right amount of precautions, nothing less, nothing more. I'm afraid of being infected for sure, but I need to live my life too and this virus looks like it's not going anywhere, so we just have to live with it" (Ruby).

Subtheme 2.2: Impact on personal and social life - "I feel we live in an isolated zone..."

Similar to the people in the community, participants felt the psychological impact of the pandemic and its restrictions. They described being paranoid about whether sterilization used in their clinic was adequate, or if they had inadvertently treated patients who were COVID-19 positive. One participant felt that this would destroy his reputation were it to be known in the community that a COVID-19 patient visited his clinic.

"I fear for my family to get infected, to be honest I am afraid to open my clinic because I'm going to sacrifice my reputation that I've build over years if an infected asymptomatic patient came and I treated him, or if anyone tested positive and claimed that he/she visited my clinic, also, there is still a risk that other patients will get infected, even if the protocols are followed and the authorities will lockdown my clinic, and all my hard work through years will drain down the sink" (Morad).

A participant was concerned about the change in the interaction between patients and healthcare professionals as this might affect the therapeutic relationship.

"The old friendly system that we used to use with them [patients] won't be applicable anymore, we'll have to be more formal" (Sarah).

They also expressed feelings of sadness being isolated, socially distanced and quarantined from their family and friends recognizing that culturally they are a people who valued human relationship and expressed this physically by hugging and being friendly. One participant described this:

"You know in the normal situation we make a lot of gatherings and family dinners, we always shake hands and hug each other, it's in our blood" (Nadeem).

While they were given passes by the authorities to freely move around in the community because of their medical profession, they reported that they only went out to buy groceries. There were many participants who overwhelmingly reported that they did not visit family and friends out of fear that their exposure to patients might have "contaminated" them and they would in turn, infect vulnerable family members.

"No social gatherings at all even when my sister was sick, I didn't pay her a visit. I was scared that she could have caught the virus from me (although I did not have any symptoms, but you know, I deal with many patients). Also, people didn't want me near them because I worked in a health center, so it was a mutual feeling between me and my family that we shouldn't see each other for the time being" (Sarah).

Still others felt that they were treated differently by other members of the family, fearing that they were infective because of their profession. As one participant, whose father was a retired dentist, expressed:

"On the personal side, I think my dad is still treating me differently [does not hug her], even till now, maybe because he is a dentist [therefore he knows the risk I am exposed to]. I don't know, but he is still afraid of me, he didn't give me a hug since the beginning of all of this" (Ruby).

Some became more innovative in the way they reached out to family and friends using other forms of communication such as video conversations. However, younger participants, interviewed when the number of cases were tapering down, expressed less fear and were less adherent to the social distancing and quarantine measures with some feeling that there will be "rebound socializing" after the crisis.

- *"Yes, honestly I gathered with my friends and didn't adhere to social distancing at all, maybe it wasn't the smartest thing to do, but I wasn't afraid" (Dalida).*

Theme 3: The unanticipated gains - "I felt I'm more than just a dentist"

From the chaos and despair in a very challenging situation sprung unexpected gains. The participants explained how the pandemic had changed them and transformed their behaviors and practices. There was a strong sense of empathy and concern for the people in their community and a need to rally together and support each other at this tumultuous time, despite the financial and emotional burden. While there were mixed feelings on leadership styles at the peak of the pandemic, many highlighted that they appreciated those who stepped up and provided strong leadership. This better prepared them for the future.

Sub-theme 3.1: Altruism was second nature – "you had a noble purpose to work 24/7..."

The Jordanian community is known as a collectivistic society, prioritizing the needs of others over their own individual desires. These social values and focus on the community's well-being were heightened during the peak of the pandemic. Participants admitted that they went out of their way to ensure that they could get to their work practices to service the community and their dental needs; some car-pooled with others as they had no other means of transportation at this time. Their main concern was to provide oral healthcare.

"There was no transportation method for me to go to work, so I used to meet up with my friends every day and go to work together. It wasn't that hard but still, we got stopped by police a couple of times, and we showed them that we are dentists" (Dalida).

One participant, a female dentist, described how she drove fifty kilometers (round trip) each day to pick up a nurse who worked in her clinic. The pandemic seemed to bring out the best in people.

"Most of us were females, especially the nurses, I even used to pick up a nurse from her home to work and bring her back, I drove about 50 kilometers a day, and it wasn't disturbing at all. I was very happy to do it" (Leen).

These acts of altruism were common, with most of the participants reporting how they or others volunteered to do more and sacrificed more, including their own health and financial security "for the greater good". Many could not raise prices for services even though they were facing mounting economic burden.

"The price raise for each patient is about 12–20 JDs, but you can't raise this price for the patient, because he is also in financial problems like us, now we work not for the profit but for the country for each other to help each other, it's not humane to raise the price during this time" (Morad).

One participant commented that as a consequence of the pandemic, she now felt gratitude and a greater appreciation for the work she does as a dentist. There has been a shift in reference points in terms of what makes people happy. Despite the loss of income for many and the long hours of work, participants were more satisfied in their jobs because they were connecting with the community on a more meaningful level, rather than a fee for service.

"Actually, while the crisis was at its peak, I was happier and felt like I'm a human and more comfortable dealing with patients, because back then it was like you had a noble purpose to work 24/7... me it was more than just a job, it was taking a part in something greater and helping the people in need, I felt like I'm more than just a dentist. I felt like a hero working for the greater good" (Leen).

Sub-theme 3.2: Leadership and change – "he brought the best out of everyone around him"

What was evident was the need for strong, robust leadership and role-modeling during the pandemic. This type of leadership

style “*brought the best out of everyone*” (Leen). There were mixed reviews on the leadership in different settings across all health sectors (private and public). One participant was particularly dissatisfied with the leadership and management and felt that some of the specialists avoided patient contact by sitting in their offices, delegating their work to the residents. This participant highlighted the importance of seniors being better role models for others in a pandemic.

... the head of the residents his role was very unsatisfying he only managed our schedule in the clinic, but he didn't treat any patients at all as I said before some people took advantage of the situation just to work less. ... our superiors should be more caring, and specialists shouldn't just throw all the workload on residents (Dalida).

Despite the above, there were examples of exemplary leadership during adversity. One example showcased how the Director of a dental clinic stepped up and took charge. He went above and beyond to source volunteers from the community, using his connections, to assist him with raising donations for medicines and then distributing those medicines to people in need. He led his staff by example and was strict in maintaining the highest standards within his dental practice. He protected his community as a father protected his children.

“We acted like a true family, and the Director did an outstanding job. He is a true leader, he brought the best out of everyone around him, and in that period that was exactly what we needed. He raised donations for those in need, like those patients who couldn't pay for their medication, he also gathered lots of volunteers who came to help, because we had at least 60–70 people queuing in line while in the crisis waiting for their medicine. It was a lot of pressure. People were afraid of medicines running out” (Leen).

Overall, the pandemic contributed to a reassessment of priorities. For some they have realized the importance of meaningful connections with community and family over wealth - “*The crisis taught us something, that working less produces more, there is no need to work 8 continuous hours*” (Bashar). Further COVID-19 instigated a positive change in dental professionals' ways of thinking and working. The pandemic has been a wake-up call. They believed they were better prepared to maintain and respond to public health issues post the crisis and will continue to uphold these best practices, including the donning of PPE, for the health and safety of the community and themselves.

“I think we should keep wearing the same protective gear even when this crisis is over. I think this a big reminder for all health care providers” (Haytham).

Discussion

While this qualitative study explored the impact of the COVID-19 pandemic on dental professionals who were working in Jordan, our findings resonated with experiences of many healthcare workers globally (20, 21). Participants in this study confirmed that they had to modify their practices upon re-opening of clinics, and re-enforced the need to adopt stricter sterilization procedures, personal protective measures and screening protocols to maintain their own and the public's health and safety (9, 22, 23). As with many healthcare workers, dentists are required to be in close proximity with patients, which places them at high-risk for contracting the infection through dental aerosols and respiratory droplets during procedures (8). It was, therefore, not surprising, that routine dental services were suspended, and care was restricted to emergency cases only (24). However, dental professionals in many parts of the world were not prepared for the restrictions imposed on their practice (25, 26) and those interviewed in this study were no exception. Consequently, they were confronted with many challenges including uncertainties about the distinction between emergency, urgent cases, and non-urgent cases. Participants expressed indecision regarding cases they were allowed to treat, particularly in the absence of clear guidelines from their own professional association and seemingly *ad hoc* rulings from authorities which confused rather than clarified. In addition, they also faced the moral dilemma of extending only symptomatic treatment to non-emergency cases when this was clearly not aligned with professional guidelines (27). They had the additional responsibility of considering the collective welfare of the public, their own safety and balancing this with providing definitive treatment for all patients as required by their professional ethics (28). Unlike dental health workers, many primary healthcare workers continued to work during the pandemic. However, congruently, they also had to contend with changes in their practices including retraining and redeployment to cope with the rapidly increasing number of positive COVID-19 cases (20). This is particularly true for frontline nurses who must adapt to the increased workloads, discomfort with extra layers of PPEs and greater risk of exposure to occupational hazards, including contact with contaminated instruments and patient secretions, contributing to higher anxiety not only for their own safety but that of their families (29).

Compounding these are the perceptions and beliefs derived from misinformation in different forms and platforms from all sectors of society (30). In our study, the perceptions and beliefs among dental professionals and the public related to COVID-19 being a conspiracy was also confirmed in a cross-sectional study among the general public in Jordan which identified that almost half (47.9%) believed COVID-19 was a

global conspiracy while over four-quarters (82.7%) believed that it was a test or trial from God (31). Similarly, a study in Ecuador among healthcare workers showed that those who believed in the conspiracy theory were more likely to experience anxiety and psychological distress (32) and were identified to have higher vaccine hesitancy (33). Lack of knowledge and stigma can invoke fear and aggression (34), highlighting the importance of authorities providing factual, evidence-based, and consistent communication in a crisis.

While restrictive measures may have mitigated the caseload of the virus, the measures instituted impinged on the personal freedom of people (35). Research reports that isolation and quarantine measures can cause increased stress, anxiety and depression (36), and this was a concern reported by participants in our study. The greatest fear and anxiety for dentists during the pandemic was the possibility of inadvertently acquiring and transmitting the virus to other patients and to their own families which was similar to the findings of a large study involving dental professionals across 30 different countries (11). Social distancing measures during the pandemic, also impacted on family relationships. Family members were fearful that they may harbor the COVID-19 infection (37). This had serious mental health effects and should be considered in future interventions. Similar findings of depression, anxiety and distress were reported among other Jordanian nurses and doctors, further reinforcing the need for more psychological support for frontline healthcare workers during a pandemic (13).

Of final note, given that Arabic culture is collectivist, where social life is family-centric rather than egocentric and common good transcends individual interests (38), the collectivist nature of the Jordanian dental professionals in our study was clearly present. Altruism and overall strong leadership in a crisis surfaced during the turmoil. In most settings, many went above and beyond to mitigate the social, economic and financial impact of the pandemic through advocacy and volunteerism. Many were adamant that they were better prepared and would continue with personal protective measures and biosafety practices within their clinics after the pandemic which further emphasizes the strong collectivist values and desire among Arabs to protect others in the community (39). Therefore, future guidelines and protocols published by dental associations and other healthcare organizations for use during a pandemic need to consider the collectivist orientation and strong family ties within communities to ensure the appropriateness of restrictions, resulting in less fear and greater acceptance of changes to practice. While this study considers dentists as primary healthcare workers who like others in the health workforce who are required to work in close proximity to patients, the transferability of research findings to other primary healthcare workers may be limited because of inherent differences in roles and responsibilities.

The sample size of the study, while considered small, was determined by achievement of theoretical data saturation and pragmatic considerations during the pandemic. However, a strength of this study was ensuring that dental practitioners from different sectors of practice, including private, public and military were included. As recruitment of the sample was done through convenience and purposive sampling, this may have resulted in sample selection bias.

Relevance to clinical practice

Considering that this is a small qualitative study, the findings provide rich insights into the impact of the COVID-19 pandemic at its peak, on primary healthcare workers who work closely with patients. Our study provides researchers an opportunity to confirm these perceptions in similar studies with other healthcare worker subgroups. Of note from this study is the impact of misinformation and rumors which can further increase mental health distress among the community and within an already strained healthcare workforce. Practice implications from this study include the need for frontline health staff and the general public to have effective leadership and access to trusted sources of information to remain informed. Further infection control policies, guidelines, screening tools and protocols for various healthcare professionals should be standardized and based on international benchmarks, including consistent public health orders, such as the importance of mandatory vaccinations for all workers in the health system. To avoid risk of exposure and further psychological distress, sufficient funding and resource allocation of personal protective equipment is necessary to sustain stringent infection control measures and maintain safety in practice. Finally, in view of the collectivist culture in Jordan and the impact of restrictions such as social distancing on mental health, there is a need for access to greater mental health support interventions and services for both healthcare workers and the public in a crisis.

Conclusions

The pandemic and requisite control measures adversely impacted the professional dental practice and the personal life of dentists working in Jordan. Effective leadership and positive role-modeling of best biosafety practices sustained staff morale and confidence in often challenging working environments. Fear, anxiety and stress are natural responses to the pandemic particularly one as pervasive as COVID-19, however, it is imperative upon health authorities to provide enhanced mental health support for healthcare workers in the frontline of the pandemic response.

Data availability statement

The data supporting the conclusions of this article will be made available by the authors upon reasonable request, however, pseudonyms will be used to protect the identity and privacy of participants.

Ethics statement

The studies involving human participants were reviewed and approved by Isra University Ethics Committee [no (JS/BA/94)]. The patients/participants provided their written informed consent to participate in this study.

Author contributions

RA-A, LR, AG, OA-R, AV, YS, and DM were responsible for the study conception and design, were responsible for drafting the manuscript, and made critical revisions to the paper for important intellectual content. RA-A and OA-R collected and translated the data. DM, RA-A, and YS collated and prepared the data. LR, DM, OA-R, and RA-A performed the data analysis which was validated by YS, AG, and AV. All authors made substantial contributions to the study and fulfilled the definition of authorship set up by the International Committee of Medical Journal Editors (ICMJE).

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Anxiety in a regular day of work: A 24 hour psychophysiological investigation in young dentists with gender comparison

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Introduction and aim: Dentistry is a highly demanding profession with a strong mental and physical involvement, possibly generating anxiety. Very few studies assessed psychophysiological activity in dentists, while none tried to relate it with gender during a routine working day. This study aims at evaluating correlations between gender, psychophysiological indexes, and psychological variables.

Materials and methods: Data were acquired at the Dental Clinic of the University of Padua on 20 healthy young dentists (10M-10F) during a 24h period of a working day. Physiological variables (measured with E4 Empatica) were electrodermal activity (EDA), heart rate variability (HRV) and heart rate (HR). Participants anxiety was measured through a self-reported scale on patient-relationship anxiety and through the Generalized Anxiety Disorder-7 Questionnaire (GAD-7).

Results: 5 (3F, 2M) participants over 20 had a GAD-7 score ≥ 10 . Female gender, in comparison to Male, was associated with higher perceived patient relationship anxiety ($p=0.002$) and lower HRV ($p\text{-adj}=0.022$). The gender Male, although being associated with lower level of self-reported anxiety ($p=0.002$), showed an equal number of subjects with a GAD-7 score ≥ 10 ($p=0.371$). No interaction between gender and EDA was found, nor an effect of GAD score on EDA, HRV and HR values. Higher values of EDA were found during sleep time; a difference between sleep time and working time EDA ($p=0.037$) and a difference between sleep time and daytime ($p=0.0045$). A different HR between sleep and all daytime ($p<0.001$) was also highlighted.

Conclusion: 25% of dentists fell within generalized anxiety disorder diagnosis, compared to a maximum of 8.6% in the general population. A possible general biomarker of excessive stress response was measured: a shift of circadian sympathetic activity was found in dentists; a higher activity during sleep in comparison to working time and daytime. The Female gender was associated with higher perceived patient-approach anxiety, lower parasympathetic activity, and a comparable sympathetic activity to the Male gender, thus fostering a possible vulnerability to excessive stress. This study underlines the need to empower the psychological approach to stress and patient-relationship in dentistry.

KEYWORDS

dentistry, anxiety, stress, gender, psychophysiology

Introduction

Patients' anxiety for dental procedures is a well-established problem, but who cares about the dentist's point of view (Armfield and Heaton, 2013)? Stress and anxiety were examined among dental and health professionals and from these studies, it appears that the quality of life of dentists is lower than the general population (Myers and Myers, 2004). Probably this is related to the intrinsic nature of the helping professions (Maslach and Pines, 1977; Rada and Johnson-Leong, 2004), but not solely; being a dentist is a high demanding profession with a strong mental and physical involvement, possibly generating stress and anxiety (DiMatteo et al., 1993). Besides the intrinsic issues of a helping profession, dentists have often to face the management of the dental office. Indeed, the relationship with the patient, the scheduling pressure and the management of employees represent the main causes of stress for dentists (Myers and Myers, 2004). According to some authors, this occupational stress can also lead to a higher risk for cardiovascular diseases (Cutright et al., 1977; Cooper et al., 1978, 1988). The need for professionals to access techniques to manage their stress and improve the communication with the patient is also reported (Moore and Brødsgaard, 2001). It remains to be clarified whether gender differences in anxiety and occupational stress exist. The literature reports a predisposition for anxiety in women, although the factors that may cause this vulnerability remain unclear, Kessler et al. found that the prevalence of a generalized anxiety disorder in women (6.6%) is higher than in men (3.6%) (Kessler et al., 1994; Altemus et al., 2014). Conversely, when anxiety is evaluated in dentists during work, this gender difference seems not to be relevant (Altemus et al., 2014; Davidovich et al., 2015; Asif et al., 2022). The data on anxiety and stress in dentists often derive from questionnaires without ever providing objective measures. However, wearable monitoring devices can measure parameters such as electrodermal activity (EDA), heart rate (HR) and heart rate variability (HRV) and thus provide a step toward an objective psychophysiological measurement of anxiety and stress during the working day (Lu et al., 2020; Posada-Quintero and Chon, 2020; Schuurmans et al., 2020). These psychophysiological data are very important. An increase in HR is associated with increased risk of death (Nauman et al., 2011), more specifically higher HR is associated with both cardiovascular mortality and non-cardiovascular mortality (Woodward et al., 2014; Alhalabi et al., 2017). A reduced HRV is associated with increased cardiovascular risk (Weber et al., 2010), lower resiliency (stress tolerance) in the face of stressful situations (Hansen et al., 2009). Noteworthy longer periods of reduced HRV are associated with worrying, with decreased explicit positive affect, and with increased tension (Verkuil et al., 2016). Furthermore HRV is highly related to a flexible control over behavior (Thayer et al., 2012), that is hugely important in helping professions such dentistry. The well-known flight or fight memorandum still holds to this day (Cannon, 1915). EDA (being a pure sympathetic index), can provide information on the sympathetic activity and the flight or fight response, because an excessive sympathetic activity can thus fostering healthy related issues (Dickerson and Kemeny, 2004; Andela et al., 2015; Resmini et al., 2016; Richardson et al., 2016; Mohd Azmi et al., 2021). Synthesizing the relevance of all the above-mentioned data, this study aims to investigate the relationships between peripheral psychophysiological parameters measured with a wearable monitoring device and working hours, gender, self-reported anxiety while confronting the patient (VAS-anxiety) and questionnaire measured anxiety (GAD-7) in young dentists.

Materials and methods

Participants and setting

Psychophysiological measures and psychological data were acquired from 20 healthy young dentists with at least 1 year of employment attending a post-graduate course at the Dental Clinic of the University of Padua (Padua, Italy). The age of the 20 participants ranged from 26 to 36 years ($M = 28.95$, $SD = 2.98$), 50% were Male. Exclusion criteria were cardiovascular pathologies or psychiatric disorders. Inclusion criteria were being a dentist at the Dental Clinic of the University of Padua, with less than 5 years of clinical experience. Participants enrolled in the present study have signed informed consent prior to participation. The study was approved by the Ethical Committee of Department of General Psychology, University of Padua, n. 3274/2019.

Procedure

Participants were invited and informed about the aim of the study through an information leaflet, and written informed consent was obtained from all subjects after they received all necessary information on the study. Participants were asked to wear a Empatica E4 (Empatica Inc.) wristband, for 24 consecutive hours while they were working, during sleep and during other daytime activities. Furthermore, subjects were asked to fill-in a diary reporting start and end time of the three different conditions ("work," "sleep," "daytime"). Data were collected between March and July 2022.

Anxiety assessment

Anxiety levels were scored with the Generalized Anxiety Disorder questionnaire GAD-7 and with a Visual Analog Scale (VAS) about Self Perceived Anxiety (Spitzer et al., 2006; Swinson, 2006; Facco et al., 2011). Anxiety scores during the clinical activity were obtained through a self-reported VAS, stating a single item question: "on a scale from 0 to 10, where 0 is nothing at all and 10 is extremely, how do you rate yourself anxious while relating to patients"? A value of 7 (or more) at VAS analog test was taken as the cutoff in defining subjects anxious in relating to patients (ANX+). Participants that reported a VAS-anxiety < 7 were defined "ANX-". GAD-7 was also used as gold-standard measure to report general anxiety symptoms. A value of GAD ≥ 10 was considered as a positive GAD and defined as "GAD+," while a value < 10 was reported as "GAD-".

Physiological assessments

The physiological parameters were obtained through Empatica E4, a wearable device in the form of a wristband that allows for measuring Electrodermal Activity (EDA), blood volume pulse – from which heart rate (HR) and heart rate variability (HRV) are derived, skin temperature, and movement (Garbarino et al., 2014). EDA is a property of the skin that underlines the variation of the electrical conduction in response to sweat secretions and it is a sympathetic index (Boucsein, 2012). HRV is the physiological phenomenon of variation in the time interval between heartbeats. It is a parasympathetic index that reflects vagal activity, it is measured with the root mean square of the successive differences between inter beats intervals (Ernst, 2017; Kim et al., 2018). Participants were asked to wear the Empatica E4 for 24h on their non-dominant hand. HR was expressed in beats per minute (bpm) and derived through Empatica

algorithms to the blood volume pulse. They provide also the inter beats intervals (IBI) from photoplethysmography (PPG) signal. HRV was obtained by extraction of the root mean square of successive differences between normal heartbeats (RMSSD) extracted by first calculating from IBI each successive time difference between heartbeats in *ms*, over a short-term period of 30 s. Then, each of the values was squared and averaged before the square root of the total was obtained. The sensor used to detect blood volume pulse is a PPG sensor, which is known to be subject to missing data as a result of movement or pressure artifacts (Chen et al., 2015). Artifacts were removed, discarding zero values and other single data point outliers. The analysis of EDA included the extraction of a parameter called skin conductance level (SCL). The electrodes used were silver coated with copper underlay on brass electrodes. The threshold for the amplitude of significant signal was set to a minimum rise of 0.005 μ Siemens. SCL values were then normalized using the min-max method. Physiological data were down-sampled to 1hz and labeled as belonging to one of the three monitoring periods (defined as condition “work,” “sleep” and “daytime”). Data of each subject were then aggregated into periods, expressing their mean values.

Statistical methods

As a first step, characteristics of subjects with anxiety ($N=5$; $GAD \geq 10$) were compared to subjects with no anxiety ($N=15$; $GAD < 10$) using independent *t* tests and a chi-square test, the same analysis was performed splitting groups according to Self-Perceived Anxiety cut-off. We then evaluated if the physiological parameters differed among subjects during the three periods of the day (factor “condition,” 3 levels, within-subjects) and according to the anxiety symptoms reporting both using GAD-7 and Self Perceived Anxiety, (factor “anxiety,” 2 levels, between subjects). The statistical model to test this was a two-way mixed ANOVA model. We then repeated the analysis considering gender differences (factor “gender,” 2 levels, between-subjects) and anxiety symptoms reporting. The analyzes were performed with R version 3.5.1, also used to check for assumptions of normally distributed residuals on all levels of the model. Separate models were considered for each type of parameter (EDA, HR, and HRV). Post-hoc tests were then performed using Tukey for multiple comparisons.

Results

Male and Female groups were comparable (Table 1). An initial qualitative outcome was that 5 participants showed a GAD-7 score ≥ 10 (3F, 2M) and that 10 participants reported a VAS anxiety ≥ 7 (7F, 3M). Chi-square statistics showed a significant imbalance of Gender distribution as regards Self-Perceived Anxiety [$\chi^2(1,30)$, $p=0.002$], a higher number of women in comparison to men reported anxiety in confronting the patients (Table 2). However, there was no effect of Gender distribution when

TABLE 1 Participant characteristics according to gender.

	Female $N=10$ Mean (SD)	Male $N=10$ Mean (SD)	value of p (χ^2/t -test)
Age	27.9 (1.91)	29.1 (3.81)	0.390
Height (cm)	169 (4.62)	177 (5.97)	0.004
Weight (kg)	59.4 (14.2)	72.0 (9.36)	0.041
Body mass index	20.8 (4.52)	23.0 (2.29)	0.215
GAD score	7.70 (5.08)	5.40 (4.33)	0.290

The two groups were comparable according to age, weight, BMI and GAD score.

considering GAD+ vs. GAD-population ($p = 0.371$; Table 3). Therefore, Two-Way Mixed ANOVA analyzes were performed considering only GAD as anxiety factor.

TABLE 2 Gender factor and EDA, HRV, HR values in ANX– and ANX+ dentists.

		ANX – ($N=10$)	ANX + ($N=10$)	Total ($N=20$)	value of p
Gender factor					0.002*
	Female	3 (30.0%)	7 (70.0%)	10 (50.0%)	
	Male	7 (70.0%)	3 (30.0%)	10 (50.0%)	
EDA					0.392
	Mean (SD)	0.120 (0.099)	0.101 (0.067)	0.111 (0.085)	
	Range	0.032–0.414	0.017–0.279	0.017–0.414	
HR					0.423
	Mean (SD)	77.262 (11.541)	79.627 (11.144)	78.444 (11.311)	
	Range	54.292– 91.993	48.124– 96.388	48.124– 96.388	
HRV					0.819
	Mean (SD)	64.613 (19.381)	63.469 (19.152)	64.041 (19.112)	
	Range	41.182– 130.594	31.951– 97.734	31.951– 130.594	

Chi-squared statistics showed a significant imbalance of gender distribution concerning self-perceived anxiety [$\chi^2(1,30)$, $p=0.002$]. A higher number of women in comparison to men reported perceived anxiety. ANX – = VAS-anxiety < 7 ; ANX + = VAS-anxiety ≥ 7 ; * = $p < 0.05$.

TABLE 3 Gender factor and EDA, HRV, HR values in GAD – and GAD + dentists.

		GAD – ($N=15$)	GAD + ($N=5$)	Total ($N=20$)	value of p
Gender factor					0.371
	Female	7 (46.7%)	3 (60.0%)	10 (50.0%)	
	Male	8 (53.3%)	2 (40.0%)	10 (50.0%)	
EDA					0.423
	Mean (SD)	0.116 (0.091)	0.095 (0.060)	0.111 (0.085)	
	Range	0.017–0.414	0.017– 0.239	0.017–0.414	
HR					0.316
	Mean (SD)	77.591 (11.867)	81.004 (9.339)	78.444 (11.311)	
	Range	48.124– 96.388	59.470– 92.643	48.124– 96.388	
HRV					0.117
	Mean (SD)	66.279 (20.279)	57.326 (13.506)	64.041 (19.112)	
	Range	36.097– 130.594	31.951– 82.811	31.951– 130.594	

Chi-squared statistics did not show any significant correlation. 40% of Male and 60% of Female subjects scored ≥ 10 according to the GAD-7 questionnaire. GAD – (it means a GAD-7 score < 10); GAD + (it means a GAD-7 score ≥ 10).

Electrodermal activity

The results of the Two-Way Mixed ANOVA showed that there was a significant main effect of conditions [$F(2,54)=5.2118$, $p=0.0085$] on physiological value EDA. A pairwise comparisons using t-tests with pooled SD revealed significant pairwise differences between conditions “sleep” and “daytime” ($p=0.0045$) and between “sleep” and “work” ($p=0.0367$), showing a higher EDA activity during “sleep” in comparison to “daytime” and “work” (Figure 1). There was no interaction effect for EDA, when considering Gender and GAD $\pm$ [$F(1,56)=1.1432$, $p=0.2896$], with GAD+ (Mean 0.095, SD=0.091) and GAD- (Mean=0.116, SD =0.116) performing overall similarly during the different conditions (Figure 2).

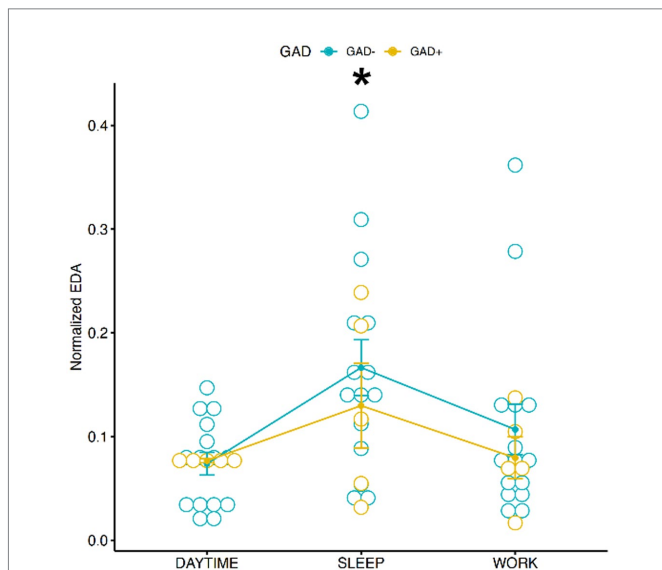


FIGURE 1
Distribution of normalized EDA during the 3 conditions according to GAD $\pm$. There was no difference between groups according to factor GAD-or GAD+ while EDA values were clearly different during daytime or work in comparison to sleep. EDA values were higher during sleep than daytime and work conditions. $*=p<0.05$.

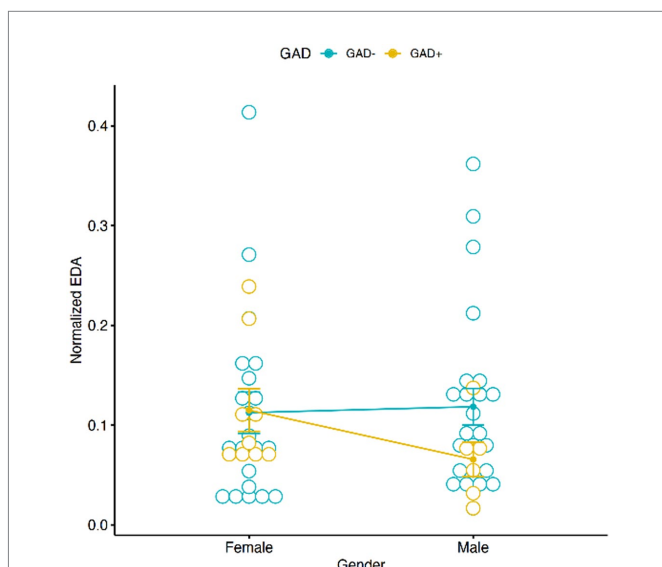


FIGURE 2
Graphic distribution of normalized EDA according to GAD $\pm$ and Gender. No significant interaction was found between Gender, EDA and GAD $\pm$.

Heart rate variability

Analysis on HRV did not show any significant correlation with GAD $\pm$ and conditions (Figure 3), nor among GAD $\pm$ and gender effect (Figure 4). However, the Tukey multiple comparisons of means showed a statistically significant difference between Male and Female HRV values ($p\text{-adj}=0.022$), with Females showing a lower HRV in comparison to Males.

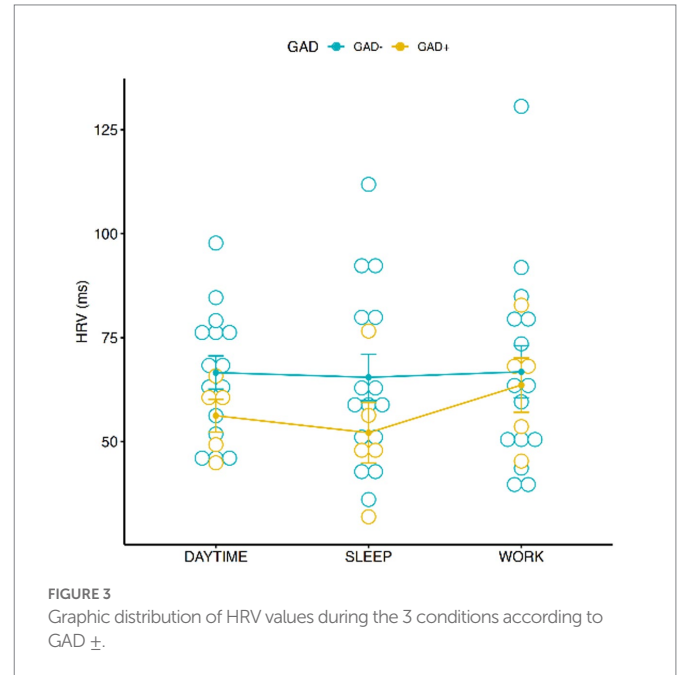


FIGURE 3
Graphic distribution of HRV values during the 3 conditions according to GAD $\pm$.

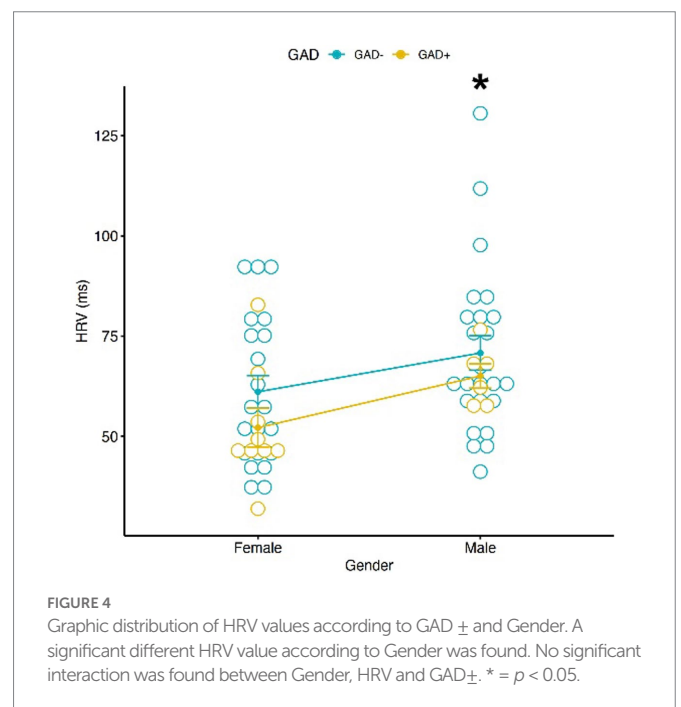


FIGURE 4
Graphic distribution of HRV values according to GAD $\pm$ and Gender. A significant different HRV value according to Gender was found. No significant interaction was found between Gender, HRV and GAD $\pm$. $*=p<0.05$.

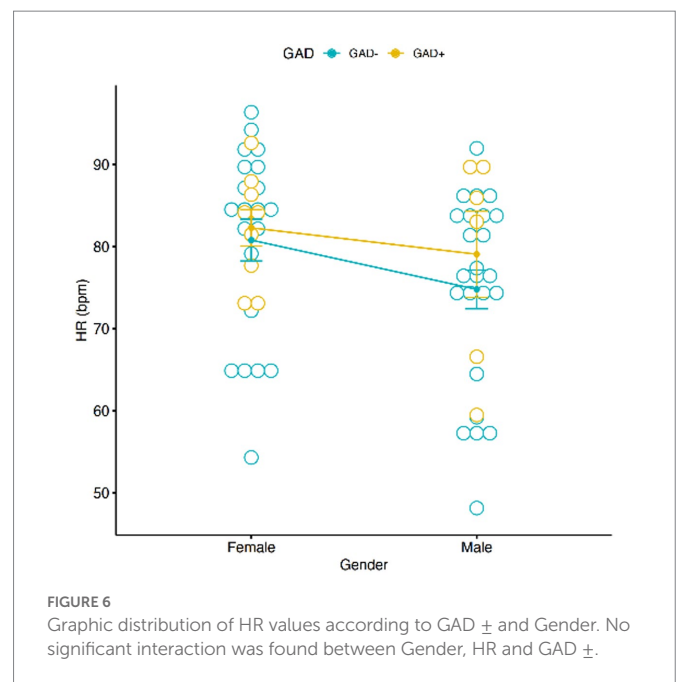
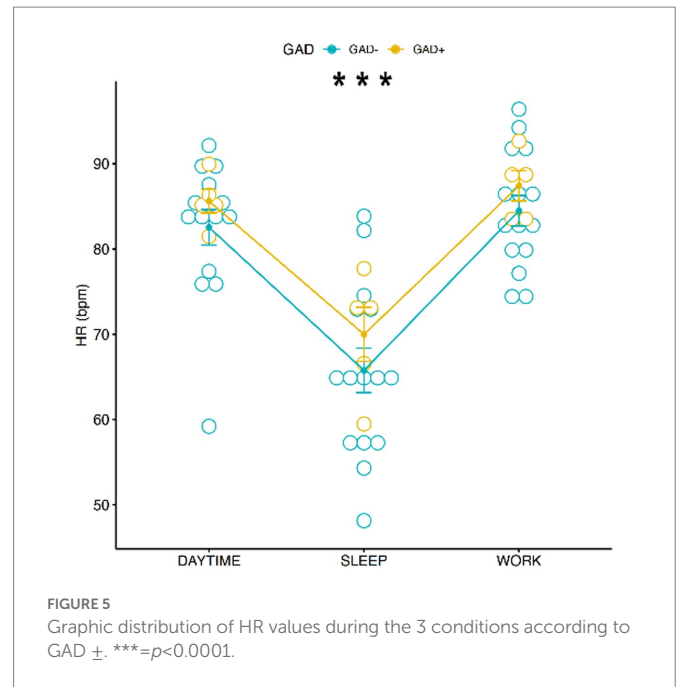
Heart rate

A significant main effect of conditions on HR was found [$F(2,54)=25.94$, $p<0.001$; Figure 5], the pairwise comparisons using

t-tests with pooled SD showed a significant difference between “sleep” and “daytime” ($p < 0.001$) and “sleep” and “work” ($p < 0.001$). No correlation was found between HR, Gender and GAD $\pm$ (Figure 6). Females showed an average HR value 5.59 bpm higher than Males, without reaching the accepted alpha statistical significance level. Tukey multiple comparisons did not show any significative difference between Female and Male HR values ($p\text{-adj} = 0.057$).

Discussion

In this study, several interesting issues have been elucidated. Curiously, neither GAD-7 scores nor self-reported anxiety values interact with the physiological condition in a statically significant way, a result possible due to the limited number of subjects participating. This study nonetheless showed some interesting data from an innovative psychological and physiological perspective. The Female gender is associated with a higher HR (although not statistically significant, but useful, given the consistency of the other parameters, to Figure out a global pattern of activation), higher perceived patient relationship anxiety and, a lower HRV. However, the Male gender although being associated with a lower level of self-reported anxiety, showed an equal number of subjects with a level compatible with a moderate Generalized Anxiety Disorder; a comparable number to the Female group. HR was higher in our Female sample confirming the existing literature, however the difference with the Male sample values was not statistically significant as expected. Maybe this can be attributed to a higher level of anxiety in our Male sample in comparison to the general Male population. Our findings also highlight that women show lower vagal activity compared to men, providing an interesting relationship between self-report anxiety and physiological data. This work underlines differences in HRV values based on RMSSD that are novel compared to the current scientific literature (Koenig and Thayer, 2016). Usually there is no difference between RMSSD according to gender and, if any is reported, Females show higher parasympathetic activity. The current scientific literature has showed the association between an increased morning cortisol concentration and stress levels in dentists (Nijakowski et al., 2022). It has been also highlighted the usefulness of salivary tests to evaluate sympathetic activity (Tammayan et al., 2021). Furthermore in tracking stress the efficacy of oximetry have been already showed (Hunasgi et al., 2018), but no information about dentists' sympathetic activity during sleep have been previously reported. The present paper highlights differences in EDA circadian rhythms. More specifically dentists maintained a similar sympathetic activity across daytime and working time. In contrast with the literature a higher sympathetic activity was found during the night in comparison to the rest of day (Grassi et al., 2010). This could open some interesting perspectives about EDA values during sleep stages and working day values in order to deepen our understanding of circadian rhythms in dentists that refer to be stressed or actually have anxiety issues. The shift of EDA circadian rhythms (if shown to be consistent by future research) could represent a possible biomarker of work-related stress. Future studies will uncover if in dentists there is any association between nocturnal excessive sympathetic activity, sleep stage, quality of sleep, perceived stress and anxiety. Usually the above-mentioned indexes are associated with bad health and impaired mental health (Sano et al., 2015;



Zhang et al., 2018). In the Introduction several important studies were elucidated, that showed the relevance of this psychophysiological perspective, so it will be interesting to evaluate the results of this study not solely according to a Gender comparison but also to the reference population according to age. A comparison with the reference population according to HRV, HR [both defined in Umetani et al., (1998)] and EDA, showed that HRV was higher in our sample 64.041 ms (± 19.112) in comparison to 43 ms (± 19), reported by the general population paired by age. HR was perfectly in line with the expected results: 79 bpm (± 10) in the general population in comparison to 78.444 bpm (± 11.311), provided by our sample. EDA values cannot be compared to the general population because a wrist-worn EDA general classification is still lacking, but

nonetheless the shift in sympathetic night activity, according to EDA, remains valuable. Noteworthy 50% of participants reported a self-Perceived VAS Anxiety ≥ 7 and 5 over 20 (3F, 2M) were compatible with a moderate GAD diagnosis (GAD-7 score ≥ 10). This is more than expected, as reported by Spitzer et al. (2006): the disorder has an estimated current prevalence in the general medical practice of 2.8 to 8.5% and in the general population of 1.6 to 5.0% (Leon et al., 1995; Olsson et al., 1997; Roy-Byrne and Wagner, 2004; Kessler et al., 2005). No interactions between gender and EDA were found, nor an interaction between GAD score and EDA value. It is relevant to underline that probably this lack of interaction may be caused by the limited sample. A further limitation of this study is the impossibility of comparison of self-reported anxiety with gender due to inhomogeneous samples. The relevance of a psychological approach in a very demanding profession such as dentistry was highlighted by the high number of professionals with a moderate generalized anxiety disorder. The Female gender correlation with higher heart rate activity (although non statistically significant), lower parasympathetic activity (HRV) and with comparable sympathetic activity to the Male gender, can thus provide a possible vulnerability to excessive stress. This hypothesis can be confirmed by the higher Female self-reported anxiety related to patient approach. However, this also poses some interrogatives about Males' perceived stress because GAD-7 Males scores were comparable with Females' ones and there was no statistically significant difference between Male and Female HR values, giving rise to a question: "Do Females exaggerate perceived anxiety or Males underestimate it?" Studies with higher numbers are needed to disentangle more clearly the relationship between self-reported anxiety, questionnaires, and psychophysiological activity.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

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Ethics statement

The studies involving human participants were reviewed and approved by Comitato etico della ricerca in psicologia, Dipartimento di Psicologia, Padova. The patients/participants provided their written informed consent to participate in this study.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Editorial bullying: an exploration of acts impacting publication ethics and related environment

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Bullying and misconduct in the realm of scientific and scholarly publishing have the potential to jeopardize the transparency and integrity of academic discourse. While misconduct issues among authors have been extensively discussed, the role of editors in perpetuating or mitigating such problems has garnered less attention. Scientific publishing serves as the gateway for disseminating innovative research findings globally, and the role of editors, especially Editor/s-in-chief, is pivotal in safeguarding the rigor and credibility of published research. Editor bullying and misconduct involve behaviors that undermine the scientific process, compromise research integrity, and harm the careers and wellbeing of individuals. These actions may manifest as biased decision-making, suppression of dissenting voices, or the exploitation of power dynamics in the peer review process. To address these issues, preventive and therapeutic approaches are suggested, including enhancing awareness, recognizing and mitigating exacerbating factors, and upholding professionalism. Moreover, the importance of a conflict-of-interest declaration for editors is highlighted to ensure transparency and integrity in the editorial process. The present mini-review aims to shed light on editor bullying, illuminating its gravity and the urgency to address these issues within the academic publishing domain/s. This review underscores the more subtle, yet equally significant, issue of professional misconduct in the editorial realm of scientific journals.

KEYWORDS

academic bullying, editor, ethics, harassment, scientific publishing, peer-review, personal criticism, intimidation

Background

Bullying behaviors may be defined as recurring efforts to undermine, unsettle, or evoke fear in a targeted individual or group (Scott et al., 2008). Traditionally, workplace bullying often gravitates toward the well-documented issues of sexual harassment, overt bullying, and acts of discrimination (Cleary et al., 2010; Jagsi et al., 2023). These forms of mistreatment have long been at the forefront of discussions surrounding workplace dynamics and employee wellbeing. Numerous studies and legislative measures have emerged to address and combat these deeply ingrained problems, highlighting the importance of creating inclusive and respectful work environments (Averbuch et al., 2021; Hay, 2021; Moss et al., 2022; Iyer et al., 2023). However, the landscape of professional bullying is far more complex and pervasive than its traditional manifestations. Academic bullying and misconduct have infiltrated the seemingly impartial realm of scientific and scholarly publishing, raising concerns about the very foundations of knowledge dissemination and academic discourse (Smith, 2003; Godlee, 2004). In other words, bullying, a pervasive issue in various professional settings extends beyond traditional workplace bullying; and even involves instances where editors misuse their positions of authority, exhibit hostile behavior, or engage in questionable practices that compromise the integrity of the editorial process (Teixeira and da Costa, 2010).

The role of Editors particularly the Editor-in-Chief/s in scientific journals is pivotal as they are entrusted with safeguarding the rigor and credibility of published research. In other words, the role of Editor/s is vital in maintaining the integrity and credibility of academic discourse. Nevertheless, as with any position of power, there is a potential for misuse leading to a growing concern in the academic community (Godlee, 2004; Faggion, 2021). Such conduct can manifest in various ways, including biased decision-making, suppression of dissenting voices, and the exploitation of power dynamics in the peer review process. In the domain of scientific publishing, considerable attention has been devoted to authorial misconduct, encompassing phenomena like “honorary and/or ghost authorships,” “plagiarism,” “self-citations,” and strategies for upholding publishing ethics (Baskin and Gross, 2011; Al Lamki, 2013; Helgesson and Eriksson, 2015); nevertheless, it is imperative to acknowledge that professional misconduct can also manifest from the editorial perspective (Barbour et al., 2016). According to Zapf et al. (2003), public humiliation, such as belittling comments, is a form of bullying behavior that some editors may display. Moreover, as per Einarsen et al. (2009), publicly berating individuals such as authors of manuscripts submitted to journals in front of colleagues and/or using derogatory language against individuals including authors submitting manuscripts to a journal are clear signs of bullying behavior by journal editors. In this context, ensuring the quality, transparency, and integrity of this process is of paramount importance in scientific publishing, which serves as the cornerstone of academic knowledge dissemination, serving as the gateway to sharing innovative research findings with the global scientific community. Actions, such as those referenced above are indicative of an effort to intimidate authors, a behavior that can significantly hinder the open exchange of ideas and erode the fundamental tenets of scholarly exploration. The World Medical Association (WMA), the (ICMJE), and the Committee on Publication Ethics (COPE) have collectively outlined ethical responsibilities for editors in the publication and dissemination of research findings (International Committee of Medical Journal Editors, 1997; Cockcroft, 2000; Wager, 2012; World Medical Association, 2013). Likewise, the COPE guidelines include a section addressing the handling of misconduct, primarily intended for editors; however, authors should also familiarize themselves with the procedures that editors will follow when addressing suspected misconduct, which involve thorough investigation and resolution of such issues. The present study seeks to contribute to the scientific understanding of editorial bullying within academic journals, exploring the complex dynamics through which journal editors may exhibit bullying behavior; however, it was demanding to cite indexed references for each variable as scholarly articles often focus on broader issues rather than individual cases.

The present mini-review seeks to shed light on these issues, highlighting their gravity and the urgency to address them within the academic publishing landscape.

What is editor bullying and misconduct?

Editor bullying refers to the abuse and/or misuse of power and influence in positions of authority within academic publishing.

It involves behaviors that undermine the scientific process, compromise the integrity of research, and harm the careers and wellbeing of individuals. In addition, the dissemination of submission-related information including details such as manuscript number, title, and editorial decision to colleagues and peers without obtaining prior consent from the authors constitutes a breach of editorial ethics and is considered a form of editorial misconduct (Barbour et al., 2016). In a longitudinal analysis, Petersen AM (Petersen, 2019) investigated the editorial activity of ~7,000 editors affiliated with a well-known journal (denoted as PO) during the 10-year period spanning 2006–2015. The results revealed a striking disparity in power distribution among editors of this reputed journal, with the top 10 editors overseeing a substantial 3,366 articles, constituting 2.4% of the total 141,986 articles scrutinized in this study (Petersen, 2019). Moreover, Petersen (2019) reported that articles handled by extremely active editors of PO had significantly faster acceptance rates, had higher rates of citations to the Editors’ research, and lower citation impact relative to the other studies published in this journal. These results provided corresponding lines of evidence supporting an underlying self-citation strategy thereby suggesting either a lack of interest or scientific misconduct on the part of the Editors of PO (Petersen, 2019). This conspicuous inequality raises concerns about inadvertent incentives that may potentially foster biased decision-making at the editorial level, possibly fueling unethical conduct. Results by Petersen (2019) imply that editors could become less discerning in evaluating article quality and may be susceptible to imbalances driven by power. Furthermore, this study (Petersen, 2019) suggested that these effects become more pronounced as editors accumulate experience, in alignment with behavioral research on the evolution of misconduct and susceptibility to temptation in power-driven environments.

Potential factors associated with editor bullying/misconduct

Breach of confidentiality

Authors have a legitimate expectation of confidentiality during the peer review process. Unauthorized disclosure of manuscript-related information violates this expectation and can deter authors from submitting their work to that journal or even engaging with the peer review system altogether (Shahan et al., 2006).

Personal criticism of author/s

In the realm of academia and scholarly discourse, it is essential to maintain a high standard of professionalism and ethical conduct. One fundamental principle that must be upheld is the notion that personal criticism of the author/s is inappropriate. While robust critique and constructive feedback are essential components of the peer review process, they should always focus on the content, methodology, and presentation of the research, rather than targeting the author personally and/or the institution/s of author/s. Personal criticism shifts the focus away from the research and into the monarchy of personal attacks. According to Prasad and

Ioannidis (Wallace and Siersema, 2015) “reputational tarnishing”, “degree of moralizing”, and “calls to suspend/censor/retract the work or the author” are forms of obsessive criticism. According to an article published in the journal *Science*, “rude paper reviews are pervasive and sometimes harmful” (Wilcox, 2019). This not only detracts from the intellectual rigor of scholarly discourse but also creates an environment where authors may become reluctant to share their work for fear of personal attacks. Preventive and therapeutic approaches in this context may encompass various strategies, such as enhancing awareness, recognizing and mitigating exacerbating elements, imposing constraints on the quantity of content handled by editors, purposefully pairing commissioned editorials, assimilating contentious discussions from unregulated platforms like social media or PubPeer into the pages of scientific journals, upholding dignity, prioritizing evidence-based discourse, and abstaining from making personal statements/comments (Wallace and Siersema, 2015).

Intimidation

Author intimidation by journal editors may manifest in several ways, each with varying degrees of severity. The following are common instances of intimidation, often stemming from the editorial process:

Unjustified delays/rejections

Editors may unduly delay and/or bypass the review process and render decisions based on personal judgment. This can leave authors in limbo, anxious about the fate of their work and future career prospects (Powell, 2016). In March 2012, Stephen Royle, a cell biologist at the University of Warwick, United Kingdom initiated a personal mission for publication (Powell, 2016). His recent research addressed a contentious question concerning how cells detect the alignment of chromosomes before division. Initially submitted to *Nature Cell Biology*, a well-reputed journal in his field, the manuscript faced rejection without undergoing a review (Powell, 2016). Pending several rejections and resubmissions, Royle’s manuscript was accepted for publication pending a delay of 317 days with an additional delay of 53 days until online publication (Powell, 2016). Royle expressed that the multiple rejections had a demoralizing impact, particularly on his student, who needed the study published for graduation (Powell, 2016). Royle further stated that the average time from first submission to publication mirrored that of a human gestation period, ~9 months (Powell, 2016).

Harsh or unprofessional feedback

Maintaining a respectful tone in peer reviews is crucial, irrespective of the overall quality of the manuscript. Authors invest significant effort in conducting their studies, preparing, and submitting their papers, often presenting their best work for evaluation. Therefore, it is imperative to maintain a collegial and respectful demeanor, acknowledging and appreciating these dedicated efforts. Editors may provide feedback in a condescending, disrespectful, or unconstructive manner (Zazgyva et al., 2017). This not only undermines the author’s confidence

but also detracts from the quality of the manuscript revision. If an editor finds fault with the scientific quality of a manuscript, it is imperative to maintain professionalism and objectivity in the critique, refraining from making statements that pertain to the author’s representation of their institution based on the perceived inadequacies within the manuscript. Certain journals provide their assigned editors with the discretion to refrain from including unprofessional or discourteous comments when communicating with authors (Mavrogenis et al., 2020). This stands in contrast to other journals with policies that prohibit editors from redacting any content, obliging them to present reviewers’ comments to authors in their entirety. The responsibility for overseeing reviewer comments falls on journal editors. In instances where researchers encounter a rude peer review, it is advised not to be disheartened but instead to respond to the editor. Authors can express that they have received a review that they find inaccurate or impolite, and request to be reassigned to another reviewer for a more objective evaluation of their manuscript. However, in cases where an editor-in-chief (the most powerful authority on the journal’s platform) may opt to reject a manuscript without conducting a peer review and provides the authors with harsh feedback in an unprofessional manner, whom should the authors contact for communication? It is suggested that the assessment of scientific merit should remain focused on the content and methodology of the research rather than making implications and/or generalizations about the author’s experience in the field of study, age, gender and/or institutional affiliation. According to Nobarany and Booth (2015), inexperienced researchers exhibited a higher frequency of unreserved criticism compared to their experienced counterparts. Additionally, reviewers tended to employ positive politeness strategies, such as compliments, more frequently when engaging with less experienced authors (Nobarany and Booth, 2015).

Editors as authors in their own journals—Navigating ethics and integrity

The phenomenon of editors publishing multiple articles within their own journal/s warrants careful consideration from an ethical standpoint. In a systematic review, Helgesson et al. (2022) assessed studies on the prevalence of editors publishing in their own journals and performed a regularizing ethical evaluation of this practice. In this systematic review (Helgesson et al., 2022), 15 studies were included. The results showed that self-publishing varied significantly across fields, journals, and editors, encompassing those who refrained from publishing in their own journal to others who extensively contributed to their own journal (Helgesson et al., 2022). The authors also noted that numerous studies incorporated into their systematic review exhibited methodological inaccuracies (Helgesson et al., 2022). However, findings of this systematic review (Helgesson et al., 2022) indicated instances where self-publication rates were notably elevated. Helgesson et al. (2022) proposed that editors-in-chief and associate editors, vested with substantial influence in their respective journals, abstain from publishing research articles within the journals they oversee. Helgesson et al. (2022) further proposed that journals should establish stringent

and transparent protocols regarding the handling of manuscripts submitted by members of the editorial board. Authors of the present mini-review applaud the study by Helgesson et al. (2022) as such practices may raise concerns about the potential compromise of the peer review process, as editorial oversight may be perceived as influencing the objectivity and rigor of the evaluation. Moreover, repeated publication of studies authored by journal editors within their own publication domain may create an appearance of impropriety, casting doubt on the impartiality and fairness of the editorial decision-making process. From a scholarly perspective, this may undermine the principle of merit-based publication, where contributions are assessed solely on their academic and scientific merits. Furthermore, the act of publishing multiple articles within one's own journal may contribute to the distortion of citation metrics and impact factors, influencing the perceived significance and impact of the journal within the academic community. Ethical guidelines within the scientific community emphasize the importance of transparency, fairness, and avoidance of conflicts of interest. Therefore, editors engaging in the practice of publishing multiple articles within their own journal should be vigilant in adhering to rigorous editorial standards and transparent disclosure of potential conflicts, thereby upholding the integrity and credibility of the scientific publishing process.

Recommendation/anonymous surveys

Typically, publishers extend invitations to authors to partake in surveys assessing their experiences with the publication process. However, authors of the present mini-review propose that journals should also proactively invite authors to participate in anonymous surveys specifically focused on the submission, review process and communication with the handling editor and editor-in-chief. The implementation of such anonymous surveys holds the potential to uncover and address any potential conflicts of interest and/or controversies that may arise during manuscript submission, interactive review, and decision phases, which might otherwise remain undisclosed in the final published article. Engaging in such initiatives can also serve as a valuable educational tool for editors, reviewers, and prospective authors submitting future contributions.

Conclusion

The pervasive issue of bullying and misconduct in professional settings and their negative impact on academic publishing

cannot be overlooked. The implementation of routine mandatory educational training for authors, reviewers, and editors may serve as a proactive measure that can effectively mitigate the risk of bullying within the realm of scientific publishing.

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The scope of this mini-review is expressly devoid of any intention to direct scrutiny toward any specific entity, be it a journal, editor, reviewer, panel of reviewers/editors, and/or publisher. The primary objective of this mini-review is to elucidate the elements that have the potential to undermine the transparency of scientific research and its dissemination.

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Psychophysiological wellbeing in a class of dental students attending dental school: anxiety, burnout, post work executive performance and a 24 hours physiological investigation during a working day

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Aim: To the best of our knowledge, dental school students have never been evaluated for stress, anxiety, burnout, physiological indexes during a 24-h working day, and executive function performance post-work and post-work after returning from vacation; therefore, this research has been conducted.

Methods: Data were acquired at the Dental School of the University of Padua on 16 students in their 4th year, far from the exam session. While performing clinical activity on the dental chair and during a working day, electrodermal activity (EDA), heart rate variability (HRV), and heart rate (HR) were recorded. Participants' stress was measured with the Perceived Stress Scale (PSS-10 scale) and anxiety with the General Anxiety Disorder Questionnaire (GAD-7) and State-Trait Anxiety Inventory (STAI-Y-2), while burnout with the Maslach Burnout Inventory (MBI-HSS). Executive functions were evaluated using the Tower of London test (TOL-R).

Results: Three students (2F/1M) had a GAD-7 score ≥ 10 . Five students (4F/1M) showed trait anxiety. Moderate levels of perceived stress were reported in 85% of participants. MBI-HSS showed that 7 participants scored high on emotional exhaustion and 7 on depersonalization. TOL-R performance ($M = 15.85$, $SD = 4.01$) was below the normative value $p < 0.00001$. A second test, after the holidays, showed normal values. EDA was higher during children's treatment ($p < 0.05$), ANOVA showed high HR during working time ($p < 0.001$), and HRV was higher in males ($p < 0.001$).

Conclusion: Based on the sample size evaluated, it is reported that being a dental student has a moderate impact on stress, anxiety, and burnout while a strong impact on executive functions buffered by rest.

KEYWORDS

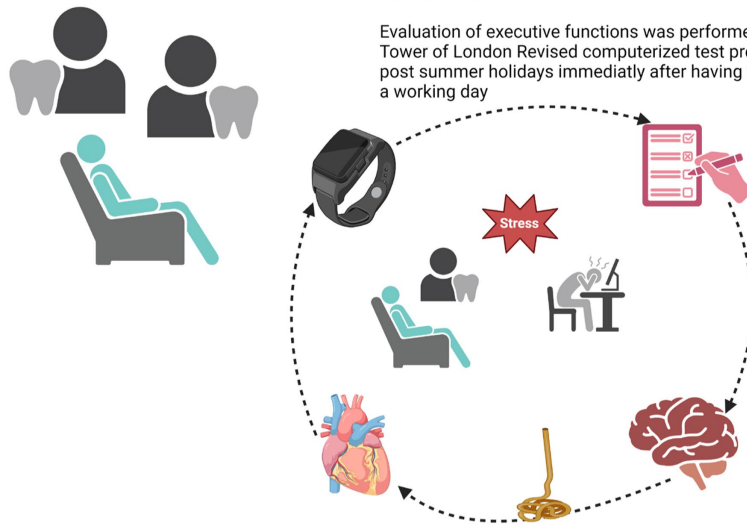
anxiety, dentistry, executive functions, psychophysiology, stress, burnout

Introduction

Material and methods

The following questionnaires were administered:
State trait anxiety inventory 2
General anxiety disorder 7
Maslach Burnout inventory HSS
Perceived Stress scale-10

Conclusion



Many studies tried to assess stress and anxiety among dental students with validated questionnaires such as the Perceived Stress Scale (PSS), Maslach Burnout Inventory (MBI), and General Anxiety Disorder questionnaire (GAD), and others based their evaluations on customized interview questions with the limit of never supplying objective measures (Alzahem et al., 2011; Smolana et al., 2022). Therefore, the heterogeneity of questionnaires and interview questions used in the different studies does not allow for the reaching of solid conclusions (Elani et al., 2014). Despite these limitations, Deeb et al. found that 40% of dental students in their sample encountered the criteria for burnout subscales (Deeb et al., 2018). The beginning of clinical training and contact with patients are the main stressor agents for dental students (de Souza et al., 2023). Female students report

In addition to questionnaires, a psychophysiological measurement of stress and anxiety can be performed by monitoring psychophysiological variables such as electrodermal activity (EDA), heart rate (HR), and heart rate variability (HRV) (Queirolo et al., 2023). EDA is an index of pure sympathetic activity, which shows the activation of the “fight or flight response,” while HRV is a pure parasympathetic index that is directly proportional to a better ability to manage stress and healthy conditions (Tiwari et al., 2021; Rahma et al., 2022). These indexes are of paramount importance and extensively validated in the literature in relation to stress and affective responses with HRV a little ahead of EDA. Several meta-analyses and systematic reviews support that HRV is an index of wellbeing and is lowered in anxiety or stress-related disorders (Thayer et al., 2012; Cheng et al., 2022; Peabody et al., 2023). EDA, although extensively validated, is still on the rise for ecological applications outside of lab applications (Posada-Quintero and Chon, 2020; Zhu et al., 2023). However, it must be underlined that models for stress detections based on EDA usually reached 82.6% accuracy (Klimek et al., 2023). With limitations of consensus on the threshold adopted and filtering used,

there are also some interesting studies that support EDA as the moderator between depression and suicidal ideation in patients with anxiety and depressive symptoms (Sarchiapone et al., 2018; Pruneti et al., 2023). These parameters can be measured with wearable monitoring devices and can provide data for psychological-related issues (Hickey et al., 2021) and the evaluation and monitoring of work-related performance (Bhoja et al., 2020; Claverie et al., 2020). Particularly, psychophysiological variables are gaining interest in the assessment of stress and burnout in the field of occupational medicine (De Looff et al., 2018). Recent findings in Dentistry suggest that they can also supply information to assess dental anxiety in patients (Drury and Simonetti, 2019; Košir et al., 2021; Torres-Gomez et al., 2021).

The aim of this study is to examine psychophysiological parameters during working hours, psychological data, and executive functions in dental students, comparing their physiological parameters during the day (working hours activity, daytime, i.e., non-working hours activity, and sleep), and investigate if there is any difference between those working with adults (C.rossa group) and those working with pediatric patients (Treviso group). Furthermore, as a secondary outcome, this study aims to explore gender differences according to physiological or psychological data.

Materials and methods

Psychological data and physiological measures were recorded from 16 healthy dental students attending the Dental School of the University of Padua (Padua, Italy) between 31 October 2022 and 22 December 2022 for the first part, far from exam sessions and the retest of TOL-R after summer holidays far from exam sessions. Exclusion criteria were cardiovascular diseases or psychiatric disorders. A diary with relevant information was also compiled by participants to assess if there would have been any excessive stress during the day or working activity. The inclusion criteria were being a dental student at the Dental Clinic of the University of Padua, attending the pedodontics unit, or a general dentistry office with adult patients. The age of participants (11 females and 5 males) ranged from 23 to 32 years. This study is composed of a mixed design: a within-participants study and a between-subjects study. The physiological activity of each participant was evaluated according to three periods: working time, daytime, and sleep during 24 h. Furthermore, students were also divided into two groups: 8 worked in the pedodontics office with pediatric patients (Treviso group; younger than 14 years) and the other 8 spent the working day in a general dental office (C.rossa group; with adult patients). Written informed consent was obtained from all the participants. Data were acquired between September 2022 and January 2023. The study was approved by the Ethical Committee of Azienda Ospedale—Università di Padova, n. 278n/AO/23.

Evaluation of stress

The stress levels of participants were measured through the Perceived Stress Scale (PSS-10). Scores ranging from 0 to 13 are considered low stress. Scores ranging from 14 to 26 are considered moderate. Higher than 26 would be considered high perceived stress. This scale reflects the perceived stress levels in the last month.

Evaluation of anxiety and burnout

Anxiety levels of participants were measured with the State–Trait Anxiety Inventory Y2 (STAI-Y2) (Spielberger, 1989) and the Generalized Anxiety Disorder questionnaire (GAD-7) (Spitzer et al., 2006). Maslach Burnout Inventory HSS questionnaire was also administered to participants (Maslach and Jackson, 1981). The subjects can be defined as anxious with STAI-Y-2 scores equal to or greater than 44, while regarding the GAD, different thresholds define normal, moderate, or severe generalized anxiety. The GAD value that the literature describes as the cutoff for a diagnosis of generalized anxiety disorder is a value equal to or greater than 10. Burnout is a multidimensional phenomenon. Suggestion of possible burnout syndrome is suspected when someone shows high levels of emotional exhaustion and depersonalization accompanied by low levels of personal realization (Maslach and Jackson, 1981; Maslach, 1993). MBI-HSS Italian's normative data suggest high emotional exhaustion when the scores are equal to or above 23, high depersonalization when scores are up or above 6, and low professional realization when scores are lower or equal to 31 (Sirigatti and Stefanile, 1993).

Evaluation of cognitive performance

The Tower of London test (TOL) at the end of a regular day of work and after the summer holidays is the only evaluation that was repeated to explore if resting activities could buffer their very low executive performance in the first instance. This cognitive test evaluates executive functions, a set of modules very sensitive to excessive stress that regulate the cognitive system's planning, control, inhibition, and coordination processes (Schnirman et al., 1998; Boccia et al., 2017).

Physiological measures

Physiological parameters were obtained using Empatica E4, a wearable device in the form of a bracelet that measures electrothermal activity (EDA), blood pulse volume—from which heart rate (HR) and heart rate variability are derived (HRV)—temperature, and movement (Garbarino et al., 2014). EDA is a property of the skin that highlights the variation of electrical conduction in response to sweat secretions and is a pure sympathetic index (Boucsein, 2012). HRV is the physiological variation of the time interval between heartbeats. It is a parasympathetic index that reflects vagal activity and is measured by the root mean square of successive differences between the beat intervals (Shaffer et al., 2014; Ernst, 2017; Kim et al., 2018). This monitoring device was worn by students on their non-dominant hands for 24 h during a working day, and they were asked to report the start and the end of their activity during the day. The 24 h were divided into three monitoring periods called conditions: “work,” “sleep,” and “daytime.” We assume that daytime temporization reflects a similar physiological activity to a non-working day. HR was expressed in beats per minute (bpm) and derived through Empatica algorithms from the blood volume pulse. From inter beats intervals (IBI) and photoplethysmography (PPG) signal, HRV was extracted as the root mean square of successive differences between normal heartbeats (RMSSD) by first calculating from IBI each successive

time difference between heartbeats in *ms*, and then over a short-term period of 30 s. Then, each squared and averaged value was obtained before the square root of the total was derived. The sensor used to detect blood volume pulse is a PPG sensor, which is known to be subject to missing data due to movement/pressure artifacts (Chen et al., 2015). Artifacts were removed, discarding zero values and other single data point outliers. The analysis of EDA resulted in the extraction of the skin conductance level. The electrodes used were silver coated with copper underlay on brass electrodes. The threshold for the amplitude of the significant signal was set to a minimum rise of 0.005 μ Siemens. EDA values were then normalized using the min-max method. Physiological data were down-sampled to 1 Hz and labeled as belonging to condition “work,” “sleep,” or “daytime.” Data of each subject were then aggregated into periods and groups expressing their mean values.

Statistical methods

As a first step, the characteristics of the subjects with anxiety were compared with those without anxiety using dependent t-tests and a chi-squared test. We then next evaluated whether working with children or adults presents some differences. Then, we evaluate if physiological parameters (independently of working setting) differed between subjects during the three periods of the day (“condition” factor, 3 levels, within-subjects), according to anxiety symptoms reported using GAD-7 and STAI-Y2 (factor “anxiety,” 2 levels, between subjects) or gender differences (factor “gender,” 2 levels, female or male). The analyses were performed with R version 3.5.1, which was also used to test the hypothesis of normally distributed residuals on all levels of the model. Separate models were considered for each parameter type (EDA, HR, and HRV).

Results

Welch’s *t*-test and the χ -squared test related to EDA, HR, and HRV according to STAY or GAD-7 values did not show any significant outcome. Pearson correlation test analyzing anxiety or stress and executive performance did not show any significant outcome.

Stress

Fourteen participants showed moderate stress perceived levels, 1 participant showed high perceived stress levels, and only 1 subject scored low on the stress perceived scale (Mean = 19.56, SD = 4.098). The diaries showed five stressful complaints during working activity compared to 7 in non-working activity.

Anxiety

Approximately 31.25% of participants (4F, 1M) showed levels adequate for trait anxiety diagnosis measured with the STAI-Y2 questionnaire (mean = 40.5625, SD = 7.8057). The two groups (adult/pediatric patients) did not show differences in the distribution of trait anxiety. The chi-square statistic (Anxiety-Gender) was not significant. GAD questionnaires revealed that three subjects (2F, 1M) showed

levels of anxiety above the cutoff for the diagnosis of a moderate generalized anxiety disorder (GAD-7 ≥ 10).

Burnout

Five participants showed both high levels of emotional exhaustion and depersonalization. Seven participants showed high levels of emotional exhaustion, 7 showed high levels of depersonalization, and 3 showed low levels of personal realization. None showed high emotional exhaustion, depersonalization, or low levels of personal realization.

Electrodermal activity

Welch’s two-sample *t*-test showed a significant difference ($t = -2.6598$, $df = 32.593$, $p\text{-value} = 0.01203$, 95% confidence interval -2.3586374 to -0.3136082) among EDA values of students in the dental office working with adults (mean = 0.7474038) and pediatric patients (mean = 2.0835266) (Figure 1).

Heart rate

Welch’s two-sample *t*-test did not show a significant difference between the two groups (adults/pediatric patients). The ANOVA showed an effect of daytime versus night-time status independently of group pertinence, sex, or anxiety: heart rate during working hours was higher than during sleep and non-working daytime status ($p < 0.001$) (Figure 2).

Heart rate variability

Welch’s two-sample *t*-test did not show a significant difference between the mean HRV values of the two groups (adults/pediatric patients). On the other hand, the ANOVA showed a higher parasympathetic tone in men ($p < 0.001$) than in women regardless of working conditions (day, work, and sleep) (Figure 3).

Cognitive performance

Cognitive performance at the Tower of London test at the end of a working day was deficient; 13 out of 16 subjects performed below-average scores (Mean = 15.87, SD = 4.01) and 62% of our sample showed a performance at least below 1.5 SD and 37% more than 2 SD below average (Figure 4). TOL-R validated values are 22.6 with SD = 4.7, and it has shown to be psychometrically superior about reliability in comparison to TOL (Schnirman et al., 1998). Given the result, we also investigated participant commitment to doing the test, and only one dental student declared to have provided a low effort doing the test. Therefore, we administered the TOL-R also after the summer holidays to understand if this drop in cognitive performance was due to excessive workload as suggested by the questionnaires. Data showed that cognitive performance, after holidays, returned to normal value (Mean = 19.56, SD = 4.81). We also checked with the F-test for equality of variances (after checking the Kolmogorov–Smirnov normal

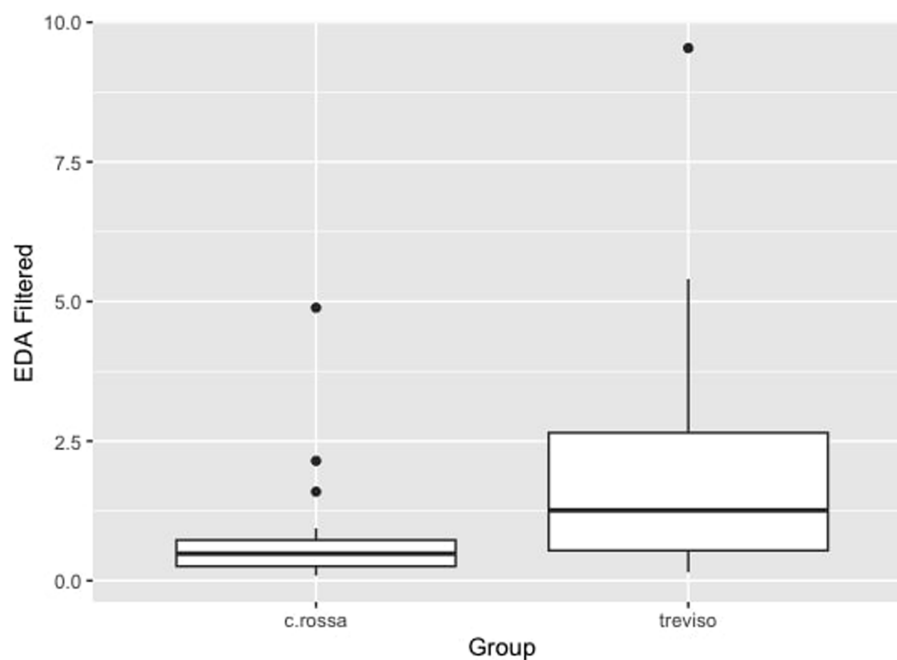


FIGURE 1

Electrodermal activity, EDA, comparison between Croce Rossa group (dental student dealing with adults) and Treviso (dental student dealing with children) $p < 0.05$.

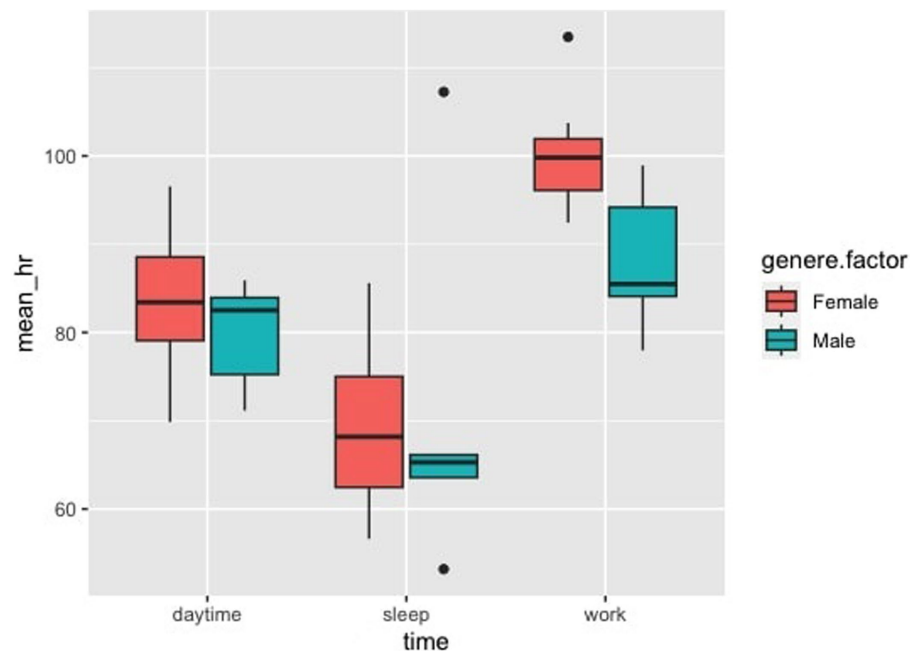


FIGURE 2

Heart rate, HR, according to anxiety levels and conditions: no effect have been found for anxiety levels on physiological data, but there is a difference between HR in relationship to work vs. sleep and work vs. daytime, $p < 0.001$.

distribution of our TOL-R scores). Our sample population's variance ratio is considered equal to the TOL-R population's variance ratio, the p -value was 0.5242 ($p(F \leq 1.3737) = 0.7379$), and $F = 1.3737$ in the H_0 regions of acceptance [0.4301, 2.6517]. Therefore, their low performance cannot be explained by a difference in variance between

the two samples, but they pertain to two different groups with the same variance. Given the assumption, we calculate a one-tail T-test to evaluate the magnitude of the difference between TOL-R validation values and the data provided by our sample. The values from TOL-R validation are greater than those of our sample $p < 0.00001$ $T = 5.1059$

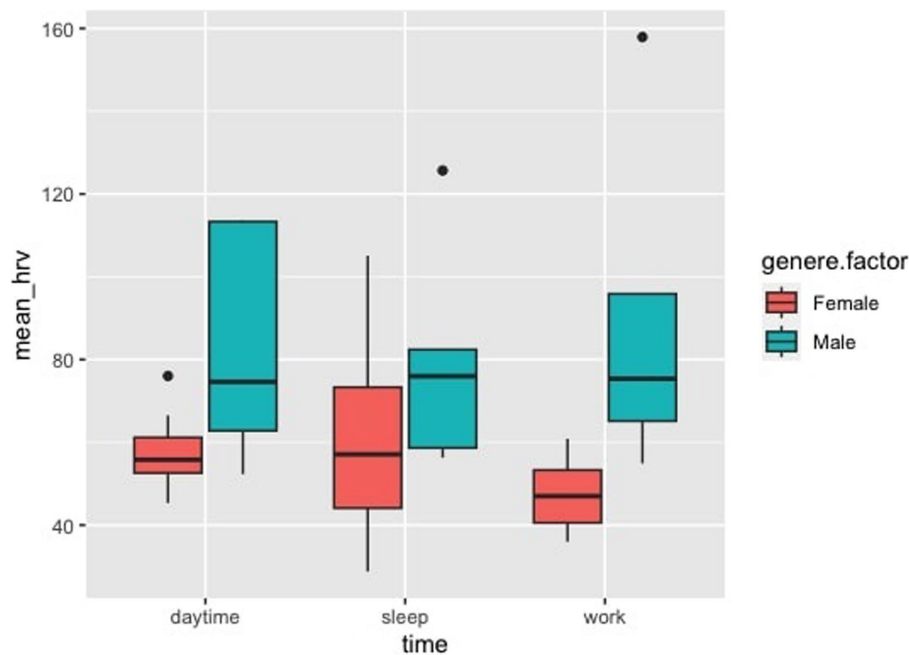


FIGURE 3

Heart rate variability, HRV. Analysis of variance in relationship to being female or male in three different times: daytime = non-working activities, sleep, and working activities = dental students working in the Dental Clinic. It is possible to appreciate that male independently of conditions express higher parasympathetic activity, $p < 0.001$.

region of acceptance $H_0 [-\infty, 1.682]$, the effect size d is large 1.58, indicating that the magnitude of the difference between the averages is large.

Discussion

Several studies tried to measure stress in dentists with both objective and subjective parameters (DiMatteo et al., 1993; Moore and Brødsgaard, 2001; Myers and Myers, 2004; Newton et al., 2006; Bodner, 2008; Tammayan et al., 2021). Very few have tried to investigate the physiological and psychological activity in an entire working day (Queirolo et al., 2023). However, no study, to the best of our knowledge, has ever addressed a class of young students in a holistic evaluation through the psychological, physiological, and executive functions conundrum.

Starting from the analysis of psychological data, the fact that working with patients is an anxiety-producing event is confirmed (Enkling et al., 2006). Significant is the fact that as many as 31.25% of dental students have an STAI-Y2 score that demonstrates trait anxiety, in agreement with the largest meta-analysis carried out in 2019 (Quek et al., 2019), which showed anxiety disorders in 33.8% of medical students (95% confidence interval, 29.2–38.7%). The prevalence of generalized anxiety disorder in our sample was 18.75%, while among the medical professionals, it ranges from 2.8 to 8.5% and from 1.6 to 5% in the general population (Leon et al., 1995; Olfson et al., 1997; Roy-Byrne and Wagner, 2004; Kessler et al., 2005).

The two groups showed different sympathetic activities, as shown in Figure 1. Working in contact with children (Treviso group) caused greater sympathetic activity, probably because relating to a child is more complex than with a collaborating adult (C.rossa group). In the

within-participants analysis, heart rate was shown to be different in the working condition compared to both the non-working daytime condition and the sleeping condition, with average levels close to tachycardia in the working condition (Figure 2). This demonstrates the considerable cardiovascular effort these young students are subjected to. It should be remembered that a higher heart rate is associated with a higher chance of death from both cardiovascular and non-cardiovascular causes (Woodward et al., 2014; Alhalabi et al., 2017).

The Tower of London test showed below-average scores, with a small number of subjects (2) meeting the normative values at the end of a working day (Figure 4). This has huge implications demonstrating how much stress, subcomponents of burnout, and anxiety can alter planning ability and mental organization. Executive skills are the hallmark of the functioning of the prefrontal cortex. The dependence of cognitive fatigue due to work is also confirmed by normal values post-holidays. A higher level of stress corresponds to worse performances in identifying and treating caries and/or other oral pathologies. Until 2018, no one cared about this relationship when Plessas et al. highlighted a “gap” in the literature (Plessas et al., 2018). A subsequent study filled the pre-existing “gap” demonstrating that stress measured with VAS in relation to time pressure is an important marker of poor clinical performance (Plessas et al., 2019). Using anxiety or perceived stress, we did not find any significant correlation with executive functions; nonetheless, their executive performance was below normative values, and they have already demonstrated moderate stress and a high prevalence of general anxiety disorder and anxiety. The secondary outcome, to investigate the presence of gender differences, has reported that female students had a lower parasympathetic tone regardless of the condition analyzed (daytime, work, and sleep), as shown in Figure 3. This finding contrasts with

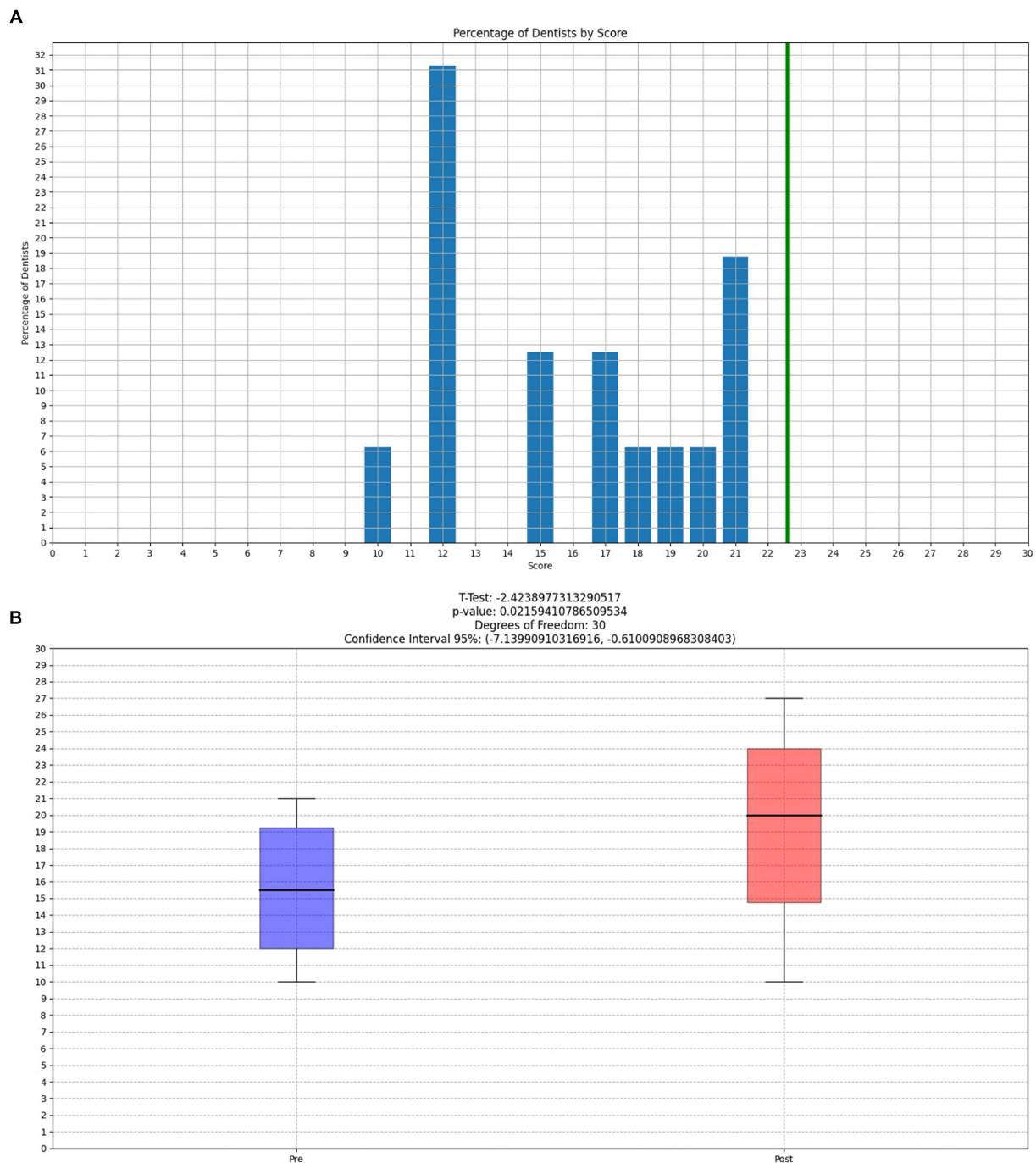


FIGURE 4

(A) Dentists' Tower of London Revised (TOL-R) score, showing the densities of post-work scores. The Green line represents the mean of normal Normative value for TOL-R (22.6). Participants showed a mean of 15.87 and a comparable SD in comparison to normative values 4.87 vs. 4.01. From this image, it is possible to appreciate that no participant reaches the mean of normative value. (B) T-test between pre-holidays and post-holidays Tower Of London-Revised (TOL-R) cognitive performance.

the current literature, which shows a higher parasympathetic tone in female than in male (Koenig and Thayer, 2016).

The study we have conducted concretely demonstrates that a lower cognitive performance is associated with stress biomarkers (lower HRV in Females, higher EDA in dental students working with pediatric patients, and higher HR in all groups during working time).

The limited sample suggests being cautious to generalize the data to the general population; furthermore, it is difficult to understand what has contributed to the actual situation. Longitudinal studies, therefore, are needed. Another weakness resides in the fact that no correlation between anxiety or stress and executive performance was found; for anxiety, this probably resides in sample limitations, while for stress, it is because all subjects scored high in their perceived

stress levels and were quite homogeneous in this sense; furthermore, the distribution of perceived stressful events was quite the same across the working day and non-working day activities and above all, no complaint suggesting a non-routine day of work has been reported by participants.

The data presented in this study highlight the complex relationship between stress, anxiety, burnout, and executive functions. Our data showed that general anxiety disorder and trait anxiety appear to be very common in dentistry and can be found in dental school attendance periods. Quite all participants referred to moderate perceived stress levels, but more than half showed a performance in executive function far lower than expected, highlighting the difference between the perception of stress and performance in people perceiving being moderately stressed. This study also highlights that subcomponents of burnout can be detected already from attending dental school. In comparison with the data presented by Deeb, our research on a whole class of dental students highlights 43.75% of emotional exhaustion and the same percentage for depersonalization, and we also evaluate personal realization (18.75% of our sample showed low personal realization) that relates to mastery and social connections. We did this investigation because burnout can be buffered by personal realization; in fact, being in an environment that promotes development and a caring and positive attitude can significantly impact stress-related issues (Karasek, 1979; Karasek and Theorell, 1990). Although based on a small sample size, our study underlines that burnout is a multidimensional construct and that the data presented by Deeb suffer from inflation because of methodological issues: proxy questions, partial evaluation where personal realization was not taken into account, and data of participants with all the three subcomponents of burnout were not provided (it is necessary to meet all the three subcomponents criteria for a burnout diagnosis). This data supports the necessity of psychological counseling and the urge to implement stress management, which has been shown to be useful in the general population (O'Toole et al., 2018; Vos and Vitali, 2018; Nakao et al., 2021), in dentists (Chapman et al., 2017), and probably also in young dental students.

Conclusion

From the data, although on a limited sample, appears that a dental student loving his/her future job can buffer the effect of emotional exhaustion and depersonalization on self-perceived stress to manifest the burnout syndrome. However, if dental students are stressed, personal realization cannot alter the deficit in goal-oriented behavior, i.e., it is confirmed that performance is affected by fatigue or stress and loving his/her job is not enough to buffer and therefore refrain from poor executive performance. A deficit in those skills that allow an individual to anticipate, plan, set goals, implement goal-directed projects, monitor, and self-regulate their behavior to adapt it to new conditions is of paramount importance because being a dentist requires these functions as a prerequisite. It is very important to underline that executive performance went back to normative values after the holidays, highlighting the relevance of rest. The interplay between cognitive workload (deficient performance at the Tower of London revised), anxiety, burnout, and stress is supported also on a physiological

basis as the HR during working day was higher than daytime HR. Dentists working with children and, more specifically, females appear to be more at risk. This is the consequence of a higher sympathetic activity, a higher heart rate, and a lower parasympathetic tone. From a general overview, it is possible to sustain that being a dentist is stressful both from a psychological as well as a physiological perspective. All these data show the urge for psychological counseling, training in stress management, the importance of a global approach that can allow for improving performance through improving subjective wellbeing, and prove the relevance of rest.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Ethical Committee of Azienda Ospedale – Università di Padova, n. 278n/AO/23. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

LQ: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing – original draft. AR: Writing – original draft. SP: Writing – review & editing. FL: Writing – review & editing. CB: Writing – review & editing. GZ: Project administration, Supervision, Writing – review & editing.

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Gender equality among medical and dental academic researchers in West Africa: a theoretical analysis of a compendium of research

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Background: This study conducted theoretical analyses of the findings of a study on gender disparities in research productivity and leadership in medical and dental research institutions in Nigeria. The aim was to highlight the connectedness of the study findings, and to develop a conceptual framework that can inform future studies on gender equity in academia across West Africa.

Methods: A content analysis of the research outputs was conducted using four theoretical frameworks to assess the alignment of the study findings with gender equality goals. The research examined policy effectiveness and institutional practices using the 2008 USAID Gender Equality Framework; analyzed how personal traits, societal expectations, and organizational practices intersect using Fagenson's Theory of Gender and Career Development; uncovered gendered power dynamics and inform strategies for institutional reform using the Feminist Institutionalism Analytical Lens; and shed light on disparities in mentorship, collaboration, and academic publishing using the Academic Literacies Theory.

Results: The key domains influencing gender inequality and requiring targeted actions are: first, the patriarchal societal, cultural, and religious values that shape gender roles, restricting women's career advancement. Second, institutional policies and organizational culture that limits female leadership and research productivity. Third, individual and generational perspectives influence advocacy, with younger individuals recognizing inequality more readily. Research productivity and leadership disparities can be addressed through mentorship and training programs for early-career researchers that foster the development of gender-sensitive advocates. The developed conceptual framework outlines three core research and action domains—societal, institutional, and individual factors—and their sub-factors, alongside targeted interventions influencing gender inequality, proposed targeted recommendations and expected outcomes.

Conclusions: The findings emphasize the multifaceted nature of gender disparities. Strategic actions are needed to address the issues that foster gender equality in medical and dental research institutions, and to support female researchers in West Africa. These actions should focus on the younger generations to drive needed changes.

KEYWORDS

inequality, gender, theoretical frameworks, leadership, research productivity, West Africa, Nigeria

Introduction

In Nigeria, there were 86,885 non-academic male staff and 51,671 academic male staff in the 2018/2019 academic year (1). In contrast, the female workforce consisted of 46,869 non-academic and 16,009 academic staff members in the same academic year (1). This gender disparity also extends to medical and dental research institutions. Within this broader gender gap, it is important to recognize that women in health research face disproportionate challenges including a lower sense of belonging compared with their male colleagues, sexual harassment, and lower pay (2–4). To tackle this issue, it is essential to gain an understanding of the factors contributing to gender inequality in research productivity and leadership roles within medical and dental research institutions.

We conducted a project that identified the obstacles limiting the progression of female researchers in Nigeria's academic landscape; explored how researchers perceive gender disparities within the realm of medical and dental research institutions in Nigeria; examined the decision-making processes employed to address and navigate gender inequities within medical and dental research institutions in Nigeria; explored perspectives on the establishment of a conducive environment for female medical and dental researchers; and identified strategies for enhancing the underrepresented presence of women in the field of scientific research (4).

The project was conducted in four phases. First, a series of interviews were conducted with 30 researchers, comprising 21 female researchers and 9 male researchers, who hailed from Ghana, Senegal, Burkina Faso, Niger, and Mali. The age spectrum among the participants spanned from 30 to 56 years, and their research experience encompassed a range of 5 to over 30 years. Four key themes emerged as barriers to women's career development. First, family- and environment-related barriers were highlighted, with gender norms assigning domestic tasks and responsibilities to women, thereby limiting the time they could devote to research. Second, an institutional culture and policies insensitive to gender dynamics were identified, which exacerbated gender disparities and hindered women from achieving leadership positions. Third, there was a call for emancipation programs for women in research to build resilience and enhance critical decision-making, as existing strategies often focused narrowly on addressing spousal relationships rather than broader structural challenges. Finally, individual perceptions of professional and personal success were noted, with many women viewing themselves as equally competent as their male peers, yet still facing persistent gender discrimination (6).

Second, a qualitative study was implemented between March and July 2022 in Nigeria to delve into the perspectives of researchers regarding gender inequalities and disparities in the career progression and trajectory of medical and dental researchers in Nigeria. Data was generated from 54 medical and dental professionals who took part in the in-depth interviews. The sample comprises 48% females and 52% males, 65% of respondents who were younger than 50 years, and 22% had reached the professorial cadre. Three core themes emerged:

institutionalized male dominance in research institutions, shifting narratives on gender equality in academia, and women leading the push for change. Female medical and dental researchers are challenging androcentric norms in knowledge production, questioning patriarchal values that contribute to low female enrolment in training, limited research outputs, and underrepresentation in senior leadership roles (7).

The study also identified differences in perspectives based on generational and gender divisions. Among the younger generation, both males and females shared a common view on gender inequality in leadership positions and research opportunities, particularly disadvantaging female academics. They emphasized the necessity for change from a human rights perspective. Conversely, the older generation exhibited divergent opinions. Males acknowledged the presence of gender inequality in leadership and research opportunities, but proposed changes based on commodifying women. Older females adhered to traditional views regarding gender inequality. Recommendations for change included removing barriers to education for girls, which restrict their access to capacity-building opportunities (4).

Third, in June 2022, a bibliometric analysis was carried out to evaluate disparities in productivity, influence, collaboration trends, and authorship roles among researchers in the field of dentistry and oral sciences in Nigeria. Specifically, this involved a search and analysis of articles authored by Nigerian dentists, published between 2012 and 2021, and accessible within the Web of Science database related to dentistry and oral sciences researchers. Data was gathered on gender-based distinctions in research output, academic impact, collaborative patterns, and authorship roles, including first, last and corresponding authorship. We identified 413 unique authors who published a total of 1,222 articles on dentistry and oral sciences in Nigeria between 2012 and 2021. Females had a slightly higher average number of citations per author compared to males, and a higher percentage of papers published by males listed international collaborators and domestic collaborators, but these differences were not statistically significant. Significantly, more females than males were listed as first authors, while a significantly greater percentage of males than females were listed as last authors. Additionally, a slightly higher percentage of females than males were listed as corresponding authors (8).

Fourth, between April and May 2023, a descriptive qualitative study was undertaken to gather data through in-depth interviews involving eight senior female researchers who had previously held leadership positions within medical and dental research institutions in Nigeria. The selection of interviewees was based on a pool of 20 eligible female faculty members at Nigerian universities, who occupy managerial roles, and actively contribute to the promotion, design, execution, and dissemination of biomedical, clinical, and socio-epidemiological research within Nigeria. The explorative study shed further light on the patterns of male dominance within research and academic institutions, the gender disparities in women's entry into such institutions, the necessary environment, and resources to promote women's advancement into managerial positions, and the factors contributing to the observed gender differences in research

productivity. While participants acknowledged the increasing presence of females in the medical and dental research academia, there was no consensus that a higher number of first female authorships corresponded to a proportional increase in junior authorships. Patriarchal social practices were identified as potential contributors to the lower participation of females in collaborative research within the dental academia (4).

The findings from this project suggest that gender disparities in research productivity and leadership roles within medical and dental research institutions in West Africa, particularly in Nigeria, are rooted in patriarchal institutional practices, limited access to professional resources, and cultural norms that restrict women's agency. This study aimed to analyze these findings through four theoretical lenses that highlight the impact of patriarchal institutions on advancing gender equality in higher education institutions. The theoretical analysis of the project findings will guide the development of a conceptual framework aimed at driving systemic reforms and targeted empowerment initiatives.

The four theoretical perspectives—the USAID Gender Equality Framework (9), Fagenson's Theory of Gender and Career Development, the Feminist Institutionalism Analytical Lens, and the Academic Literacies Theory—offer complementary yet conflicting approaches to addressing gender disparities in academia. The USAID Gender Equality Framework (9) focuses on structural reforms, advocating for policies and institutional support to ensure equitable access, but it underemphasizes individual agency (10). Fagenson's theory, in contrast, highlights individual career development, mentoring, and networking, prioritizing personal agency within existing systems, potentially clashing with systemic reform approaches (11). Feminist Institutionalism critiques patriarchal systems, calling for structural change to dismantle entrenched inequalities, creating tension with theories like Fagenson's that emphasize adaptation over transformation (12–14). The Academic Literacies Theory highlights implicit norms and power dynamics in academia, aligning with systemic critiques but diverging from frameworks prioritizing resource redistribution by focusing on the hidden curriculum over overt structural change (15, 16).

Methods

Ethics approval

Ethical approval for the conduct of first phase was obtained by the Senegalese National Health Research Ethics Committee was obtained for this study (0000050/MSAS/DPRS/CNERS). Ethics approval for the conduct of the study was obtained from the Institute of Public Health, Obafemi Awolowo University, Ile-Ife, Nigeria (IPH/OAU/12/1617).

Theoretic analyses

A content analysis of the research outputs was conducted to assess their alignment with gender equality goals. Using the

USAID Gender Equality Framework (9), the research examined policy effectiveness and institutional practices. Fagenson's Theory of Gender and Career Development guided the analysis of how personal traits, societal expectations, and organizational practices intersect. The Feminist Institutionalism Analytical Lens uncovered gendered power dynamics and inform strategies for institutional reform, while the Academic Literacies Theory shed light on disparities in mentorship, collaboration, and academic publishing. Findings from bibliometric analysis and interviews were triangulated to ensure validity.

Results and discussion

The study results offer insights into a regional context that elucidates the observed gender disparity in the career trajectories of women in research. This adds valuable context to the global discourse on promoting gender equity in global research career development. Furthermore, the findings from the Nigerian segment of the study support a feminist institutionalist perspective that contends societal inequality is perpetuated within political and social institutions, such as higher education institutions (17). Understanding how context-specific institutional rules, processes, and norms contribute to gender inequality enactment can inform institutional gender equality programs and strategies. This study is the first to explore the how and why of gender inequality enactment in medical and dental schools in Nigeria, thus providing a framework to support potential gender reforms within these institutions.

Barriers to the career advancement of women researchers in some West African countries

The current study highlights that the gendered roles of women in overseeing domestic and caregiving duties remain significant barriers to their participation and advancement in research. This aligns with Milewski et al. (18), who highlight the challenges women face balancing work and family life, often resulting in precariousness. Our study shows that family responsibilities frequently limit women researchers' time for career development, echoing Sayer's (19) observation that women spend more time on unpaid domestic work than men. In African households, subordinate roles (20) often require women to seek spousal approval for career pursuits, deterring many from entering research. This dynamic may contribute to persistent gender disparities in West African biomedical research careers (21), necessitating further investigation.

Organizational factors also hinder women's career progression. Research institutions in West Africa often reflect societal gender inequalities, with organizational cultures favoring male professors and students (22, 23). Leadership structures and power dynamics are shaped by male expectations, forcing women to navigate both domestic gender norms and institutional biases. These challenges frequently lead women to prioritize societal expectations over

career ambitions. Prior studies had identified that male-dominated networks, bullying, and harassment are common challenges women face in male-dominated institutions (24). However, some academic institutions implement programs to promote gender equity, primarily targeting individual and interpersonal interactions (25).

Institutional changes need to be complimented with individual empowerment. Empowerment involves a socio-political process where women become aware of and transform relations of domination. For example, in our study, some women researchers in Togo prefer their husbands take second wives in polygamous unions to delegate domestic tasks and create career time (26). Divorce is less favored, likely due to societal stigma that limits leadership opportunities for unmarried women.¹ The USAID Gender Equality Framework (9) underscores the importance of addressing individual, structural, and societal factors contributing to these disparities. In addition, the findings align with Fagenson's theory, which highlights the interplay of family dynamics, organizational factors, and career development strategies. Traditional gender roles continue to influence the work-family dynamic, and the disproportionate share of unpaid domestic work limits their time for research and career advancement (18, 19, 27).

Spousal support reduces the likelihood of women leaving the workforce due to domestic pressures (28, 29). Cultural differences in spousal support are notable. In Saudi Arabia, women emphasized the importance of spousal assistance with household tasks over financial support (30), while in India, shared domestic responsibilities and emotional encouragement were key to career advancement (31, 32). Our study on Nigerian medical and dental academia revealed that male involvement in decision-making, and the lack of shared domestic responsibilities constrain women's career advancement. Unlike previous discussions, this study highlights the restricted autonomy of educated, socially advantaged women beyond household needs, calling for an intersectional feminist approach to address these intertwined dimensions of identity and power.

The current study findings highlight the need for further exploration of women's empowerment and emancipation within the context of societal constraints. This imbalance is worsened by limited mentoring, and perceived poor organizational support (33). This imbalance affects their engagement in research activities and hinders career progression highlighting the need for spousal support for career advancement (34). Using the academic literacies theory lens, this struggle aligns with the view of academic writing as a complex skill requiring training (35), emphasizing the need for innovative solutions to support skill acquisition within their contexts. Local traditions must be

considered to address cultural barriers to women's career progression. Empowerment should be framed as a multidimensional socio-political process extending beyond academic literacy to navigating complex institutional dynamics.

Strategies to enhance women's involvement in research and academia through policies that increase access to essential resources such as time, support networks, and career development opportunities are needed. Addressing the burden of unpaid domestic work, promoting equitable resource access, and empowering women to manage dual roles and decision-making within the family are critical. Achieving gender equality requires both short-term empowerment initiatives and long-term systemic reforms, tailored to culturally appropriate strategies, to create an inclusive and equitable academic environment.

Researchers' perceptions of gender equality enacted in the medical and dental research field in Nigeria

The study also observed that research institutions in West Africa often replicate broader societal gender inequalities, aligning with Fagenson's theory and feminist institutionalism. Male-dominated networks within these institutions create additional barriers for women, reinforcing power structures and organizational cultures that cater to male expectations (36). These challenges highlight systemic issues that demand institutional reforms to foster gender equity, as emphasized by Rathgeber (23).

The individuals who participated in the current study expressed a growing awareness of the need for change, and are advocating for a shift in the current paradigm both at the individual and collective levels, among women in academia. To facilitate this transformation, several opportunities were identified. These include the implementation of institutional policies explicitly promoting gender equality, and the establishment of specialized gender-focused units within research institutions dedicated to implementing these policies.

This has significant implications, particularly in how domestic responsibilities and career interruptions for family-related reasons can disproportionately affect women's research outputs and career advancement compared to their male counterparts. The study suggests that the limited environmental support for research within Nigerian institutions may have a more pronounced impact on women. This is because women often find it challenging to access sponsored opportunities for capacity development due to their obligations to stay home, even when such opportunities arise (37). For instance, women may be less able to take up research grant opportunities, even when these grants are designed to favor the selection of female researchers, due to the caregiving responsibilities they bear. These interruptions to capacity building and empowerment opportunities during the early stages of a woman's career can be difficult to overcome in later years, leading to a widening gender competency gap. The failure to recognize years spent managing households as valuable managerial skills and the insufficient

¹Merluzzi J, Phillips DJ. Leadership and the single woman penalty: a role expectations account of promotion penalties toward female professionals. Available online at: <https://sites.insead.edu/facultyresearch/research/file.cfm?fid=58706> (accessed December 27, 2024).

acknowledgment of home caregiving as valuable work skills contribute to women lagging in assessments of their suitability for leadership roles.

In essence, the study underscores the urgent need for institutional and societal changes to address these deeply entrenched gender disparities within research institutions. The USAID Gender Equality Framework (9) shed light on the pervasive gender disparities within research institutions, that are primarily rooted in deeply ingrained patriarchal values present in both societal and institutional contexts. In addition, study participants' growing awareness of the need for change; the need to establish gender-focused units and promote gender equality policies underscores the importance of policy implementation and structural changes within research institutions. In addition, the revelation that domestic responsibilities and career interruptions disproportionately affect women's research outputs and career advancement reinforces the principles in the USAID Gender Equality Framework (9).

Navigating gender inequity within research institutions and the role of a supportive environment for female medical and dental researchers

While institutional policies and advocacy can contribute to closing gender gaps in research, complete elimination of these disparities remains unlikely. Implementing effective gender equality policies through gender mainstreaming, is a challenging but valuable endeavor (38). In the context of medical and dental research institutions, gender-sensitive policies enacted by dedicated gender focal units could drive progress toward gender equality in research outputs and the representation of women in senior positions. These policies should promote a gender-sensitive review of criteria for appointments and promotions, recognizing the value of home-management skills as administrative abilities. Such efforts could help bridge the gender gap in managerial positions and encourage men to take on caregiving roles without adverse consequences.

The current study findings align with the focus that organizational cultures can either facilitate or hinder women's career advancement (39). The perpetuation of patriarchal values within medical and dental research institutions will require proactive individual and collective advocacy and action by women for organizations to recognize and accommodate women's work-life balance needs (40), including the competency gap resulting from young researchers' career interruptions, and the need for female researchers to access mentorship programs, capacity-building initiatives within organizations that can enable women navigate their careers (41). In addition, the failure to recognize women's skills in managing households and caregiving as valuable managerial and work skills, respectively, reflects a broader societal issue that institutionalizes harmful discriminatory gender norms, beliefs, and stereotypes that hinders women's advancement, and that needs to be addressed.

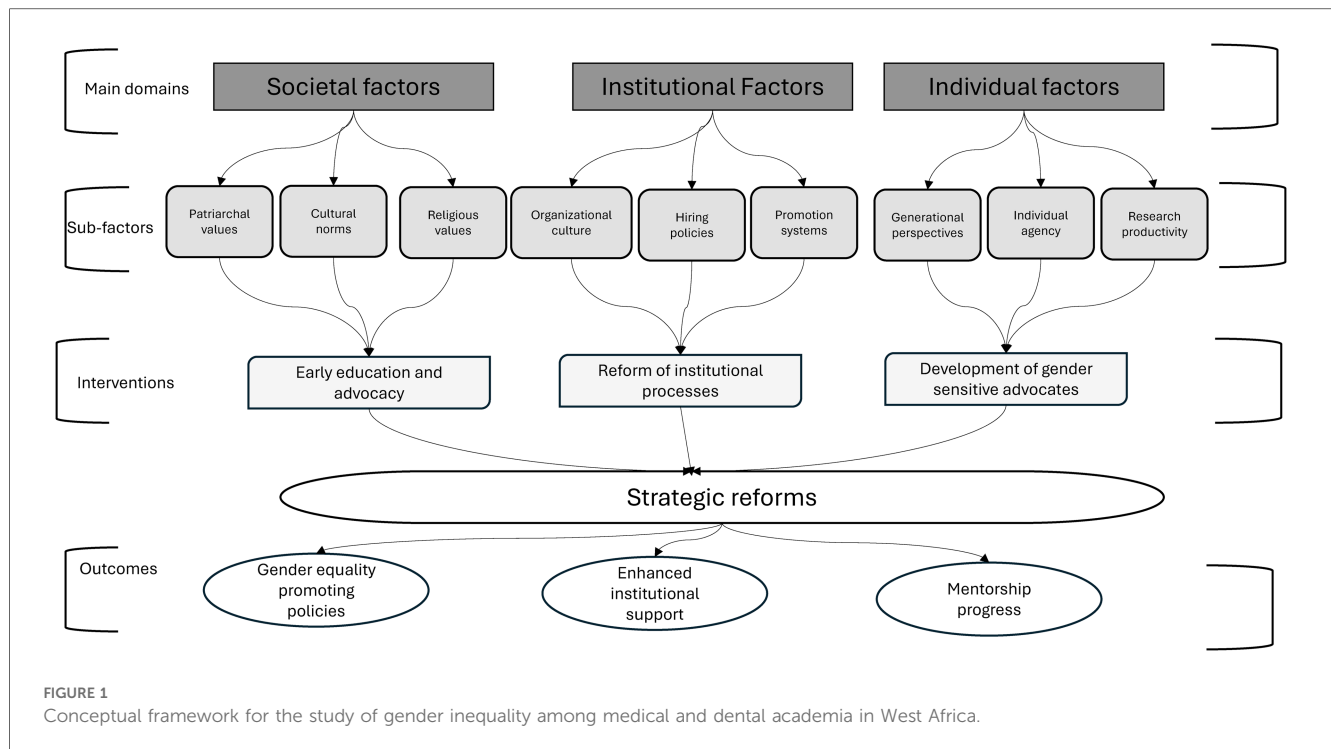
Medical Women's Associations are known for their success in advocating for policies benefiting women in clinical practice (42). They may need to also focus on addressing gender equality challenges in research. Establishing advocacy groups within academia, involving both women and supportive male allies, could be instrumental in championing gender equality and reshaping traditional notions of masculinity. Advocacy involves a combination of individual and collective actions aimed at gaining political commitment, societal acceptance, and systemic support for specific goals (43). While effective, advocacy can be complex, especially for those with limited resources and influence. Further research is needed to assess how gender equality within research institutions contributes to broader sustainability objectives.

Advocacy, while impactful, often brings about change gradually. In contrast, mentorship, especially when led by women mentoring other women and with the support of male allies, has the potential to drive more rapid transformation in the research context (44). Female mentors play a pivotal role in inspiring other women, fostering a sense of belonging and confidence. Institutionalizing mentorship within research organizations or professional associations helps with taking proactive steps to empower women to engage actively in research alongside their peers. However, mentorship strategies need to be gender-sensitive, and not inadvertently reinforce existing gender inequalities or hierarchies (45). Providing mentors with training in gender-sensitive mentorship practices can mitigate these risks.

The feminist institutionalization analysis highlights the need to embed gender considerations in institutional structures and practices making it less vulnerable to shifts in leadership or external pressures. It recognizes that achieving gender equality often requires persistent efforts to challenge and transform entrenched gender norms, including challenging traditional notions of masculinity within research contexts. Advocacy to change traditional notions can, however, be complex, particularly for those with limited resources and influence. The study findings on the need for gender-sensitive policies, dedicated units, advocacy, mentorship, and the acknowledgment of the complexities involved in achieving gender equality also aligns well with the principles and approaches outlined in the USAID Gender Equality Framework (9). Institutional change is often met with resistance and requires sustained efforts. Supportive networks and alliances are also needed to drive gender equality initiatives. Further research is needed to understand the broader impact of gender equality within research institutions on sustainability goals in view of the need to develop a comprehensive plan to address the gender gaps identified.

Conceptual framework to study gender inequity in scientific research in West Africa

Figure 1 depicts the conceptual framework for this study. It outlines three core research and action domains—societal, institutional, and individual factors—and their sub-factors, alongside targeted interventions influencing gender inequality, proposed targeted recommendations and expected outcomes. First,



the patriarchal societal, cultural, and religious values shape gender roles, restricting women's career advancement. Addressing these barriers requires early education and advocacy to promote gender-sensitive attitudes. Second, institutional policies and organizational culture can further limit female leadership and research productivity, making it essential to reform hiring, promotion, and mentorship processes for inclusivity. Third, individual and generational perspectives influence advocacy, with younger individuals recognizing inequality more readily. Fourth, research productivity and leadership disparities can be addressed through mentorship and training programs for early-career researchers that foster the development of gender-sensitive advocates.

The framework emphasizes the interconnectedness of societal norms, institutional dynamics, and individual agency in shaping gender disparities. It aligns with the gender-transformative program framework, which demonstrates how changes in one part of a societal system can ripple outward, influencing networks and diffusing gender-related outcomes beyond immediate beneficiaries. Norm-shifting programs play a crucial role in reinforcing structural changes, ensuring lasting transformations, and expanding gender-transformative initiatives to achieve widespread societal norm change (46). This underscores the necessity of multi-level actions to address gender inequality in medical and dental academia in West Africa, recognizing that interventions targeting any of the subfactors in Figure 1 can spark meaningful change. Sustained efforts can drive reforms, ultimately achieving the outcomes outlined in the conceptual framework.

Gender inequality and health are deeply interconnected, underscoring the need for programs that transform gender dynamics and norms (47). Such programs must address institutional systems and social structures that distribute power

and privilege while simultaneously deconstructing gender norms at the individual level (48). Empowering young leaders and cultivating institutional gender experts to drive inclusivity and advocate for meaningful change in the medical and dental academia in West Africa could be a strategic approach based on the findings of the current study.

Youth-led initiatives are recognized as powerful drivers of gender equality, women's rights, and empowerment, fueled by their passion, creativity, and determination to challenge societal norms and shape a more inclusive future for women and girls (49). However, the transformative potential of young male and female academics in medical and dental fields remains underappreciated. There is a pressing need to inspire and mobilize young academics to actively address gender inequality in their institutions. This would require creating platforms for collaboration, providing mentorship and leadership training, and fostering an enabling environment that promotes gender-reform actions (50). In addition, equipping young academics with the tools and resources to identify and address structural and cultural barriers to equity would empower them to drive meaningful and sustainable change within their institutions. Addressing restrictive gender norms and practices that could hinder the effectiveness of interventions is an essential step in addition to individual level interventions intended to achieve empowerment outcome (51).

The anticipated outcomes include strengthened institutional support, actionable gender-equality policies, and mentorship programs to empower future female leaders in medical and dental academia across West Africa. These efforts are expected to lead to secondary outcomes such as greater representation of women in leadership roles, improved retention and career advancement for female academics, reduced gender disparities in

research productivity, and the creation of a more inclusive and equitable academic environment that benefits all members (52, 53). However, achieving meaningful change may be slow without building alliances with broader social justice movements. Accelerating progress on gender inequality in medical and dental academia will also require active collaboration with men and boys to challenge patriarchal norms through intersectional, antipatriarchal social action (54). This transformative social action must be informed by robust evidence and tailored to the West African context, as indicated by findings from research underpinning this theoretical analysis.

The evidence on gender inequality within medical and dental academia in West Africa remains limited, revealing a significant gap in the global gender equality response. Investing in context-specific gender equality initiatives is more likely to be effective, as these actions address the unique cultural, institutional, and societal factors that shape gender dynamics in the region. Context-specific interventions can better identify and address the root causes of inequality, ensure they are relevant to local needs, and encourage greater stakeholder support, leading to more sustainable and impactful outcomes. While addressing gender inequality does not have to begin with targeting its root causes, it should ultimately aim to eliminate them (55). Moreover, gender inequality in medical and dental academia often manifests in more subtle and implicit forms, necessitating targeted gender policies that address these underlying causes (55). These further highlights the need for institutional reforms beyond individual empowerment efforts to tackle gender inequality in this context.

Study limitations

Although the study provides valuable insights into gender inequities in medical and dental academia in West Africa, it is limited by several factors. The contextual application of theoretical frameworks, developed in broader settings, may not fully capture localized socio-cultural dynamics. Over-reliance on self-reported data introduces potential biases, while limited regional coverage of the study also restricts the generalizability of findings. The study also lacks an intersectional analysis of factors like race and class.

In addition, the study offers limited exploration of men's roles as advocates for gender equity and insufficient analysis of empowerment dynamics beyond academia. Also, theoretical frameworks were used statically, without examining their adaptability to evolving gender dynamics. Addressing these limitations through broader regional and disciplinary coverage, intersectional analysis, and engagement with male allies can enhance future research. This would provide a more comprehensive understanding and actionable strategies for fostering gender equity in West African academia.

Conclusions

This study highlights the complex interplay of societal, cultural, and institutional factors contributing to gender inequality in

scientific research within West African medical and dental research institutions. Rooted in patriarchal norms and institutional biases, these disparities manifest as underrepresentation of women in leadership roles, limited research productivity, and constrained agency in career advancement. Despite these challenges, women researchers are demonstrating resilience and advocacy, though systemic support remains insufficient.

The findings emphasize the urgent need for culturally sensitive strategies, including reforms in institutional policies, mentorship programs, and advocacy initiatives to address visible and hidden barriers. Promoting early education to challenge gender norms, empowering younger leaders, and fostering gender-sensitive organizational cultures are critical for meaningful change. Additionally, enhancing access to resources and recognizing domestic management as a valuable skill for leadership can support the progression of women in academia.

By leveraging these insights and integrating evidence-based approaches, research institutions in West Africa can take strategic steps toward creating equitable and inclusive academic environments, ultimately bridging gender gaps and enhancing research outcomes.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Institute of Public Health Research Ethics Committee, Obafemi Awolowo University, Ile-Ife, Nigeria. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

MF: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. AG-C: Project administration, Supervision, Validation, Writing – review & editing. GM-P: Conceptualization, Funding acquisition, Methodology, Project administration, Supervision, Validation, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Career aspirations of dental students: insights from a multinational study using social cognitive career theory (SCCT)

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Background: Dental students' career choices are shaped by many factors, including their personal abilities and goals, environmental factors and the resources available to them. Understanding the drivers for this career pathway decision is crucial for educational institutions' development of comprehensive curricula. This study applies Social Cognitive Career Theory (SCCT) to investigate the professional aspirations of dental students globally, providing insights into the factors that influence career choices of dental students from different regions to understand how personal, socioeconomic and cultural differences influence their decisions.

Methods: A cross-sectional, multicentred survey was conducted between May and July 2023, involving 1964 dental students from over 20 countries. Self-administered questionnaires based on SCCT were used to assess participants' self-efficacy, professional and personal outcome expectations, career goals, and career path preferences. Statistical analysis, including multivariable logistic regression and mediation analysis, was employed to identify the relationships between the SCCT framework, sociodemographic factors and career aspirations.

Results: The study revealed that 51.2% of participants preferred a specialty in clinical dentistry, while 28.1% aimed for general dentistry. Mediation analysis demonstrated notable pathways from career planning training to career aspirations through self-efficacy, professional and personal expectations. Self-efficacy mediated 26.7%–98.65% of the effect on career preferences coming forward as a key mediator. Demographic statistics demonstrated that regional and economic differences significantly impacted students' career choice, where students from higher-income countries reported more likely to choose general dentistry and those from lower-income countries were more drawn to specialty fields or public health.

Conclusions: This study offers new insights into the global career aspirations of dental students through the prism of the SCCT. These findings highlight the need for dental schools and associations to offer tailored career planning training based on students' backgrounds at an early phase of their education. Providing support and career guidance, especially in underserved regions, can help students make informed decisions that align with their personal and professional goals. This will ultimately contribute to a more diverse and well-prepared global dental workforce.

KEYWORDS

career choice, career counselling, continuing dental education, dental societies, dental students, social cognition

Introduction

Career aspirations encompass the professional objectives individuals establish for themselves, which subsequently inform their decision-making processes and delineate their professional trajectories. Per young adults, career aspirations bear particular significance, as this transitional stage entails the formation of professional identities and the pursuit of designated career paths (1). The examination of young adults' career aspirations yields valuable insights into their motivations, values, and expectations, thereby enabling the development of tailored interventions and support mechanisms to facilitate their professional advancement and achievements (2). Discerning the elements that influence these aspirations additionally facilitates the identification of potential barriers and opportunities for intervention, ensuring that young adults are sufficiently equipped to successfully navigate the intricate and dynamic landscape of professional endeavours (2, 3).

Higher education significantly influences students' career aspirations, including those pursuing dental education (2). While dental schools play a crucial role in equipping students with the requisite knowledge and skills to practice their chosen profession (4, 5), other entities such as dental student organisations, dentist associations and similar NGOs also contribute to shaping their diverse career trajectories, thereby fostering awareness of the extensive opportunities available within the healthcare domain. By collaborating with dental schools, through mentorship programs, career guidance services and professional networks, these organisations provide students with awareness of extensive opportunities within the healthcare domain and support their professional development (5, 6). Altogether this apparatus of institutions guides students in navigating the intricate network of professional endeavours, casting light on the diverse career alternatives and nurturing the competencies necessary for success in these paths (6). Consequently, elucidating the significance of the combined role of dental education institutions, dental professional organizations and student-led NGOs in shaping students' career choices and aspirations is essential for cultivating a well-prepared and motivated workforce, capable of facing the evolving demands of the dental profession and enhancing oral health outcomes for the broader population (7).

The Social Cognitive Career Theory (SCCT) offers an invaluable framework for comprehending dental students' career aspirations. This theory, formulated by Lent, Brown, and Hackett, posits that career development is governed by three principal elements: self-efficacy, outcome expectations, and personal goals (8, 9). Self-efficacy pertains to an individual's conviction in their capacity to successfully execute a particular task or attain a specific outcome. Outcome expectations represent the anticipated repercussions of engaging in a particular behaviour, while personal goals embody an individual's commitment to pursuing a designated career trajectory (10, 11). By employing SCCT to examine dental students' career aspirations, crucial insights can be gained into the factors that motivate and direct their professional selections and pinpoint potential areas for targeted interventions. For instance, augmenting self-efficacy and providing realistic outcome expectations may encourage students to investigate a broader array of career options within the dental field, while fostering the development of well-defined personal goals can support their long-term career success and satisfaction. Moreover, the SCCT framework can assist educators, administrators, and policymakers in dental education institutions to more comprehensively understand the factors driving students' career decisions, empowering them to devise more efficacious and tailored learning environments that foster career development and ultimately enhance the calibre of the dental workforce.

Understanding the career goals of dental students is essential for developing tailored interventions and support systems that foster their success and professional progress (5, 7). Through a variety of direct and indirect channels, dental education institutions have a crucial role in influencing students' career choices and objectives. Career planning training tailored to the specific needs of dental students globally can eventually lead to a more prepared and motivated dental workforce capable of addressing the changing needs of the dental profession and enhancing the general public's oral health outcomes in a broader array (5).

The overarching goal of this study was to examine the career aspirations of dental students from various countries and regions using a self-administered questionnaire grounded in SCCT. The primary objectives were: (a) to explore the relationships between self-efficacy, outcome expectations, and personal goals as

outlined in the SCCT framework and their impact on dental students' career aspirations; and (b) to identify key factors influencing these aspirations, including sociodemographic variables and educational experiences. The secondary objectives were: (a) to investigate students' specific career preferences; and (b) to examine their preferred agencies and media for career planning training.

Materials and methods

Design

An analytical multicentre cross-sectional survey-based study was conducted between May and June 2023, to explore the career intentions of undergraduate dental students and recent graduates worldwide. The study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies, and data was collected via an online self-administered questionnaire (SAQ) using KoBoToolbox (Kobo Inc., Cambridge, MA, USA, 2023) (12, 13).

Setting

This study emerged from a collaborative initiative between the World Dental Federation (FDI), the International Association of Dental Students (IADS), and the European Dental Students Association (EDSA). After protocol finalisation, ethical clearance, and instrument validation, national delegates from IADS and EDSA were briefed about the study. Interested delegates received a single-login URL to access the SAQ, preventing duplicate responses. To enhance representativeness, data collectors used social media, instant messaging, printed materials, and direct emails via IADS and EDSA mailing lists. While efforts were made to engage underrepresented regions through national dental associations and student leaders, the online survey's voluntary nature may have introduced self-selection bias, favouring students more engaged in digital platforms and dental organisations.

Population

The target population encompassed dental students and those who had graduated recently. Inclusion criteria stipulated that participant should: (a) either be an undergraduate dental student enrolled in a full-time degree programme; be an intern dentist where vocational training was mandatory for professional licensure; or have graduated after 1 January 2020; (b) be at least 18 years of age; and (c) have given their consent to participate in the study. Conversely, the exclusion criteria were: (a) being enrolled in preparatory courses, like pre-dental, or having graduated before 1 January 2020; (b) being younger than 18 years; and (c) not having given consent for study participation.

Given the global scope and the diverse representation from various regions, a pooled analysis approach was utilised. The

data from all participating countries were aggregated to ensure a robust analysis. The sample size was determined to achieve a confidence level of 95% with a more precise margin of error of 2.5%, as calculated using Epi InfoTM version 7.2.4 (14). The required minimum sample size for this study was 1,532 valid responses.

Instrument

The SAQ comprised multiple-choice and Likert-like scale items categorised as follows:

- sociodemographic characteristics, encompassing gender, age, nationality, country of study, academic year, university type (public vs. private), and study loan (yes vs. no);
- self-efficacy regarding the ability to determine one's career path;
- outcome expectations (both professional and personal ones) of selecting specific career paths;
- goals to be realised through chosen career paths; and
- preferred career paths and learning resources to facilitate career planning.

The SAQ was based on the SCCT scale for medical students developed by Rogers et al. to evaluate self-efficacy, outcome expectations and career goals (11). Rogers scale demonstrated robust internal validity. Content validity was achieved by aligning items with the SCCT theoretical model and obtaining feedback from an expert review panel on the relevance of the scale items. Construct validity was further established through confirmatory factor analysis (CFA) ensuring its feasibility for use in subsequent research (11).

To validate the SAQ, a panel of experts in dental practice policy, dental education, health psychology, and dental public health was consulted. These experts provided feedback on the SAQ items. Based on their insights, necessary amendments were made to the items to enhance their relevance and clarity. Moreover, the CFA of SCCT components indicated an acceptable fit of the model to the data with a χ^2/df ratio of 6.28. The Root Mean Square Error of Approximation (RMSEA) was 0.0519, with a 90% confidence interval of 0.0495–0.0542, indicating a reasonable fit. The Comparative Fit Index (CFI) was 0.936, and the Tucker–Lewis Index (TLI) was 0.929, both suggesting acceptable fit. Additionally, the Standardized Root Mean Square Residual (SRMR) was 0.0392, indicating a good fit.

The SAQ was produced primarily in English, but to maximise coverage and reduce sampling bias, versions in Albanian, Arabic, Czech, French, German, Indonesian, Italian, Spanish, and Turkish were also developed. The choice of languages was based on the logistical capabilities of the investigators' team. For each language, two independent forward translations were conducted. A review panel then compared these translations to produce a consensus version for each language (Supplementary Table S1).

Variables

The socioeconomic categorisation of countries was based on the World Bank (WB) classification: low income, lower middle income, upper middle income, and high income (15). Geographically, countries were classified as per the FDI geopolitical scheme into: Africa, Asia Pacific, Europe, Latin America, and North America (16).

For the outcome variables, self-efficacy was measured using 7 items, each graded on a 5-point Likert-like scale ranging from “Strongly Disagree (1)” to “Strongly Agree (5)”. The overall self-efficacy score was calculated as a composite of all items in this domain, thus ranging between 7 and 35. Similarly, the professional outcome expectations had 8 items with a total score ranging between 8 and 40, and the personal outcome expectations had 4 items with a total score ranging between 4 and 40. Goals had 6 items with a total score ranging between 6 and 30.

Data quality control

The initial sample comprised 2,293 respondents. Rigorous techniques were employed to remove low-quality entries and ineligible participants (17). The reasons of responses removal included graduation year ($n = 8$), age limitation ($n = 14$), response duration ($n = 182$), and response pattern ($n = 125$). Following these refinements, the final sample consisted of 1,964 respondents (Supplementary Figure S1).

Ethical considerations

This study was carried out in accordance with the Declaration of Helsinki for research involving human subjects, and it was thoroughly reviewed and approved by the Ethics Committee of the Faculty of Medicine, Masaryk University (decision no. 12/2023). All participants had to provide their informed consent digitally prior to getting access to the SAQ.

Statistical analyses

Statistical analysis was conducted using SPSS version 28 and the R-based package Jamovi (18, 19). Descriptive statistics used frequencies, percentages, means, and standard deviations. The Shapiro–Wilk test assessed normal distribution with a significance level (p) < 0.05 . Inferential statistics, e.g., Chi-squared (χ^2), Mann–Whitney (U), Kruskal–Wallis (H), multivariable logistic regression, and mediation analyses were performed with a significance level (p) less than 0.05.

Results

Sociodemographic characteristics

The study included 1,964 participants, of whom 71.8% were female and 28.2% were male, with a mean age of 22.42 ± 2.85

years. Nearly two-thirds (66.7%) were enrolled in clinical years, and 7% were recent graduates: 0.6% from the class of 2020, 2.4% from 2021, 2.5% from 2022, and 1.5% from 2023. The majority (87%) were domestic students, meaning they were studying in their country of nationality (Table 1).

According to the World Bank classification, 48.6% studied in high-income countries, 31.9% in upper-middle-income countries, 15.7% in lower-middle-income countries, and 3.8% in low-income countries. Most participants were studying in Europe (69.1%), followed by Africa (14.5%) and the Asia Pacific region (8.9%). Financial aid was received by 22.6% of the participants, and 29.3% reported receiving career planning training (Supplementary Table S2).

Self-efficacy in career planning

When asked about their confidence in choosing a career path, 25.6% of participants expressed uncertainty about selecting a career that would fulfil their expectations and goals, 24.8% were unsure

TABLE 1 Sociodemographic characteristics of dental students participating in FDI-IADS-EDSA survey of career planning, May–July 2023, ($n = 1,964$).

Variable	Outcome	Frequency (%) / Mean $\pm$ SD
Gender	Female	1,411 (71.8%)
	Male	553 (28.2%)
Age	Years	22.42 $\pm$ 2.85
Academic year	First year	314 (16%)
	Second year	340 (17.3%)
	Third year	361 (18.4%)
	Fourth year	362 (18.4%)
	Fifth year	297 (15.1%)
	Sixth year	101 (5.1%)
	Internship/Vocational Training	51 (2.6%)
	Graduated [†]	138 (7%)
[†] Graduation year	2020	11 (0.6%)
	2021	48 (2.4%)
	2022	50 (2.5%)
	2023	29 (1.5%)
Clinical training	Pre-clinical Student	654 (33.3%)
	Clinical Student	1,310 (66.7%)
Nationality	International Student	256 (13%)
	Domestic Student	1,708 (87%)
Economic level	Low Income	74 (3.8%)
	Lower-middle Income	308 (15.7%)
	Upper-middle Income	627 (31.9%)
	High Income	955 (48.6%)
Region	Africa	284 (14.5%)
	Asia Pacific	174 (8.9%)
	Europe	1,357 (69.1%)
	South America	128 (6.5%)
	North America	21 (1.1%)
Financial aid	No Aid	1,520 (77.4%)
	Aid Received	444 (22.6%)
Career planning training	Not Received	1,389 (70.7%)
	Received	575 (29.3%)

about choosing a career that would fit their personality type, 25.2% doubted their ability to choose a career that would enable them to live the desired lifestyle, and 21.4% were uncertain about selecting a career that aligned with their interests and abilities. Furthermore, 44.9% were unsure about what they were willing to sacrifice for their career path, 24.6% could not determine what they valued most in a medical career, and 42.6% struggled to find valid and accurate information for making their career choice. The mean score of the self-efficacy subscale was 26.75 ± 4.67 (range: 7–35) (Table 2).

No statistically significant difference was found in self-efficacy scores between female (26.67 ± 4.74) and male (26.97 ± 4.49) participants, or between students aged ≤ 22 years (26.65 ± 4.78) and those >22 years (26.90 ± 4.51). However, international students (27.95 ± 4.69), pre-clinical students (26.99 ± 4.87), and those who received career planning training (28.47 ± 4.50) had significantly higher self-efficacy scores ($p < 0.001$, $p = 0.046$, and $p < 0.001$, respectively) than domestic students (26.58 ± 4.64), clinical students (26.64 ± 4.57), and those who did not receive career planning training (26.04 ± 4.55) (Table 3).

Professional expectations

Regarding their professional expectations, 82.2% of participants believed their chosen career path would be intellectually stimulating, while 83.7% anticipated it would offer work satisfaction. Additionally, 78.8% expected their career to facilitate interaction with colleagues, and 82.1% felt it would allow them to practice clinical skills aligned with their perceived abilities. Furthermore, 77.9% expected their career to provide a good income, 71.4% believed it would enable them to perform a wide range of work, 79.6% felt it would be compatible with their interests, and 79.5% anticipated it would help them achieve their desired professional success. The mean score of the professional expectations subscale was 32.31 ± 5.19 (range: 8–40) (Table 2).

There was no statistically significant difference in professional expectations scores across gender ($p = 0.458$) or age groups ($p = 0.472$). However, international students (32.89 ± 5.19), pre-clinical students (32.77 ± 4.80), and those who received career planning training (33.61 ± 5.14) demonstrated significantly higher professional expectations scores ($p = 0.013$, $p = 0.018$, and $p < 0.001$, respectively) compared to domestic students (32.22 ± 5.18), clinical students (32.07 ± 5.36), and those without career planning training (31.77 ± 5.11) (Table 3).

Personal expectations

In terms of personal expectations, 60.1% of participants believed their chosen career path would allow them to work their desired number of hours. Additionally, 61.4% expected it would enable them to engage in leisure activities and interests they enjoy, 61.2% anticipated achieving a satisfactory work-life balance, and 69.2% felt it would support their desired lifestyle.

The mean score of the personal expectations subscale was 14.75 ± 3.56 (range: 4–20) (Table 2).

There was no statistically significant difference in personal expectations scores between genders ($p = 0.524$) or age groups ($p = 0.179$). However, international students (15.46 ± 3.66), pre-clinical students (15.27 ± 3.27), and those who received career planning training (15.46 ± 3.49) had significantly higher scores (all $p < 0.001$) compared to domestic students (14.64 ± 3.54), clinical students (14.49 ± 3.68), and those without career planning training (14.46 ± 3.56) (Table 3).

Career goals

In evaluating their career goals, 62.5% of participants reported having a clear set of goals for their future career path, and 67.3% had discussed these goals with their families or partners. Moreover, 52.9% had taken the necessary steps to achieve their career goals. Additionally, 64.5% had examined their interests, values, and abilities to determine their career path, 51.2% had established a timeframe for making their decision, and 64.2% were receiving substantial support in pursuing their goals. The mean score of the career goals subscale was 21.93 ± 3.91 (range: 6–30) (Table 2).

There was no statistically significant difference in career goals scores between genders ($p = 0.732$) or age groups ($p = 0.411$). However, international students (22.65 ± 3.75), pre-clinical students (22.34 ± 3.76), and those who received career planning training (23.48 ± 3.42) and financial aid (22.22 ± 3.94) had significantly higher scores ($p < 0.001$, $p = 0.001$, $p < 0.001$, and $p = 0.026$, respectively) compared to domestic students (21.82 ± 3.92), clinical students (21.72 ± 3.97), and those without career planning training (21.28 ± 3.92) or financial aid (21.84 ± 3.90) (Table 3).

Career preferences

The most preferred career path among participants was specialty clinical dentistry (51.2%), followed by general clinical dentistry (28.1%), business/entrepreneurship (4.2%), academia (3.6%), and public health (2.2%), with approximately 10.7% undecided. If their first preference was not achievable, the second most preferred paths were specialty clinical dentistry (28.6%), general clinical dentistry (24%), academia (13.5%), business/entrepreneurship (12.7%), and public health (6.6%), while around 14.7% did not have a secondary preference (Table 4).

General clinical dentistry was significantly more common among participants aged over 22 years (32.5% vs. 24.8%; $p < 0.001$) and clinical students (29.5% vs. 25.2%; $p = 0.049$) compared to their counterparts. Students from high-income countries (34.3%) and North America (42.9%) were the most likely to prefer general clinical dentistry. Conversely, students from low-income countries (60.8%) and South America (67.2%) were more inclined to prefer specialty clinical dentistry. No statistically significant differences were observed

TABLE 2 Self-efficacy, professional expectations, personal expectations and career goals of dental students participating in FDI-IADS-EDSA survey of career planning, May–July 2023, (*n* = 1,964).

Item		Strongly agree (=5)	Rather agree (=4)	Not sure (=3)	Rather disagree (=2)	Strongly disagree (=1)	Total ($\mu \pm SD$)
Self-efficacy	How confident are you at this stage of your training that you could...?						
	Choose a career path that will fulfil your expectations and goals.	469 (23.9%)	992 (50.5%)	355 (18.1%)	122 (6.2%)	26 (1.3%)	3.89 $\pm$ 0.88
	Choose a career path that will fit well with your personality (e.g., being an extrovert/introvert).	496 (25.3%)	981 (49.9%)	338 (17.2%)	120 (6.1%)	29 (1.5%)	3.91 $\pm$ 0.89
	Choose a career path that will enable you to live the type of lifestyle you desire.	605 (30.8%)	865 (44.0%)	318 (16.2%)	134 (6.8%)	42 (2.1%)	3.95 $\pm$ 0.97
	Choose a career path that will fit your interests and abilities.	577 (29.4%)	966 (49.2%)	275 (14.0%)	119 (6.1%)	27 (1.4%)	3.99 $\pm$ 0.90
	Decide what you are and are not ready to sacrifice in order to choose a career path.	334 (17.0%)	749 (38.1%)	578 (29.4%)	258 (13.1%)	45 (2.3%)	3.54 $\pm$ 0.99
	Decide what you value most in a medical career (e.g., relationships with patients, prestige, or technical skills, etc.).	506 (25.8%)	974 (49.6%)	333 (17.0%)	116 (5.9%)	35 (1.8%)	3.92 $\pm$ 0.90
	Locate valid and accurate information to help you choose between equally desirable specialties.	313 (15.9%)	815 (41.5%)	528 (26.9%)	253 (12.9%)	55 (2.8%)	3.55 $\pm$ 1.00
	Overall Score (Range: 7–35)						26.75 $\pm$ 4.67
Professional expectations	When thinking about the type of career path you are interested in (e.g., clinical practice, academia, public health), how much do you expect at this stage of your training that your choice of career path will...?						
	Be intellectually stimulating.	578 (29.4%)	1,036 (52.7%)	241 (12.3%)	83 (4.2%)	26 (1.3%)	4.05 $\pm$ 0.84
	Provide you with work satisfaction.	668 (34.0%)	975 (49.6%)	222 (11.3%)	78 (4.0%)	21 (1.1%)	4.12 $\pm$ 0.83
	Allow you to interact with your colleagues.	563 (28.7%)	985 (50.2%)	303 (15.4%)	88 (4.5%)	25 (1.3%)	4.00 $\pm$ 0.86
	Let you practice clinical skills that best suit your perceived abilities.	684 (34.8%)	928 (47.3%)	236 (12.0%)	90 (4.6%)	26 (1.3%)	4.10 $\pm$ 0.87
	Provide you with a good income.	721 (36.7%)	809 (41.2%)	290 (14.8%)	102 (5.2%)	42 (2.1%)	4.05 $\pm$ 0.96
	Allow you to perform a broad spectrum of work.	484 (24.6%)	918 (46.7%)	420 (21.4%)	122 (6.2%)	20 (1.0%)	3.88 $\pm$ 0.89
	Be compatible with your interests.	596 (30.3%)	967 (49.2%)	289 (14.7%)	80 (4.1%)	32 (1.6%)	4.03 $\pm$ 0.87
	Allow you to achieve your desired professional success.	711 (36.2%)	850 (43.3%)	293 (14.9%)	81 (4.1%)	29 (1.5%)	4.09 $\pm$ 0.90
Overall Score (Range: 8–40)						32.31 $\pm$ 5.19	
Personal expectations	When thinking about the type of career path you are interested in (e.g., clinical practice, academia, public health), how much do you expect at this stage of your training that your choice of career path will...?						
	Allow you to work the number of hours that you desire.	432 (22.0%)	748 (38.1%)	453 (23.1%)	270 (13.7%)	61 (3.1%)	3.62 $\pm$ 1.07
	Allow you to pursue leisure time activities/ interests that you like.	399 (20.3%)	807 (41.1%)	453 (23.1%)	258 (13.1%)	47 (2.4%)	3.64 $\pm$ 1.02
	Allow you to have your desired work/recreational balance.	404 (20.6%)	797 (40.6%)	481 (24.5%)	246 (12.5%)	36 (1.8%)	3.66 $\pm$ 1.00
	Allow you to have your desired lifestyle.	518 (26.4%)	842 (42.9%)	410 (20.9%)	152 (7.7%)	42 (2.1%)	3.84 $\pm$ 0.97
	Overall Score (Range: 4–20)						14.75 $\pm$ 3.56
Career goals	When you think about the type of career path that you might choose (e.g., clinical practice, academia, public health), please indicate if, at this stage of your training, you agree or disagree with the following statements:						
	I have a clear set of goals for my future with regard to choosing a career path.	472 (24.0%)	755 (38.4%)	445 (22.7%)	219 (11.2%)	73 (3.7%)	3.68 $\pm$ 1.07
	I have discussed my goals in relation to my career path choice with my family/partner.	556 (28.3%)	766 (39.0%)	318 (16.2%)	256 (13.0%)	68 (3.5%)	3.76 $\pm$ 1.10
	I am taking the steps needed to achieve my goal of choosing a career path.	902 (45.9%)	137 (7.0%)	366 (18.6%)	525 (26.7%)	34 (1.7%)	3.69 $\pm$ 1.33
	I have examined my interests, values, and abilities in detail to come up with my goal of choosing a career path.	425 (21.6%)	842 (42.9%)	452 (23.0%)	203 (10.3%)	42 (2.1%)	3.72 $\pm$ 0.99
	I have a set time frame in which to make a decision about my choice of career path.	339 (17.3%)	666 (33.9%)	455 (23.2%)	348 (17.7%)	156 (7.9%)	3.35 $\pm$ 1.19
	I am getting lots of support to achieve my goal of choosing a career path.	572 (29.1%)	689 (35.1%)	411 (20.9%)	204 (10.4%)	88 (4.5%)	3.74 $\pm$ 1.12
	Overall Score (Range: 6–30)						21.93 $\pm$ 3.91

TABLE 3 Overall scores of self-efficacy, professional expectations, personal expectations and career goals among dental students participating in FDI-IADS-EDSA survey of career planning, stratified by sociodemographic characteristics, May–July 2023, (n = 1,964).

Variable	Outcome	Self-efficacy	p.	Professional expectations	p.	Personal expectations	p.	Career goals	p.
Gender	Female	26.67 ± 4.74	0.386	32.35 ± 5.20	0.458	14.71 ± 3.58	0.524	21.90 ± 3.92	0.732
	Male	26.97 ± 4.49		32.18 ± 5.16		14.86 ± 3.52		21.98 ± 3.88	
Age group	≤22 years	26.65 ± 4.78	0.327	32.39 ± 5.10	0.472	14.85 ± 3.51	0.179	21.86 ± 3.96	0.411
	>22 years	26.90 ± 4.51		32.18 ± 5.30		14.61 ± 3.63		22.01 ± 3.83	
Academic year	First year	27.21 ± 5.03	0.123	33.15 ± 4.57	0.039	15.54 ± 3.08	< 0.001	22.61 ± 3.76	0.006
	Second year	26.79 ± 4.71		32.43 ± 4.98		15.02 ± 3.42		22.10 ± 3.74	
	Third year	26.35 ± 5.04		32.18 ± 5.58		14.63 ± 3.68		21.47 ± 4.05	
	Fourth year	26.90 ± 4.22		32.01 ± 5.04		14.42 ± 3.64		21.85 ± 3.85	
	Fifth year	26.56 ± 4.53		31.78 ± 5.35		14.33 ± 3.72		21.53 ± 4.07	
	Sixth year	27.27 ± 4.49		33.02 ± 5.59		15.16 ± 3.38		21.97 ± 3.61	
	Internship	26.02 ± 4.96		31.80 ± 5.09		14.55 ± 3.38		21.59 ± 4.52	
	Graduated [†]	26.64 ± 4.06		31.99 ± 5.53		14.14 ± 3.95		22.30 ± 3.85	
†Graduation year	2020	28.73 ± 2.94	0.268	33.82 ± 5.06	0.306	14.45 ± 4.87	0.216	24.82 ± 2.44	0.078
	2021	25.92 ± 4.43		30.75 ± 5.93		13.27 ± 3.76		22.19 ± 4.05	
	2022	26.62 ± 3.99		32.58 ± 5.69		14.40 ± 4.19		21.52 ± 4.04	
	2023	27.07 ± 3.73		32.34 ± 4.47		15.00 ± 3.34		22.86 ± 3.19	
Clinical training	Pre-clinical Student	26.99 ± 4.87	0.046	32.77 ± 4.80	0.018	15.27 ± 3.27	< 0.001	22.34 ± 3.76	0.001
	Clinical Student	26.64 ± 4.57		32.07 ± 5.36		14.49 ± 3.68		21.72 ± 3.97	
Nationality	International Student	27.95 ± 4.69	< 0.001	32.89 ± 5.19	0.013	15.46 ± 3.66	< 0.001	22.65 ± 3.75	< 0.001
	Domestic Student	26.58 ± 4.64		32.22 ± 5.18		14.64 ± 3.54		21.82 ± 3.92	
Economic level	Low Income	26.47 ± 5.11	< 0.001	31.68 ± 5.64	< 0.001	15.00 ± 3.53	0.006	20.57 ± 4.94	< 0.001
	Lower-middle Income	25.90 ± 4.77		30.83 ± 5.78		14.02 ± 3.82		20.88 ± 4.20	
	Upper-middle Income	27.52 ± 4.56		32.79 ± 5.38		14.83 ± 3.53		22.56 ± 3.70	
	High Income	26.55 ± 4.60		32.51 ± 4.72		14.91 ± 3.48		21.95 ± 3.76	
Region	Africa	26.09 ± 4.87	< 0.001	31.32 ± 5.79	< 0.001	14.23 ± 3.84	< 0.001	20.68 ± 4.41	< 0.001
	Asia Pacific	26.04 ± 4.84		31.09 ± 5.65		14.64 ± 3.49		21.39 ± 4.06	
	Europe	26.87 ± 4.60		32.46 ± 4.93		14.68 ± 3.51		22.12 ± 3.73	
	South America	28.10 ± 4.34		34.29 ± 4.67		16.69 ± 2.96		23.16 ± 3.40	
	North America	26.05 ± 5.23		33.38 ± 7.05		15.48 ± 3.28		22.86 ± 5.12	
Financial aid	No Aid	26.66 ± 4.63	0.052	32.18 ± 5.26	0.093	14.68 ± 3.59	0.110	21.84 ± 3.90	0.026
	Aid Received	27.07 ± 4.80		32.73 ± 4.90		15.01 ± 3.46		22.22 ± 3.94	
Career Planning Training	Not Received	26.04 ± 4.55	< 0.001	31.77 ± 5.11	< 0.001	14.46 ± 3.56	< 0.001	21.28 ± 3.92	< 0.001
	Received	28.47 ± 4.50		33.61 ± 5.14		15.46 ± 3.49		23.48 ± 3.42	

Mann–Whitney (*U*) and Kruskal–Wallis (*H*) tests were used with a significance level (*p*) < 0.05. Bold font refers to the values that are statistically significant.

in the preference for general or specialty clinical dentistry based on gender, nationality, financial aid, or prior career planning training (Table 5).

Business/entrepreneurship was significantly more popular among male students (7.1%) compared to female students (3.1%; *p* < 0.001). Academia was more commonly preferred by domestic students (3.9% vs. 1.2%; *p* = 0.027) and those receiving financial aid (5.2% vs. 3.1%; *p* = 0.037). Students from lower-middle-income countries (9.4%) and Africa (8.1%) were the most likely to choose academia as their primary career path. Regarding the public health career path, students from low-income countries (12.2%) were the most likely to prefer it, followed by those from lower-middle-income (3.9%), upper-middle-income (2.2%), and high-income countries (0.9%). Africa was the region most likely to favour the public health path (6%), while Europe was the least likely (1%; *p* < 0.001). (Figure 1).

Career planning training agencies and preferred media

Dental schools (89.9%) were the most frequently cited agency responsible for providing career planning training, followed by national dental associations (39.8%), national dental students associations (38.8%), the FDI (32.9%), the IADS (32.5%), regional dental students associations (26.2%), and regional dental associations (24%) (Table 4).

Dental schools were more commonly preferred by students from high-income countries (95%), North America (95.2%), and those who had not previously received career planning training (91.1% vs. 87%, *p* = 0.006). Conversely, the FDI was more commonly preferred by those who had received prior career planning training (38.1% vs. 30.8%, *p* = 0.002). The IADS was more commonly preferred by participants from low-income

TABLE 4 Career preferences, and career planning training agencies and preferred Media as reported by dental students participating in FDI-IADS-EDSA survey of career planning, May–July 2023, (*n* = 1,964).

Variable	Outcome	Frequency (%)
Which career path is your first preference upon graduation?	Clinical Dentistry (General Practice)	551 (28.1%)
	Clinical Dentistry (Specialty Practice)	1,006 (51.2%)
	Business/Entrepreneurship	83 (4.2%)
	Academia	70 (3.6%)
	Public Health (e.g., Gov, NGOs, IGOs)	44 (2.2%)
	Undecided	210 (10.7%)
Which career path is your second preference upon graduation?	Clinical Dentistry (General Practice)	421 (24%)
	Clinical Dentistry (Specialty Practice)	502 (28.6%)
	Business/Entrepreneurship	223 (12.7%)
	Academia	236 (13.5%)
	Public Health (e.g., Gov, NGOs, IGOs)	115 (6.6%)
	Undecided	257 (14.7%)
In your opinion, which organization(s) should be responsible for providing career guidance and information to dental students as they plan their professional futures?	Dental Schools	1,765 (89.9%)
	World Dental Federation (FDI)	647 (32.9%)
	Regional Dental Associations	472 (24%)
	National Dental Associations	781 (39.8%)
	International Association of Dental Students (IADS)	639 (32.5%)
	Regional Dental Students Associations (e.g., EDSA)	515 (26.2%)
	National Dental Students Associations	762 (38.8%)
What types of information source (s) do you prefer to use for planning your dental career?	Virtual Sources: Webinars	988 (50.3%)
	Virtual Sources: Podcasts	590 (30%)
	Virtual Sources: Blogs	481 (24.5%)
	Virtual Sources: E-books	466 (23.7%)
	In-person Sources: Continuous Education Workshops	1,207 (61.5%)
	In-person Sources: Undergraduate Elective Courses	1,236 (62.9%)
At what point in their undergraduate education do you think dental students should be introduced to information about various career paths in dentistry?	Upon entry (first years of dental school)	972 (49.5%)
	At the beginning of clinical training (e.g., 3rd/4th yr.)	314 (16%)
	Towards end (senior years of dental school)	678 (34.5%)
Do you think continuous education programs (CE) should have components about career management?	Yes	189 (84.7%)
	Unsure	23 (12.2%)
	No	6 (3.2%)

countries (41.9%) and South America (47.7%), as well as those receiving financial aid (36.7% vs. 31.3%, $p = 0.033$) (Table 6).

The most frequently suggested medium for providing career planning training was undergraduate elective courses (62.9%), followed closely by continuous education workshops (61.5%). Virtual media were less frequently suggested: webinars (50.3%), podcasts (30%), blogs (24.5%), and e-books (23.7%). Regarding

the timing of undergraduate courses, less than half (49.5%) recommended that these courses be provided during the first years of dental school, while 34.5% suggested they be offered towards graduation during the senior years, and 16% recommended the middle years of dental school, typically coinciding with the beginning of clinical training. Among recent graduates, 84.7% believed that continuous education programs should include components on career management (Table 4).

Female students were significantly more in favour of webinars (51.9% vs. 46.1%; $p = 0.020$) and blogs (26.7% vs. 18.8%; $p < 0.001$). Students aged over 22 years were more likely to favour webinars (55.5% vs. 46.5%; $p < 0.001$) and continuous education workshops (67.5% vs. 57.1%; $p < 0.001$). Clinical students were more inclined to favour webinars (53.8% vs. 43.3%; $p < 0.001$) and continuous education workshops (64.4% vs. 55.7%; $p < 0.001$). Domestic students were more likely to favour podcasts (30.9% vs. 24.6%; $p = 0.042$) (Table 6).

Students aged over 22 years were also more likely to support the provision of undergraduate career planning courses in the senior years (24.6% vs. 9.8%; $p < 0.001$). Similarly, clinical students were more supportive of offering these courses in the senior years (21.1% vs. 5.8%; $p < 0.001$). International students reported receiving career planning training more frequently than their domestic counterparts (36.3% vs. 28.2%; $p = 0.008$), and this was also more common among those who received financial aid compared to those who did not (34.2% vs. 27.8%; $p = 0.009$) (Table 7).

Multivariable logistic regression analyses

To account for the confounding effects of various sociodemographic and psychological factors, multivariable logistic regression (MLR) models were built to identify predictors of career path preferences, suggested agencies for career planning, and preferred media for career planning training.

The decision to choose general dentistry as a career path was promoted by age [AOR: 1.07 (95% CI: 1.03–1.13)] and personal expectations [1.04 (1.01–1.08)]. Compared to students from low-income countries, those from lower-middle-income countries [2.18 (1.05–4.51)], upper-middle-income countries [1.37 (0.46–4.06)], and high-income countries [2.12 (0.72–6.27)] were more likely to prefer general dentistry. On the contrary, specialty dentistry was dissuaded by age [0.95 (0.91–0.99)] and personal expectations [0.96 (0.93–0.99)]. Compared to students from low-income countries, those from lower-middle-income countries [0.44 (0.25–0.76)], upper-middle-income countries [0.37 (0.16–0.84)], and high-income countries [0.30 (0.13–0.68)] were less likely to prefer specialty dentistry. Professional expectations [1.04 (1.01–1.06)] and career goals [1.03 (1.00–1.06)] were psychological promoters of specialty dentistry (Table 8).

The only significant promoter of a business/entrepreneurship career path was male gender [2.44 (1.55–3.84)]. Receiving financial aid was a significant promoter of an academic career path [2.12 (1.24–3.61)], as was being from lower-middle-income countries [11.19 (1.45–86.61)]. The public health career path was

TABLE 5 First career preferences of dental students participating in FDI-IADS-EDSA survey of career planning, stratified by sociodemographic characteristics, May – July 2023, (n = 1,964).

Variable	Outcome	General dentistry	p.	Specialty dentistry	p.	Business	p.	Academia	p.	Public Health	p.
Gender	Female	395 (28.0%)	0.924	732 (51.9%)	0.353	44 (3.1%)	<0.001	50 (3.5%)	0.937	28 (2.0%)	0.221
	Male	156 (28.2%)		274 (49.5%)		39 (7.1%)		20 (3.6%)		16 (2.9%)	
Age group	≤22 years	284 (24.8%)	<0.001	593 (51.9%)	0.491	51 (4.5%)	0.540	44 (3.8%)	0.421	24 (2.1%)	0.619
	>22 years	267 (32.5%)		413 (50.3%)		32 (3.9%)		26 (3.2%)		20 (2.4%)	
Academic year	First year	78 (24.8%)	<0.001	173 (55.1%)	0.003	9 (2.9%)	0.185	7 (2.2%)	0.119	2 (0.6%)	0.506
	Second year	87 (25.6%)		160 (47.1%)		23 (6.8%)		14 (4.1%)		9 (2.6%)	
	Third year	86 (23.8%)		192 (53.2%)		18 (5.0%)		16 (4.4%)		9 (2.5%)	
	Fourth year	114 (31.5%)		184 (50.8%)		14 (3.9%)		12 (3.3%)		9 (2.5%)	
	Fifth year	112 (37.7%)		129 (43.4%)		8 (2.7%)		7 (2.4%)		9 (3.0%)	
	Sixth year	35 (34.7%)		50 (49.5%)		3 (3.0%)		2 (2.0%)		2 (2.0%)	
	Internship	7 (13.7%)		33 (64.7%)		3 (5.9%)		5 (9.8%)		1 (2.0%)	
	Graduated [†]	32 (23.2%)		85 (61.6%)		5 (3.6%)		7 (5.1%)		3 (2.2%)	
†Graduation year	2020	2 (18.2%)	0.788	7 (63.6%)	0.752	1 (9.1%)	0.367	0 (0.0%)	0.534	0 (0.0%)	1.000
	2021	10 (20.8%)		32 (66.7%)		1 (2.1%)		3 (6.3%)		1 (2.1%)	
	2022	14 (28.0%)		28 (56.0%)		1 (2.0%)		4 (8.0%)		1 (2.0%)	
	2023	6 (20.7%)		18 (62.1%)		2 (6.9%)		0 (0.0%)		1 (3.4%)	
Clinical training	Pre-clinical Student	165 (25.2%)	0.049	333 (50.9%)	0.849	32 (4.9%)	0.299	21 (3.2%)	0.551	11 (1.7%)	0.237
	Clinical Student	386 (29.5%)		673 (51.4%)		51 (3.9%)		49 (3.7%)		33 (2.5%)	
Nationality	International Student	82 (32.0%)	0.129	135 (52.7%)	0.604	11 (4.3%)	0.952	3 (1.2%)	0.027	2 (0.8%)	0.091
	Domestic Student	469 (27.5%)		871 (51.0%)		72 (4.2%)		67 (3.9%)		42 (2.5%)	
Economic level	Low Income	11 (14.9%)	<0.001	45 (60.8%)	<0.001	2 (2.7%)	0.919	1 (1.4%)	<0.001	9 (12.2%)	<0.001
	Lower-middle Income	68 (22.1%)		147 (47.7%)		13 (4.2%)		29 (9.4%)		12 (3.9%)	
	Upper-middle Income	144 (23.0%)		358 (57.1%)		29 (4.6%)		22 (3.5%)		14 (2.2%)	
	High Income	328 (34.3%)		456 (47.7%)		39 (4.1%)		18 (1.9%)		9 (0.9%)	
Region	Africa	60 (21.1%)	<0.001	133 (46.8%)	<0.001	13 (4.6%)	0.682	23 (8.1%)	<0.001	17 (6.0%)	<0.001
	Asia Pacific	31 (17.8%)		100 (57.5%)		5 (2.9%)		9 (5.2%)		7 (4.0%)	
	Europe	431 (31.8%)		678 (50.0%)		61 (4.5%)		34 (2.5%)		13 (1.0%)	
	South America	20 (15.6%)		86 (67.2%)		3 (2.3%)		3 (2.3%)		6 (4.7%)	
	North America	9 (42.9%)		9 (42.9%)		1 (4.8%)		1 (4.8%)		1 (4.8%)	
Financial aid	No Aid	420 (27.6%)	0.440	783 (51.5%)	0.633	63 (4.1%)	0.740	47 (3.1%)	0.037	34 (2.2%)	0.985
	Aid Received	131 (29.5%)		223 (50.2%)		20 (4.5%)		23 (5.2%)		10 (2.3%)	
Career planning training	Not Received	380 (27.4%)	0.285	701 (50.5%)	0.299	60 (4.3%)	0.749	52 (3.7%)	0.505	36 (2.6%)	0.102
	Received	171 (29.7%)		305 (53.0%)		23 (4.0%)		18 (3.1%)		8 (1.4%)	

Chi-squared (χ^2) and Fisher's exact tests were used with a significance level (p) < 0.05.

Bold font refers to the values that are statistically significant.

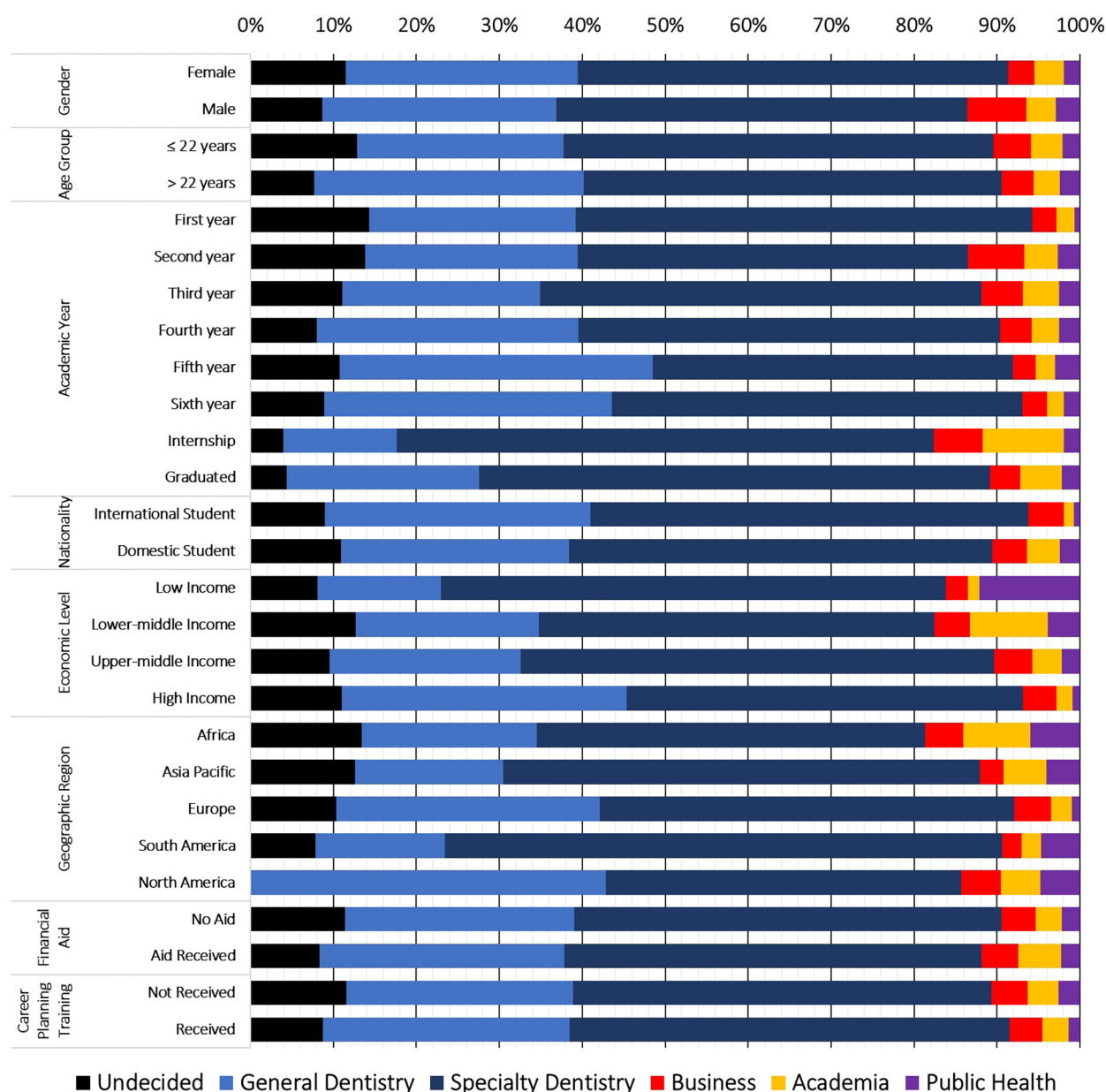


FIGURE 1
Primary career preferences among dental students participating in the FDI-IADS-EDSA survey of career planning, May–July 2023, ($n = 1,964$).

promoted by age [1.14 (1.00–1.28)], and it was less common among students from lower-middle-income countries [0.23 (0.08–0.66)], upper-middle-income countries [0.32 (0.05–2.14)], and high-income countries [0.18 (0.02–1.26)] as compared with those from low-income countries (Table 8).

The perceived competency of dental schools in providing career planning training was positively associated with higher professional expectations [1.04 (1.00–1.09)] and being from high-income countries [11.20 (2.82–44.39)], but negatively associated with prior career planning training [0.67 (0.48–0.93)]. In contrast, prior training increased the likelihood of suggesting the FDI as a competent agency [1.35 (1.09–1.68)]. Regional dental associations were less favoured by students

from high-income countries [0.38 (0.14–0.99)], upper-middle-income countries [0.51 (0.19–1.34)], and lower-middle-income countries [0.66 (0.36–1.18)] compared to those from low-income countries. Professional expectations [1.05 (1.02–1.07)] and male gender [1.26 (1.03–1.55)] were positively associated with higher odds of favouring national dental associations (Table 8).

The IADS was less commonly preferred by male students [0.70 (0.56–0.88)], whereas it was more commonly preferred by students who received financial aid [1.35 (1.08–1.70)]. Higher professional expectations [1.05 (1.02–1.08)] increased the odds of favouring the IADS, while higher personal expectations [0.93 (0.90–0.96)] decreased them. Additionally, male gender was associated with

TABLE 6 Career planning training agencies and preferred Media as reported by dental students participating in FDI-IADS-EDSA survey of career planning, stratified by sociodemographic characteristics, May – July 2023, ($n = 1,964$).

Variable	Outcome	Agencies of career planning training									
		Dental Schools	<i>p.</i>	FDI	<i>p.</i>	Reg. dental associations	<i>p.</i>	Nat. dental associations	<i>p.</i>	IADS	<i>p.</i>
Gender	Female	1,276 (90.4%)	0.185	481 (34.1%)	0.084	350 (24.8%)	0.201	545 (38.6%)	0.099	490 (34.7%)	<0.001
	Male	489 (88.4%)		166 (30%)		122 (22.1%)		236 (42.7%)		149 (26.9%)	
Age group	≤22 years	1,024 (89.6%)	0.629	388 (33.9%)	0.265	273 (23.9%)	0.856	455 (39.8%)	0.964	385 (33.7%)	0.200
	>22 years	741 (90.3%)		259 (31.5%)		199 (24.2%)		326 (39.7%)		254 (30.9%)	
Academic year	First year	295 (93.9%)	<0.001	107 (34.1%)	0.125	78 (24.8%)	0.386	135 (43.0%)	0.500	99 (31.5%)	0.499
	Second year	296 (87.1%)		111 (32.6%)		70 (20.6%)		124 (36.5%)		97 (28.5%)	
	Third year	312 (86.4%)		131 (36.3%)		102 (28.3%)		150 (41.6%)		131 (36.3%)	
	Fourth year	323 (89.2%)		105 (29.0%)		86 (23.8%)		139 (38.4%)		113 (31.2%)	
	Fifth year	282 (94.9%)		95 (32.0%)		66 (22.2%)		124 (41.8%)		103 (34.7%)	
	Sixth year	94 (93.1%)		30 (29.7%)		22 (21.8%)		43 (42.6%)		35 (34.7%)	
	Internship	47 (92.2%)		25 (49.0%)		11 (21.6%)		18 (35.3%)		18 (35.3%)	
	Graduated [†]	116 (84.1%)		43 (31.2%)		37 (26.8%)		48 (34.8%)		43 (31.2%)	
†Graduation year	2020	9 (81.8%)	0.854	3 (27.3%)	0.755	2 (18.2%)	0.727	0 (0.0%)	0.022	2 (18.2%)	0.742
	2021	42 (87.5%)		17 (35.4%)		15 (31.3%)		22 (45.8%)		17 (35.4%)	
	2022	41 (82.0%)		13 (26.0%)		14 (28.0%)		17 (34.0%)		16 (32.0%)	
	2023	24 (82.8%)		10 (34.5%)		6 (20.7%)		9 (31.0%)		8 (27.6%)	
Clinical training	Pre-clinical Student	591 (90.4%)	0.604	218 (33.3%)	0.795	148 (22.6%)	0.304	259 (39.6%)	0.917	196 (30.0%)	0.086
	Clinical Student	1,174 (89.6%)		429 (32.7%)		324 (24.7%)		522 (39.8%)		443 (33.8%)	
Nationality	International Student	233 (91.0%)	0.514	86 (33.6%)	0.812	53 (20.7%)	0.181	93 (36.3%)	0.228	79 (30.9%)	0.539
	Domestic Student	1,532 (89.7%)		561 (32.8%)		419 (24.5%)		688 (40.3%)		560 (32.8%)	
Economic level	Low Income	59 (79.7%)	<0.001	23 (31.1%)	<0.001	25 (33.8%)	0.045	27 (36.5%)	0.081	31 (41.9%)	0.001
	Lower-middle Income	257 (83.4%)		112 (36.4%)		75 (24.4%)		107 (34.7%)		123 (39.9%)	
	Upper-middle Income	542 (86.4%)		256 (40.8%)		164 (26.2%)		242 (38.6%)		208 (33.2%)	
	High Income	907 (95.0%)		256 (26.8%)		208 (21.8%)		405 (42.4%)		277 (29.0%)	
Region	Africa	236 (83.1%)	<0.001	111 (39.1%)	<0.001	78 (27.5%)	0.221	102 (35.9%)	0.030	119 (41.9%)	<0.001
	Asia Pacific	152 (87.4%)		39 (22.4%)		35 (20.1%)		66 (37.9%)		63 (36.2%)	
	Europe	1,244 (91.7%)		434 (32.0%)		326 (24.0%)		550 (40.5%)		393 (29.0%)	
	South America	113 (88.3%)		58 (45.3%)		31 (24.2%)		60 (46.9%)		61 (47.7%)	
	North America	20 (95.2%)		5 (23.8%)		2 (9.5%)		3 (14.3%)		3 (14.3%)	
Financial aid	No Aid	1,368 (90.0%)	0.719	504 (33.2%)	0.708	357 (23.5%)	0.295	601 (39.5%)	0.705	476 (31.3%)	0.033
	Aid Received	397 (89.4%)		143 (32.2%)		115 (25.9%)		180 (40.5%)		163 (36.7%)	
Career planning training	Not Received	1,265 (91.1%)	0.006	428 (30.8%)	0.002	341 (24.6%)	0.404	550 (39.6%)	0.812	445 (32.0%)	0.464
	Received	500 (87.0%)		219 (38.1%)		131 (22.8%)		231 (40.2%)		194 (33.7%)	

(Continued)

TABLE 6 Continued

Variable	Outcome	Agencies of career planning training				Preferred media of career planning training					
		Reg. Dent. Students Ass.	p.	Nat. Dent. Students Ass.	p.	Webinars	p.	Podcasts	p.	Blogs	p.
Gender	Female	389 (27.6%)	0.030	563 (39.9%)	0.109	733 (51.9%)	0.020	439 (31.1%)	0.098	377 (26.7%)	< 0.001
	Male	126 (22.8%)		199 (36.0%)		255 (46.1%)		151 (27.3%)		104 (18.8%)	
Age group	≤22 years	297 (26.0%)	0.777	457 (40.0%)	0.204	532 (46.5%)	< 0.001	341 (29.8%)	0.813	294 (25.7%)	0.134
	>22 years	218 (26.6%)		305 (37.1%)		456 (55.5%)		249 (30.3%)		187 (22.8%)	
Academic year	First year	80 (25.5%)	0.958	122 (38.9%)	0.989	130 (41.4%)	< 0.001	105 (33.4%)	0.051	85 (27.1%)	0.684
	Second year	86 (25.3%)		132 (38.8%)		153 (45.0%)		95 (27.9%)		82 (24.1%)	
	Third year	102 (28.3%)		147 (40.7%)		180 (49.9%)		103 (28.5%)		90 (24.9%)	
	Fourth year	88 (24.3%)		142 (39.2%)		194 (53.6%)		119 (32.9%)		92 (25.4%)	
	Fifth year	81 (27.3%)		111 (37.4%)		157 (52.9%)		98 (33.0%)		69 (23.2%)	
	Sixth year	26 (25.7%)		39 (38.6%)		61 (60.4%)		23 (22.8%)		20 (19.8%)	
	Internship	14 (27.5%)		19 (37.3%)		28 (54.9%)		18 (35.3%)		15 (29.4%)	
	Graduated [†]	38 (27.5%)		50 (36.2%)		85 (61.6%)		29 (21.0%)		28 (20.3%)	
[†] Graduation year	2020	4 (36.4%)	0.717	6 (54.5%)	0.313	5 (45.5%)	0.112	2 (18.2%)	0.753	3 (27.3%)	0.468
	2021	15 (31.3%)		19 (39.6%)		35 (72.9%)		9 (18.8%)		10 (20.8%)	
	2022	12 (24.0%)		18 (36.0%)		31 (62.0%)		13 (26.0%)		12 (24.0%)	
	2023	7 (24.1%)		7 (24.1%)		14 (48.3%)		5 (17.2%)		3 (10.3%)	
Clinical training	Pre-clinical Student	166 (25.4%)	0.550	254 (38.8%)	0.980	283 (43.3%)	< 0.001	200 (30.6%)	0.712	167 (25.5%)	0.447
	Clinical Student	349 (26.6%)		508 (38.8%)		705 (53.8%)		390 (29.8%)		314 (24.0%)	
Nationality	International Student	66 (25.8%)	0.863	89 (34.8%)	0.156	117 (45.7%)	0.114	63 (24.6%)	0.042	57 (22.3%)	0.375
	Domestic Student	449 (26.3%)		673 (39.4%)		871 (51.0%)		527 (30.9%)		424 (24.8%)	
Economic level	Low Income	24 (32.4%)	0.603	30 (40.5%)	0.126	36 (48.6%)	0.002	15 (20.3%)	0.061	15 (20.3%)	0.105
	Lower-middle Income	79 (25.6%)		111 (36.0%)		125 (40.6%)		92 (29.9%)		76 (24.7%)	
	Upper-middle Income	168 (26.8%)		226 (36.0%)		334 (53.3%)		174 (27.8%)		174 (27.8%)	
	High Income	244 (25.5%)		395 (41.4%)		493 (51.6%)		309 (32.4%)		216 (22.6%)	
Region	Africa	76 (26.8%)	0.849	113 (39.8%)	0.890	122 (43.0%)	0.001	81 (28.5%)	0.451	78 (27.5%)	0.284
	Asia Pacific	48 (27.6%)		68 (39.1%)		83 (47.7%)		48 (27.6%)		42 (24.1%)	
	Europe	350 (25.8%)		524 (38.6%)		693 (51.1%)		412 (30.4%)		320 (23.6%)	
	South America	37 (28.9%)		51 (39.8%)		82 (64.1%)		45 (35.2%)		38 (29.7%)	
	North America	4 (19.0%)		6 (28.6%)		8 (38.1%)		4 (19.0%)		3 (14.3%)	
Financial aid	No Aid	388 (25.5%)	0.195	585 (38.5%)	0.600	775 (51.0%)	0.264	448 (29.5%)	0.310	367 (24.1%)	0.509
	Aid Received	127 (28.6%)		177 (39.9%)		213 (48.0%)		142 (32.0%)		114 (25.7%)	
Career planning training	Not Received	373 (26.9%)	0.322	554 (39.9%)	0.125	713 (51.3%)	0.157	439 (31.6%)	0.019	349 (25.1%)	0.309
	Received	142 (24.7%)		208 (36.2%)		275 (47.8%)		151 (26.3%)		132 (23.0%)	

(Continued)

TABLE 6 Continued

Variable	Outcome	Preferred media of career planning training						
		E-books	p.	CE Workshop	p.	UG course	p.	
Gender	Female	335 (23.7%)	0.980	869 (61.6%)	0.849	893 (63.3%)	0.602	
	Male	131 (23.7%)		338 (61.1%)		343 (62.0%)		
Age group	≤ 22 years	265 (23.2%)	0.505	653 (57.1%)	<0.001	727 (63.6%)	0.467	
	> 22 years	201 (24.5%)		554 (67.5%)		509 (62.0%)		
Academic year	First year	75 (23.9%)	0.904	171 (54.5%)	0.002	206 (65.6%)	0.707	
	Second year	71 (20.9%)		193 (56.8%)		216 (63.5%)		
	Third year	83 (23.0%)		218 (60.4%)		230 (63.7%)		
	Fourth year	89 (24.6%)		230 (63.5%)		222 (61.3%)		
	Fifth year	75 (25.3%)		191 (64.3%)		188 (63.3%)		
	Sixth year	26 (25.7%)		68 (67.3%)		64 (63.4%)		
	Internship	14 (27.5%)		35 (68.6%)		33 (64.7%)		
	Graduated [†]	33 (23.9%)		101 (73.2%)		77 (55.8%)		
†Graduation year	2020	1 (9.1%)	0.612	8 (72.7%)	0.762	5 (45.5%)	0.588	
	2021	11 (22.9%)		37 (77.1%)		27 (56.3%)		
	2022	14 (28.0%)		34 (68.0%)		31 (62.0%)		
	2023	7 (24.1%)		22 (75.9%)		14 (48.3%)		
Clinical training	Pre-clinical Student	146 (22.3%)	0.302	364 (55.7%)	<0.001	422 (64.5%)	0.302	
	Clinical Student	320 (24.4%)		843 (64.4%)		814 (62.1%)		
Nationality	International Student	63 (24.6%)	0.722	145 (56.6%)	0.090	161 (62.9%)	0.988	
	Domestic Student	403 (23.6%)		1,062 (62.2%)		1,075 (62.9%)		
Economic level	Low Income	21 (28.4%)	0.307	50 (67.6%)	0.521	38 (51.4%)	0.040	
	Lower-middle Income	73 (23.7%)		186 (60.4%)		189 (61.4%)		
	Upper-middle Income	161 (25.7%)		394 (62.8%)		383 (61.1%)		
	High Income	211 (22.1%)		577 (60.4%)		626 (65.5%)		
Region	Africa	75 (26.4%)	0.045	170 (59.9%)	0.050	180 (63.4%)	0.336	
	Asia Pacific	37 (21.3%)		105 (60.3%)		97 (55.7%)		
	Europe	307 (22.6%)		834 (61.5%)		861 (63.4%)		
	South America	43 (33.6%)		90 (70.3%)		84 (65.6%)		
	North America	4 (19.0%)		8 (38.1%)		14 (66.7%)		
Financial aid	No aid	351 (23.1%)	0.221	952 (62.6%)	0.048	958 (63.0%)	0.874	
	Aid received	115 (25.9%)		255 (57.4%)		278 (62.6%)		
Career planning training	Not received	304 (21.9%)	0.003	874 (62.9%)	0.038	875 (63.0%)	0.929	
	Received	162 (28.2%)		333 (57.9%)		361 (62.8%)		

Chi-squared (χ^2) and Fisher's exact tests were used with a significance level ($p.$) < 0.05.

Bold font refers to the values that are statistically significant.

TABLE 7 Receiving career planning training and its preferred timing in undergraduate curriculum as reported by dental students participating in FDI-IADS-EDSA survey of career planning, stratified by sociodemographic characteristics, May – July 2023, ($n = 1,964$).

Variable	Outcome	Received career planning training?			Preferred timing of career planning training in dental school			
		No	Yes	<i>p.</i>	Upon entry (freshman years)	Beginning of clinical years (e.g., 3rd, 4th Yr.)	Towards graduation (senior years)	<i>p.</i>
Gender	Female	1,002 (71.0%)	409 (29.0%)	0.651	502 (35.6%)	698 (49.5%)	211 (15.0%)	0.083
	Male	387 (70.0%)	166 (30.0%)		176 (31.8%)	274 (49.5%)	103 (18.6%)	
Age group	≤22 years	802 (70.2%)	341 (29.8%)	0.522	484 (42.3%)	547 (47.9%)	112 (9.8%)	<0.001
	>22 years	587 (71.5%)	234 (28.5%)		194 (23.6%)	425 (51.8%)	202 (24.6%)	
Academic year	First year	201 (64.0%)	113 (36.0%)	0.006	171 (54.5%)	124 (39.5%)	19 (6.1%)	<0.001
	Second year	233 (68.5%)	107 (31.5%)		148 (43.5%)	173 (50.9%)	19 (5.6%)	
	Third year	278 (77.0%)	83 (23.0%)		123 (34.1%)	198 (54.8%)	40 (11.1%)	
	Fourth year	273 (75.4%)	89 (24.6%)		107 (29.6%)	185 (51.1%)	70 (19.3%)	
	Fifth year	204 (68.7%)	93 (31.3%)		72 (24.2%)	151 (50.8%)	74 (24.9%)	
	Sixth year	71 (70.3%)	30 (29.7%)		22 (21.8%)	56 (55.4%)	23 (22.8%)	
	Internship	33 (64.7%)	18 (35.3%)		8 (15.7%)	25 (49.0%)	18 (35.3%)	
	Graduated [†]	96 (69.6%)	42 (30.4%)		27 (19.6%)	60 (43.5%)	51 (37.0%)	
†Graduation year	2020	5 (45.5%)	6 (54.5%)	0.317	3 (27.3%)	6 (54.5%)	2 (18.2%)	0.648
	2021	34 (70.8%)	14 (29.2%)		6 (12.5%)	22 (45.8%)	20 (41.7%)	
	2022	37 (74.0%)	13 (26.0%)		12 (24.0%)	19 (38.0%)	19 (38.0%)	
	2023	20 (69.0%)	9 (31.0%)		6 (20.7%)	13 (44.8%)	10 (34.5%)	
Clinical training	Pre-clinical Student	434 (66.4%)	220 (33.6%)	0.003	319 (48.8%)	297 (45.4%)	38 (5.8%)	<0.001
	Clinical Student	955 (72.9%)	355 (27.1%)		359 (27.4%)	675 (51.5%)	276 (21.1%)	
Nationality	International Student	163 (63.7%)	93 (36.3%)	0.008	91 (35.5%)	128 (50.0%)	37 (14.5%)	0.764
	Domestic Student	1,226 (71.8%)	482 (28.2%)		587 (34.4%)	844 (49.4%)	277 (16.2%)	
Economic level	Low Income	49 (66.2%)	25 (33.8%)	0.009	22 (29.7%)	34 (45.9%)	18 (24.3%)	0.337
	Lower-middle Income	224 (72.7%)	84 (27.3%)		103 (33.4%)	156 (50.6%)	49 (15.9%)	
	Upper-middle Income	414 (66.0%)	213 (34.0%)		212 (33.8%)	306 (48.8%)	109 (17.4%)	
	High Income	702 (73.5%)	253 (26.5%)		341 (35.7%)	476 (49.8%)	138 (14.5%)	
Region	Africa	200 (70.4%)	84 (29.6%)	0.472	101 (35.6%)	139 (48.9%)	44 (15.5%)	0.057
	Asia Pacific	122 (70.1%)	52 (29.9%)		55 (31.6%)	81 (46.6%)	38 (21.8%)	
	Europe	964 (71.0%)	393 (29.0%)		483 (35.6%)	672 (49.5%)	202 (14.9%)	
	South America	85 (66.4%)	43 (33.6%)		33 (25.8%)	72 (56.3%)	23 (18.0%)	
	North America	18 (85.7%)	3 (14.3%)		6 (28.6%)	8 (38.1%)	7 (33.3%)	
Financial aid	No Aid	1,097 (72.2%)	423 (27.8%)	0.009	499 (32.8%)	772 (50.8%)	249 (16.4%)	0.014
	Aid Received	292 (65.8%)	152 (34.2%)		179 (40.3%)	200 (45.0%)	65 (14.6%)	

Chi-squared (χ^2) and Fisher's exact tests were used with a significance level ($p.$) < 0.05.

Bold font refers to the values that are statistically significant.

lower odds of favouring regional dental students' associations, such as EDSA [0.78 (0.62–0.99)] (Table 8).

Virtual media outlets were less favoured by male students, including webinars [0.77 (0.62–0.94)] and blogs [0.66 (0.51–0.84)]. Advancing age and academic year were associated with higher odds of favouring continuous education workshops [1.07 (1.02–1.12)] and webinars [1.10 (1.04–1.18)], respectively. Compared to students from low-income countries, continuous education workshops were less preferred by students from lower-middle-income [0.71 (0.40–1.27)], upper-middle-income [0.42 (0.18–0.99)], and high-income countries [0.38 (0.16–0.88)]. Conversely, undergraduate courses were more preferred by students from lower-middle-income [1.92 (1.11–3.33)], upper-middle-income [3.26 (1.41–7.55)], and high-income countries [4.15 (1.79–9.62)] (Table 8).

Mediation analyses

The mediation analyses aimed to explore the effect of prior career planning training on preferred career paths through the SCCT components.

For general dentistry, career planning training significantly enhanced self-efficacy [2.43 (1.99–2.87)], professional expectations [1.84 (1.35–2.34)], personal expectations [1.01 (0.66–1.35)], and career goals [2.21 (1.84–2.57)]. However, none of these factors had a significant direct effect on the preference for general dentistry, indicating that these factors partially mediated the relationship between career planning training and the choice of general dentistry with mediation contributions of 26.7%, 4.94%, 21.2%, and 37.1% respectively (Figure 2A).

For specialty dentistry, training significantly increased self-efficacy [2.43 (1.99–2.87)], professional expectations [1.84 (1.35–2.34)], personal expectations [1.01 (0.66–1.35)], and career goals [2.21 (1.84–2.57)]. Self-efficacy [0.01 (0.01–0.02)], professional expectations [0.01 (0.01–0.01)], and career goals [0.01 (0.01–0.02)] had significant direct effects on specialty dentistry preference, demonstrating substantial mediation with contributions of 98.65%, 68.5%, and 96.86%, respectively (Figure 2B).

For business/entrepreneurship, training improved self-efficacy [2.43 (1.99–2.87)], professional expectations [1.84 (1.35–2.34)], personal expectations [1.01 (0.66–1.35)], and career goals [2.20 (1.84–2.57)]. However, all these factors had direct negative effects on this career path, with considerable mediation contributions of 65.1%, 69.3%, 86.7%, and 72.3% (Figure 2C).

For academia, training enhanced self-efficacy [2.43 (1.99–2.87)], professional expectations [1.84 (1.35–2.34)], personal expectations [1.01 (0.66–1.35)], and career goals [2.20 (1.84–2.57)]. None of these factors had a significant direct impact on preferring academia, indicating minimal or negligible mediation with contributions of 1.19%, 16.2%, 12.1%, and 8.24% (Figure 2D).

For public health, training increased self-efficacy [2.43 (1.99–2.87)], professional expectations [1.84 (1.35–2.34)], personal expectations [1.01 (0.66–1.35)], and career goals [2.20 (1.84–2.57)]. Nevertheless, all these factors negatively influenced the

preference for public health, with partial mediation contributions of 28.7%, 22.2%, 4.14% and 25.5% (Figure 2E).

Discussion

This study aimed to explore how aspects of the SCCT, such as self-efficacy, outcome expectations and career goals, shape the career decisions of dental students across various career pathways such as General Dentistry, Specialty Dentistry, Business/Entrepreneurship, Academia and Public Health. Expectations and influences in students' career choices have long been a topic of interest as such insights help shape the approach of educational institutions in providing guidance during the students' formational years (1, 11). Previous studies have explored factors such as professional satisfaction, intrinsic motivations and financial stability (20–28).

To the best of our knowledge, the currently available literature is mostly region-specific and does not implement a comprehensive theoretical model in their analysis. For instance, Gallagher et al. (2008, 2009) examined career expectations among dental students at a single London Dental School (20, 21). Ellakany et al. (2023) focused on career satisfaction among dental students and dentists in Saudi Arabia, while Che Musa et al. (2016) analysed career influences among dental students in Malaysia, each with a narrow national focus (22, 23). Additionally, Sam et al. (2016) investigated working environments and speciality choices among students in a single university in Saudi Arabia, with a similar narrow focus and lack of comprehensive modelling (29). These studies illustrate the regional focus of current literature and, while diverse in their investigated aspects, they lack a holistic theoretical approach, thus limiting their broader applicability. In this aspect, the present study is a pioneer in providing a more nuanced understanding, through the prism of the SCCT framework, into the influencing factors of career path choices of dental students globally, addressing the gaps in regionally focused studies. Given the nature of the study design, the findings provide crucial insight for developing targeted interventions and career guidance programs to support dental students' decision-making process in their career planning, tailored to the specific needs of their diverse environmental context.

Self-efficacy in career planning

The findings revealed levels of uncertainty among students regarding their capacity to make an informed decision on their career pathway such that it would align with their goals, personality and lifestyle. It is important to explore this uncertainty within the context of the student's education as much as their environment. The multivariable regression analysis showed that students who reported career planning training (CPT) exhibited a higher self-efficacy, highlighting the importance of structured guidance in boosting their confidence in the decision-making process. This aligns accurately with

TABLE 8 Multivariable logistic regression (MLR) models of first career preferences, suggested agencies, and preferred Media as reported by dental students participating in FDI-IADS-EDSA survey of career planning, May – July 2023, ($n = 1,964$).

Predictor	Preferred career pathways									
	General dentistry		Specialty dentistry		Business		Academia		Public health	
	AOR (95% CI)	<i>p.</i>	AOR (95% CI)	<i>p.</i>	AOR (95% CI)	<i>p.</i>	AOR (95% CI)	<i>p.</i>	AOR (95% CI)	<i>p.</i>
Gender (Male vs. Female)	0.92 (0.73–1.16)	0.484	0.94 (0.77–1.15)	0.547	2.44 (1.55–3.84)	<0.001	0.97 (0.56–1.68)	0.925	1.44 (0.75–2.76)	0.279
Age (continuous)	1.07 (1.03–1.13)	0.002	0.95 (0.91–0.99)	0.021	1.02 (0.92–1.13)	0.740	0.94 (0.81–1.10)	0.438	1.14 (1.00–1.28)	0.042
Academic Year (continuous)	1.04 (0.97–1.11)	0.296	1.03 (0.97–1.10)	0.337	0.93 (0.79–1.08)	0.334	1.11 (0.92–1.34)	0.293	0.82 (0.68–1.00)	0.049
Nationality (Inter vs. Dome)	1.02 (0.76–1.38)	0.892	0.85 (0.65–1.12)	0.253	1.10 (0.56–2.15)	0.792	2.89 (0.89–9.45)	0.079	2.06 (0.48–8.89)	0.333
SDI (Lower-mid. vs. Low)	2.18 (1.05–4.51)	0.036	0.44 (0.25–0.76)	0.003	1.62 (0.34–7.73)	0.546	11.19 (1.45–86.61)	0.021	0.23 (0.08–0.66)	0.006
SDI (Upper-mid. vs. Low)	1.37 (0.46–4.06)	0.574	0.37 (0.16–0.84)	0.018	4.38 (0.41–46.66)	0.221	4.77 (0.34–66.39)	0.245	0.32 (0.05–2.14)	0.239
SDI (High vs. Low)	2.12 (0.72–6.27)	0.175	0.30 (0.13–0.68)	0.004	3.38 (0.32–36.23)	0.315	2.67 (0.19–37.71)	0.466	0.18 (0.02–1.26)	0.084
Region (Asia vs. Africa)	0.67 (0.37–1.23)	0.194	2.17 (1.31–3.58)	0.002	0.45 (0.10–2.03)	0.300	0.51 (0.20–1.33)	0.170	1.29 (0.37–4.53)	0.693
Region (Europe vs. Africa)	1.68 (0.71–3.98)	0.243	1.84 (0.93–3.63)	0.080	0.44 (0.07–2.90)	0.393	0.69 (0.13–3.83)	0.673	0.25 (0.04–1.50)	0.131
Region (S. America vs. Africa)	0.60 (0.22–1.68)	0.334	3.77 (1.70–8.40)	0.001	0.24 (0.02–2.23)	0.207	0.48 (0.06–3.94)	0.491	0.77 (0.10–5.89)	0.803
Region (N. America vs. Africa)	3.45 (1–11.95)	0.051	1.19 (0.39–3.65)	0.755	0.40 (0.02–6.40)	0.516	0.81 (0.06–11.71)	0.879	0.99 (0.07–14.24)	0.992
Financial Aid (Yes vs. No)	1.07 (0.84–1.36)	0.593	0.93 (0.75–1.15)	0.502	1.15 (0.68–1.94)	0.614	2.12 (1.24–3.61)	0.006	1.08 (0.51–2.32)	0.835
CP Training (Received vs. No)	1.17 (0.93–1.47)	0.188	0.95 (0.77–1.16)	0.593	1.07 (0.64–1.79)	0.801	0.80 (0.45–1.41)	0.432	0.51 (0.22–1.15)	0.104
Self-efficacy	1.02 (0.99–1.05)	0.274	1.02 (0.99–1.05)	0.161	0.98 (0.91–1.04)	0.485	1.01 (0.94–1.09)	0.771	0.96 (0.87–1.04)	0.311
Professional Expectations	0.98 (0.96–1.01)	0.191	1.04 (1.01–1.06)	0.005	0.97 (0.91–1.02)	0.212	0.98 (0.92–1.05)	0.542	0.97 (0.90–1.05)	0.407
Personal Expectations	1.04 (1.01–1.08)	0.018	0.96 (0.93–0.99)	0.004	0.96 (0.89–1.03)	0.285	1.01 (0.93–1.09)	0.896	1.02 (0.92–1.13)	0.745
Career Goals	0.99 (0.96–1.02)	0.501	1.03 (1.00–1.06)	0.036	0.99 (0.93–1.06)	0.864	1.03 (0.96–1.11)	0.410	1.01 (0.92–1.10)	0.888

(Continued)

TABLE 8 Continued

Predictor	Agencies of career planning training									
	Dental schools		FDI		Regional Dent. Ass.		National Dent. Ass.		IADS	
	AOR (95% CI)	<i>p.</i>	AOR (95% CI)	<i>p.</i>	AOR (95% CI)	<i>p.</i>	AOR (95% CI)	<i>p.</i>	AOR (95% CI)	<i>p.</i>
Gender (Male vs. Female)	0.84 (0.61–1.17)	0.298	0.81 (0.65–1.01)	0.057	0.86 (0.68–1.09)	0.208	1.26 (1.03–1.55)	0.028	0.70 (0.56–0.88)	0.002
Age (continuous)	0.98 (0.91–1.05)	0.544	0.96 (0.91–1.00)	0.067	1.01 (0.96–1.06)	0.698	1.00 (0.96–1.05)	0.996	0.97 (0.92–1.01)	0.147
Academic Year (continuous)	1.06 (0.95–1.18)	0.287	1.03 (0.97–1.11)	0.339	0.98 (0.91–1.06)	0.659	0.97 (0.91–1.04)	0.363	1.02 (0.95–1.09)	0.632
Nationality (Inter vs. Dome)	1.03 (0.64–1.66)	0.905	0.85 (0.63–1.14)	0.267	1.19 (0.85–1.66)	0.302	1.21 (0.91–1.61)	0.186	0.88 (0.65–1.19)	0.403
SDI (Lower-mid. vs. Low)	1.48 (0.73–3.00)	0.273	1.59 (0.89–2.84)	0.115	0.66 (0.36–1.18)	0.161	0.91 (0.52–1.59)	0.734	0.99 (0.57–1.72)	0.960
SDI (Upper-mid. vs. Low)	3.67 (0.95–14.14)	0.059	1.50 (0.59–3.81)	0.400	0.51 (0.19–1.34)	0.171	1.27 (0.54–2.96)	0.583	0.88 (0.38–2.05)	0.764
SDI (High vs. Low)	11.20 (2.82–44.39)	<0.001	0.83 (0.33–2.14)	0.706	0.38 (0.14–0.99)	0.048	1.58 (0.68–3.69)	0.289	0.88 (0.38–2.06)	0.775
Region (Asia vs. Africa)	0.78 (0.40–1.51)	0.459	0.45 (0.26–0.77)	0.004	0.89 (0.50–1.58)	0.683	1.02 (0.61–1.70)	0.954	0.81 (0.49–1.35)	0.416
Region (Europe vs. Africa)	0.44 (0.13–1.50)	0.189	1.01 (0.46–2.23)	0.974	1.47 (0.64–3.37)	0.368	0.81 (0.41–1.62)	0.549	0.62 (0.31–1.24)	0.172
Region (S. America vs. Africa)	0.51 (0.13–1.98)	0.329	1.46 (0.60–3.52)	0.401	1.24 (0.48–3.20)	0.660	1.29 (0.58–2.86)	0.531	1.79 (0.80–4.02)	0.157
Region (N. America vs. Africa)	1.17 (0.11–12.30)	0.899	0.52 (0.14–1.87)	0.315	0.42 (0.08–2.25)	0.310	0.22 (0.05–0.90)	0.035	0.27 (0.07–1.12)	0.071
Financial Aid (Yes vs. No)	0.93 (0.65–1.33)	0.688	0.99 (0.79–1.25)	0.959	1.16 (0.90–1.48)	0.243	1.04 (0.84–1.30)	0.702	1.35 (1.08–1.70)	0.009
CP Training (Received vs. No)	0.67 (0.48–0.93)	0.016	1.35 (1.09–1.68)	0.007	0.88 (0.69–1.13)	0.319	1.11 (0.90–1.37)	0.334	1.08 (0.87–1.35)	0.486
Self-efficacy	0.97 (0.93–1.02)	0.191	0.99 (0.96–1.02)	0.516	1.01 (0.98–1.04)	0.644	0.98 (0.96–1.01)	0.226	0.99 (0.97–1.02)	0.677
Professional Expectations	1.04 (1.00–1.09)	0.039	1.02 (0.99–1.04)	0.227	1.02 (0.99–1.05)	0.127	1.05 (1.02–1.07)	<0.001	1.05 (1.02–1.08)	<0.001
Personal Expectations	1.03 (0.98–1.08)	0.266	0.97 (0.94–1.00)	0.050	0.97 (0.93–1.00)	0.082	0.97 (0.94–1.00)	0.032	0.93 (0.90–0.96)	<0.001
Career Goals	1.00 (0.95–1.04)	0.871	1.01 (0.98–1.04)	0.594	0.99 (0.96–1.02)	0.426	0.96 (0.94–0.99)	0.008	0.99 (0.96–1.02)	0.353

(Continued)

TABLE 8 Continued

Predictor	Agencies of career planning training				Preferred media of career planning training					
	Regional Ass.	Dent. Stu.	National Dent. Stu. Ass.		Webinars		Podcasts		Blogs	
	AOR (95% CI)	p.	AOR (95% CI)	p.	AOR (95% CI)	p.	AOR (95% CI)	p.	AOR (95% CI)	p.
Gender (Male vs. Female)	0.78 (0.62–0.99)	0.041	0.90 (0.73–1.10)	0.305	0.77 (0.62–0.94)	0.010	0.86 (0.69–1.07)	0.182	0.66 (0.51–0.84)	<0.001
Age (continuous)	1.01 (0.96–1.06)	0.709	0.99 (0.94–1.03)	0.582	1.04 (0.99–1.09)	0.088	1.01 (0.97–1.06)	0.630	0.97 (0.92–1.03)	0.295
Academic Year (continuous)	1.00 (0.93–1.07)	0.909	1.00 (0.94–1.06)	0.960	1.10 (1.04–1.18)	0.002	0.96 (0.90–1.03)	0.235	1.00 (0.92–1.07)	0.905
Nationality (Inter vs. Dome)	0.95 (0.70–1.30)	0.760	1.19 (0.89–1.58)	0.244	1.14 (0.86–1.50)	0.354	1.39 (1.02–1.90)	0.039	1.04 (0.75–1.44)	0.823
SDI (Lower-mid. vs. Low)	0.70 (0.39–1.27)	0.246	0.93 (0.53–1.62)	0.796	0.89 (0.51–1.54)	0.666	1.74 (0.91–3.33)	0.094	1.66 (0.86–3.19)	0.128
SDI (Upper-mid. vs. Low)	0.66 (0.27–1.63)	0.368	2.00 (0.86–4.67)	0.109	2.04 (0.88–4.70)	0.095	1.51 (0.59–3.87)	0.392	6.49 (2.41–17.48)	<0.001
SDI (High vs. Low)	0.61 (0.25–1.50)	0.280	2.63 (1.13–6.13)	0.026	2.03 (0.88–4.69)	0.096	1.95 (0.76–5.00)	0.162	5.04 (1.87–13.58)	0.001
Region (Asia vs. Africa)	1.20 (0.69–2.09)	0.517	0.66 (0.39–1.12)	0.123	0.76 (0.46–1.26)	0.293	0.83 (0.48–1.43)	0.498	0.38 (0.20–0.73)	0.004
Region (Europe vs. Africa)	1.16 (0.55–2.46)	0.698	0.38 (0.19–0.75)	0.006	0.65 (0.33–1.29)	0.219	0.91 (0.43–1.90)	0.799	0.22 (0.10–0.48)	<0.001
Region (S. America vs. Africa)	1.30 (0.54–3.10)	0.556	0.49 (0.22–1.09)	0.079	0.84 (0.38–1.85)	0.657	1.34 (0.57–3.13)	0.501	0.28 (0.11–0.70)	0.006
Region (N. America vs. Africa)	0.76 (0.20–2.88)	0.688	0.26 (0.08–0.86)	0.026	0.32 (0.10–1.00)	0.051	0.54 (0.14–2.02)	0.357	0.11 (0.02–0.46)	0.003
Financial Aid (Yes vs. No)	1.17 (0.92–1.49)	0.194	1.05 (0.84–1.31)	0.691	0.87 (0.70–1.08)	0.202	1.18 (0.93–1.49)	0.169	1.09 (0.85–1.40)	0.489
CP Training (Received vs. No)	0.90 (0.71–1.14)	0.384	0.86 (0.69–1.06)	0.157	0.90 (0.73–1.10)	0.303	0.80 (0.63–1.00)	0.053	0.84 (0.66–1.07)	0.157
Self-efficacy	0.99 (0.96–1.02)	0.651	0.98 (0.96–1.01)	0.192	0.97 (0.95–1.00)	0.053	0.97 (0.94–1.00)	0.032	1.01 (0.98–1.04)	0.481
Professional Expectations	1.04 (1.02–1.07)	0.003	1.05 (1.02–1.07)	<0.001	1.02 (0.99–1.04)	0.166	1.01 (0.99–1.04)	0.354	1.01 (0.98–1.04)	0.377
Personal Expectations	0.98 (0.95–1.02)	0.281	0.98 (0.95–1.01)	0.132	1.00 (0.97–1.03)	0.994	1.01 (0.97–1.04)	0.631	1.00 (0.96–1.04)	0.909
Career Goals	0.97 (0.94–1.00)	0.048	1.00 (0.97–1.02)	0.732	1.00 (0.97–1.03)	0.906	1.01 (0.98–1.04)	0.417	0.99 (0.96–1.02)	0.409
Predictor	Preferred media of career planning training									
	E-books		CE workshop		UG course					
	AOR (95% CI)	p.	AOR (95% CI)	p.	AOR (95% CI)	p.				
Gender (Male vs. Female)	0.98 (0.77–1.24)	0.852	0.94 (0.76–1.16)	0.556	0.96 (0.78–1.18)	0.693				
Age (continuous)	0.99 (0.94–1.04)	0.796	1.07 (1.02–1.12)	0.006	1.00 (0.96–1.05)	0.847				
Academic Year (continuous)	1.03 (0.96–1.11)	0.430	1.05 (0.98–1.12)	0.142	0.98 (0.92–1.04)	0.507				
Nationality (Inter vs. Dome)	0.90 (0.66–1.24)	0.532	1.19 (0.90–1.57)	0.228	1.03 (0.78–1.37)	0.818				
SDI (Lower-mid. vs. Low)	0.95 (0.52–1.75)	0.877	0.71 (0.40–1.27)	0.250	1.92 (1.11–3.33)	0.020				
SDI (Upper-mid. vs. Low)	1.18 (0.45–3.07)	0.736	0.42 (0.18–0.99)	0.048	3.26 (1.41–7.55)	0.006				
SDI (High vs. Low)	1.09 (0.42–2.83)	0.867	0.38 (0.16–0.88)	0.025	4.15 (1.79–9.62)	<0.001				
Region (Asia vs. Africa)	0.67 (0.37–1.22)	0.189	1.35 (0.81–2.26)	0.249	0.48 (0.29–0.79)	0.004				
Region (Europe vs. Africa)	0.69 (0.31–1.53)	0.360	2.07 (1.04–4.13)	0.038	0.42 (0.21–0.84)	0.014				
Region (S. America vs. Africa)	1.09 (0.44–2.70)	0.851	2.03 (0.90–4.55)	0.087	0.55 (0.24–1.23)	0.142				
Region (N. America vs. Africa)	0.53 (0.14–2.04)	0.352	0.62 (0.20–1.93)	0.412	0.57 (0.18–1.80)	0.339				
Financial Aid (Yes vs. No)	1.16 (0.90–1.48)	0.245	0.81 (0.65–1.01)	0.064	0.99 (0.79–1.24)	0.935				
CP Training (Received vs. No)	1.34 (1.06–1.69)	0.015	0.79 (0.64–0.97)	0.028	1.02 (0.83–1.26)	0.846				
Self-efficacy	0.99 (0.96–1.02)	0.387	0.98 (0.96–1.01)	0.220	1.00 (0.97–1.02)	0.787				
Professional Expectations	1.01 (0.98–1.04)	0.382	1.04 (1.01–1.07)	0.002	1.03 (1.00–1.05)	0.042				
Personal Expectations	1.01 (0.97–1.05)	0.657	0.98 (0.95–1.01)	0.184	0.99 (0.96–1.02)	0.465				
Career Goals	1.01 (0.98–1.04)	0.510	1.01 (0.98–1.04)	0.453	0.98 (0.95–1.01)	0.181				

Bold font refers to the values that are statistically significant.

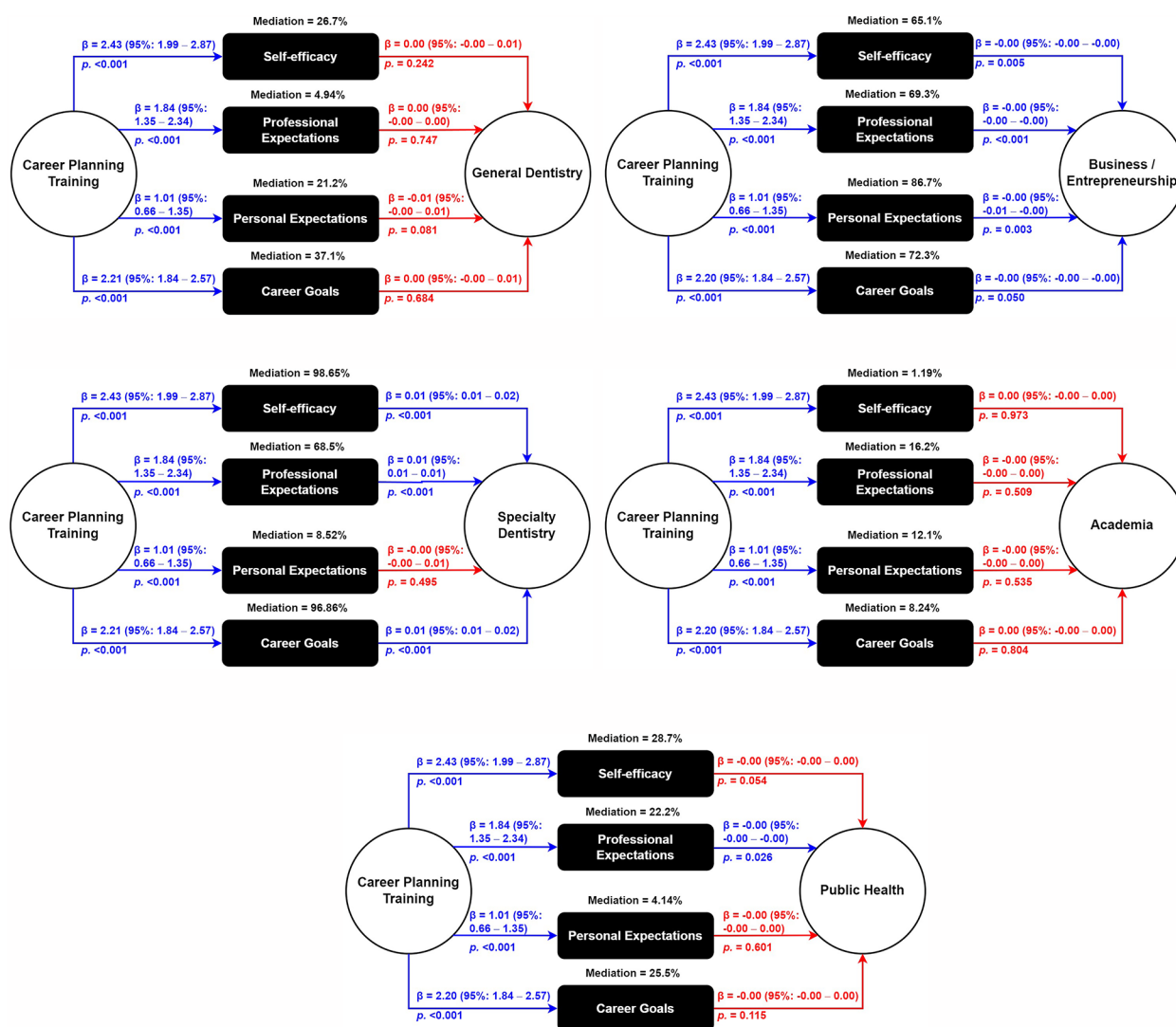


FIGURE 2

Mediation analysis for the effect of self-efficacy, professional expectations, personal expectations, and career goals on the relationship between career planning training (predictor) and primary career preferences (outcome) among dental students participating in the FDI-IADS-EDSA survey of career planning, May–July 2023, ($n = 1,964$).

existing literature and additionally with the mediation analysis, which highlighted CPT as a key mediator, positively impacting self-efficacy, especially for those pursuing speciality dentistry (28, 30, 31). When placed within the sociodemographic context, the higher self-efficacy among international and pre-clinical students could indicate that early career exploration and early exposure to information on the diverse opportunities within their field may help students feel more confident about their career choices (25, 27).

Another interesting finding was the difference in self-efficacy between pre-clinical and clinical students, with the former reporting higher levels of self-efficacy. The drop in self-efficacy seen in clinical students may be attributed to increased pressures and challenges they face during their training, as they are exposed to the demands of clinical practice and the complexities of patient care (32, 33).

Outcome expectations

Notably high professional expectations among participants were observed, with over 80% expecting intellectual stimulation and work satisfaction, in accordance with the outcomes of Gallagher et al. (20, 21)

CPT is observed, again, as a significant factor in boosting both professional and personal expectations, with students who received prior training on their career planning reporting higher confidence in their future careers. The mediation analysis revealed that professional expectations served as a significant mediator in the preference for speciality dentistry, where students who received CPT exhibited a stronger likelihood of pursuing advanced specialities. These findings reinforce the role of structured guidance in shaping professional expectations and satisfaction (21–23).

International students and those in their pre-clinical years showing higher professional expectations as compared to domestic and clinical students is a reiteration of the importance of early exposure to more diverse healthcare system settings and career opportunities as well as the need for ongoing career support through the senior years of their studies, to tackle the gap in perception between students' early expectations and the realities they encounter later into their career (30, 33).

Personal expectations—such as work-life balance, lifestyle compatibility and participation in leisure activities—were also influenced by CPT. The regression analysis revealed that students with higher personal expectations were more likely to choose general dentistry. This could be attributed to lifestyle factors weighing in on the decision to pursue a less demanding and stable career path. The mediation analysis did not show personal expectations as a strong mediator, especially in terms of special dentistry, as compared to professional expectations; however, they still played a role in shaping career preferences.

Overall, personal and professional expectations were significant mediators across all career paths, showing that CPT helps clarify students' understanding of how their careers can meet personal and professional needs.

Career goals and preferences

A significantly high portion of the participants reported having clear career goals (62.5%) and discussing their goals with their families and partners (73.7%). This finding places the role of community and social support in a strongly shaping position for students' career aspirations (34).

Another interesting factor playing into the career goal clarity was found to be financial aid. The findings suggest that economic support can alleviate the pressure of financial burden and allow students to focus more on their long-term professional development (25). This aligns with other studies where financial concerns were evaluated to dictate or limit students' career choices, particularly in lower-income regions (28, 32, 35).

Consistent with goal-setting theory, students with well-defined career goals were more likely to pursue specialty careers and entrepreneurial paths (36). The multivariable logistic regression analysis identified age and personal expectations as key predictors for career path preferences.

The mediation analysis further demonstrated that career planning training (CPT) positively influenced self-efficacy, professional expectations, and career goals, especially for students choosing specialty dentistry. In concordance with current literature, the dominance of specialty clinical dentistry (51.2%) as the most preferred career path, both as a first and second choice, indicates a strong interest among dental students to specialize, particularly in lower-income countries (23, 25, 28). General clinical dentistry on the other hand was more preferred among older students and those in their clinical years and higher-income countries. This could be attributed to the desire for faster integration into the workforce and job stability among senior dental students or recent graduates, which is consistent with

previous findings from Gallagher *et al.* (20, 21). Similarly, such preference from students in higher-income countries could also be attributed to the perceived financial stability and job market within the country's context (30–32).

However, according to the mediation analysis results, for non-clinical paths such as business/entrepreneurship and public health, CPT seemed to negatively influence preferences. Public health was less popular among students from higher-income countries, which was unexpected. While previous research has suggested public health careers might appeal to students due to their societal impact, the results indicate that financial considerations may deter students from pursuing public health, especially in wealthier regions (20, 21). Conversely, students from lower-income regions demonstrated greater interest in public health, reflecting the pressing societal needs in these areas and the strong commitment to addressing public health challenges where healthcare resources are limited (26, 35, 37). Moreover, the weaker effect of CPT for Academia (8.24%) in the mediation analysis, suggests that other factors, such as academic mentorship or research opportunities, may play a larger role. This is consistent with research suggesting that academic careers often evolve over time and are influenced by factors like mentorship and research interests rather than predefined career goals set early in one's education (34, 38).

The significant gender differences in the preference for business/entrepreneurship, where male students exhibited a stronger inclination, reflect traditional societal roles and expectations regarding financial independence and leadership, which persist across many regions despite evolving norms in the healthcare sector (21, 31, 39). These findings suggest that gender dynamics continue to influence career aspirations, even in fields where gender representation is becoming more balanced. Taken together, these results emphasise the need for culturally sensitive career guidance that considers sociocultural factors in shaping career goals and preferences.

Career planning training

When career planning agencies and preferred media are considered, the logistic regression findings align well with students' stated preferences for dental schools as the most reliable CPT source, especially in high-income countries (23, 25, 28, 33). National and international associations such as the IADS were more favoured by students from low-income countries, underscoring the need for global networking and support systems for students with fewer local resources.

Interestingly, Gen Z students still preferred in-person training over digital platforms. This suggests that students highly value personal interaction with mentors and career advisors, even in an era of digital learning. This is supported by findings from Garcia *et al.*, who investigated the effect of COVID-19 on the career perspective of dental and dental hygienist students—their findings concluded that according to student perception of the effect of the pandemic on their education, they reported a negative effect on the preclinical and clinical training pointing at the fatigue of virtual learning and the absence of hands-on practice (40).

The findings strongly support the idea that dental schools should integrate structured career counselling into their curricula to enhance students' self-efficacy and align their career goals with realistic professional expectations.

Limitations

The findings confirm the applicability of SCCT in explaining dental students' career aspirations across diverse contexts. However, regional adaptations may be necessary to account for variations in professional and personal expectations, particularly in the socioeconomic context. Additionally, while this study provides significant insights into the role of Career Planning Training, it is limited by its cross-sectional design, which prevents us from drawing causal inferences. Future longitudinal studies could explore how changes in self-efficacy and professional expectations over time affect career choices. Furthermore, the overrepresentation of European participants and the underrepresentation of regions such as Asia-Pacific may limit the global generalizability of the findings. However, subgroup analyses and regression models were applied to account for regional differences, ensuring the results remain interpretable across diverse educational and professional contexts. Finally, while the SCCT components, i.e., self-efficacy, outcome expectations, and career goals, were examined, the influence of role models on career decisions was not assessed. Given the documented impact of mentorship on career trajectories, future research should incorporate this factor for a more comprehensive understanding of career aspirations.

Implications

These findings have important implications for dental education and policy. National dental associations and schools should work collaboratively to create tailored career planning programs that address the unique needs of students in their pertaining regions. Moreover, organizations like FDI and IADS could focus on creating general CPT guidelines that can be adapted to local contexts, rather than providing CPT directly. Future research should continue exploring how CPT interventions can be tailored to students' specific career goals and regional job market conditions.

Conclusions

This study offers new insights into the global career aspirations of dental students through the lens of the SCCT. The findings show that structured career planning programs can significantly enhance students' ability to make informed decisions about their future.

The differences in career aspirations based on income level and geographic region underline the need for more personalised career planning training, particularly in low-income areas where students may have fewer resources and less support. By increasing access to

career planning training and focusing on building students' confidence and informed awareness of the available career opportunities, dental schools and associations can help ensure that students are better prepared for the diverse opportunities within the dental field.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics statement

This study was reviewed and approved by the Ethics Committee of the Faculty of Medicine, Masaryk University (decision no. 12/2023). The study was conducted in accordance with the local legislation and institutional requirements. The participants provided their informed consent to participate in this study electronically.

Author contributions

AR: Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Software, Supervision, Validation, Writing – original draft. LE: Conceptualization, Project administration, Writing – original draft. SD: Data curation, Investigation, Writing – original draft, Software. AD: Writing – original draft. CC: Conceptualization, Investigation, Writing – review & editing. DK: Data curation, Investigation, Writing – review & editing. EV: Formal analysis, Writing – original draft. RE: Conceptualization, Funding acquisition, Project administration, Resources, Writing – review & editing. MM: Data curation, Funding acquisition, Writing – review & editing. JI: Data curation, Writing – review & editing. SA: Data curation, Writing – review & editing. MA: Methodology, Writing – review & editing. DH: Methodology, Writing – review & editing. AB: Methodology, Writing – review & editing. ID: Writing – review & editing, Investigation, Data curation. ED: Data curation, Writing – review & editing, Investigation.

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Supplementary material

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De-stress your physiological activation by compressing your imagination: a brief session of hypnosis decreases sympathetic stress response in moderately stressed dentists

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Aim: This study aims to explore the effect of hypnosis on dentists' physiological stress management.

Methods: The study included 20 dentists (mean = 30, SD = 7.37) from the Dental Clinic of the University of Padua. Stress assessment was performed by recording several physiological parameters, including heart rate (HR), heart rate variability (HRV), electrodermal activity (EDA), skin conductance responses (SCRs), and the administration of the psychological stress perceived stress scale (PSS-10). Following hypnosis induction, participants were led to recall and relive a previously agreed-upon, pleasant experience, while the related psycho-physiological changes were monitored. The hypnosis session was planned on a regular working day. Physiological parameters were recorded using the Empatica E4 wristband and eSense galvanometer. Measurements were taken at baseline, during hypnosis, and after dehypnotization.

Results: Participants exhibited moderate stress levels before hypnosis (mean PSS-10 = 17.1 ± 8.1). After hypnosis, a significant and large decrease in SCRs (T-test = 3.24, DF = 19, $p = 0.002$, as shown also by Cohen's $d = 0.724$) and an increase in EDA (Wilcoxon = 50, DF = 18, $p = 0.00355$) were recorded, while HRV did not show significant changes. Friedman ANOVA for repeated measures models, and Nemenyi post-hoc correction indicated that the condition (basal, hypnosis, and post-hypnosis) significantly affected SCR levels ($p = 0.00008$), especially in the pre vs. post ($p = 0.012313$) and in the hypnosis vs. post comparisons ($p = 0.00005819$). Friedman ANOVA for repeated measures models and Durbin–Conover indicated that conditions (basal, hypnosis, or post-hypnosis) also influenced EDA levels, while HRV did not show any significant change (tested with ANOVA repeated measures). Pearson's correlation showed that PSS-10 levels were inversely correlated with SCRs in hypnosis ($p = 0.019$, DF = 18, $R = -0.51$). A linear regression model fitting delta SCRs (post-pre physiological activation) showed that SCR-pre explained part of the outcome ($R = 0.647$, $R^2 \text{ adj} = 0.386$, AIC = 99.6, $F = 13$, RMSE = 2.51,

$p = 0.002$). Regarding subjective perception, 18/20 participants reported feeling better, 2 reported no difference $\chi^2 = 29.2$, $p = 0.00000047$, $df = 2$. Furthermore, the Bayesian paired samples T-test comparing SCR-pre vs. post showed a $BF_{+0} = 20.7$, error % = 0.000824, which strongly indicates the superiority of the effectiveness of training in comparison to null hypotheses (>20 times probable than an effect than no effect).

Conclusion: Our data suggest that hypnosis could be a valuable resource for stressed dentists. Longitudinal controlled studies and larger samples are necessary to corroborate our results and to check the durability of effects over time. Anyway, our results suggests that a short session of hypnosis (or perhaps, self-hypnosis) during a regular working day may help relieve the sympathetic stress response.

KEYWORDS

dentistry, stress, HRV, EDA, hypnosis, physiology

Introduction

Dentistry is a stressful and highly demanding profession that requires strong mental and physical involvement from the dental school and may result in stress and anxiety (Collin et al., 2019; Queirolo et al., 2023; Meyerson et al., 2022). In fact, during clinical practice, dentists have to face infectious, chemical, and physical risks, as well as psychosocial stress (Moore and Brødsgaard, 2001; DiMatteo et al., 1993). According to Myers et al., the main stressors for dentists are the run behind the schedule and the management of difficult and uncooperative patients (Myers and Myers, 2004). They may, in turn, challenge psychophysical homeostasis by sudden requests that may exceed the subject's resilience (a complex concept in medicine and psychology) and dentists' available resources (Angeler and Allen, 2016; Facco, 2020; Angeler et al., 2018). In this regard, the Karasek–Theorell model of job-related mental strain seems valuable, but does not take into account the physical stress-related components (Karasek, 1979). In general, the literature focuses primarily on psychological aspects: for instance, Moro et al. found a 13% prevalence of burnout syndrome in dentists; while lower than in nurses and other doctors, burnout among dentists is relevant because it can worsen both dentists' health and patients' dental care (Moro et al., 2022). Indeed, excessive stress may affect decision-making and working performance (Chipchase et al., 2017; Plessas et al., 2018). A cross-sectional survey by Hopcraft et al. reported a current or previous self-reported depression in 26% of dentists, anxiety disorders in 23.1%, and both anxiety and depression in 6.1% (Hopcraft et al., 2023), while in the survey of Collin et al. 44% of respondents felt that work-related stress surpassed their ability to cope (Collin et al., 2019). COVID-19 pandemic contributed to worsening the working conditions of dentists as well (Owen et al., 2022).

As a whole, these disorders are associated with a high risk of maladaptive coping behavior, such as anxiolytic, antidepressant, alcohol and drug abuse, poor health, lower life expectancy, and suicidal thoughts. Many findings agree on the need for education and intervention programs to support the mental wellbeing of dental practitioners (Özarslan and Caliskan, 2021). Among these, hypnosis may help relieve anxiety and post-traumatic stress disorder as well as improve resilience (Facco, 2020; O'Toole et al., 2016; Leo et al., 2024).

According to the American Psychological Association (APA), hypnosis is “A state of consciousness involving focused attention and

reduced peripheral awareness characterized by an enhanced capacity for response to suggestion” (Elkins et al., 2015). This definition, though correct, ignores the intimate psychosomatic nature of hypnosis, i.e., its capacity to modulate the somatic and neurovegetative regulation, as well as stress reactions. During hypnosis, the subject is driven to mental imagery by focused attention and absorption, resulting in so-called plastic monoidism—i.e., a powerful image perceived as if it were almost real and experienced with psychosomatic participation, a fact yielding measurable physical changes (Williamson, 2019). There is increasing evidence of the effectiveness of hypnosis for sedation and analgesia in dentistry, surgery, and invasive procedures (Tieri et al., 2023; Queirolo et al., 2024; Girón et al., 2024; Hansen et al., 2024). Actually, hypnosis can relieve dental anxiety and phobia, allowing for facing oral surgery in full wellbeing and cardiovascular stability, and is the best option in selected cases (Tefikow et al., 2013; Steenen et al., 2024; Noergaard et al., 2019; Facco et al., 2021). The effects of hypnosis in pain and psychosomatic disorders depend on the modulation of several brain areas and circuits, including prefrontal cortex, insula and anterior cingulate cortex, engendering a partial deactivation of the default mode network and an increased connectivity between the salience network, the central executive network and involved motor areas (Casiglia et al., 2020; De Benedittis, 2024; Flammer and Alladin, 2007; Flammer and Bongartz, 2003; Thompson et al., 2019; Wolf et al., 2022; Sim et al., 2024). Interestingly, besides patients, hypnosis can be potentially useful for dentists too.

The effects of hypnosis can be studied by the analysis of psychophysiological variables, such as heart rate variability (HRV), heart rate (HR), and electrodermal activity (EDA), besides validated questionnaires and fMRI (Boselli et al., 2018; Yüksel et al., 2013). These parameters may detect the activity of the autonomic nervous system, providing information about the sympatho-vagal balance, which reflects the ability to adapt to the environmental requests and, in this context, the effects of hypnosis on both the patient and the dentist (Thayer et al., 2009; Hickey et al., 2021; Koenig and Thayer, 2016; Queirolo et al., 2024; Gullett et al., 2023; Fernandez et al., 2022). EDA allows for continuous monitoring of skin electric conductance, which depends on the activity of sweat glands; therefore, it is a sympathetic index, the fluctuation of which reflects the activation or suppression of the sympathetic nervous system (SNS) (Kasos et al., 2022; Posada-Quintero and Chon, 2020; Queirolo et al., 2024). There is some evidence that hypnotic relaxation is paralleled by increased parasympathetic

activity and reduced activity of SNS, a fact explaining the effectiveness of hypnosis in the treatment of conditions associated with strong SNS activation (De Benedittis, 2024; Kekecs et al., 2016; Kasos et al., 2020).

Despite an extensive literature search, we found no studies specifically investigating the relationship between hypnosis and dentists' stress, which may be due to the general lack of high-quality studies in this area (Fisch et al., 2017; Whitehouse et al., 1996; Cardeña et al., 2013). Moreover, it is often the case that both medical doctors and dentists are more focused on caring for others than seeking care for themselves.

Hypnosis and self-hypnosis have been reported to reduce perceived stress, alleviate symptoms of burnout, and enhance overall wellbeing. Currently, only a few randomized controlled trials (RCTs) have examined the use of hypnosis to reduce occupational stress, and although the evidence is limited in quality, the findings so far are promising (Fisch et al., 2017; Whitehouse et al., 1996; Cardeña et al., 2013). Notably, some evidence has emerged suggesting that a significant number of healthcare professionals would have welcomed hypnosis as a tool for managing the stress associated with the COVID-19 pandemic (Wozniak et al., 2022). However, the practice remains rare; in one survey, only 23 out of 1,247 healthcare workers reported using hypnosis as a complementary therapy (Aveni et al., 2016). This underutilization highlights the need for further exploration in this field and serves as the rationale for conducting the present research.

This study aims to evaluate how stress management resources can be modulated by hypnosis through SNS monitoring in dentists before, during, and after an anxiolytic hypnosis session.

Materials and methods

This prospective study was approved by the Ethical Committee of the Department of Brain and Behavioral Sciences, University of Pavia (Prot. n. [1] 131/23). The participants enrolled in this study were dentists below 45 years of age, who signed an informed consent prior to participation. Data were collected between 1 June 2024 and 31 July 2024. Hypnosis sessions were planned during a routine working day between 2 p.m. and 4 p.m. The psychological and physiological data were recorded with the following protocol:

- 3-min baseline recording of the sympathetic and parasympathetic activities with Empatica E4 wristband and eSense galvanometer;
- perceived stress evaluation by the Perceived Stress Scale (PSS-10);
- a 10-min hypnotic session, recollecting pleasant memories, during which the sympathetic and parasympathetic activities were recorded;
- a 3-min recording of sympathetic and parasympathetic activities after dehypnotization;

At the end, participants were asked "how do you feel?," with three possible answers: equal, better, or worse.

Exclusion criteria

Psychiatric or cardiovascular disorders (i.e., hypertension), presence of a relevant trait anxiety ≥ 40 evaluated with STAI-Y-2, and experience with hypnosis.

Sample size

A sample size of 19 was suggested by *a priori* power analysis to reliably detect an effect size of $\delta \geq 0.6$ with probability greater than 0.8, assuming a one-sided criterion T-test allowing for a maximum Type I error rate of $\alpha = 0.05$. Therefore, 20 participants were enrolled, also considering a possible dropout of 5%.

Physiological variables

EDA is a property of the skin reflecting the stress-related changes in electrical conduction in response to sweat secretions. Human sweat glands have sympathetic cholinergic innervation originating from the sympathetic branch of the nervous system. There are at least three possible pathways that may lead to EDA phase alterations: (1) frontal, premotor cortex, and basal ganglion; (2) limbic system and hypothalamus; and (3) the reticular formation in the brainstem. Therefore, EDA allows monitoring of SNS activity changes before, during, and after hypnosis.

The EDA electrodes were applied on the non-dominant hand, on the distal phalanges. EDA was sampled at 4 Hz with the eSense Mindfield galvanometer and extracted as the mean value of electrodermal activity after data preprocessing, excluding 0 data points and spikes. Furthermore, a derived parameter, named skin conductance responses (SCRs), has been analyzed using the eSense algorithms. The available data in the literature suggest that a relaxed frame is between 0 and 5 SCR/min. Values in the range 5–9 indicate a mild arousal (which can contribute to increasing performance) (Boscolo et al., 2024), while higher values (in the range 10–16 SCR/min) are related to an increasing level of stress (De Benedittis, 2024; Boucsein, 2012).

HRV is a parasympathetic index reflecting central autonomic network modulation that may be measured in several different ways (Thayer and Lane, 2000; Thayer and Lane, 2009; Shaffer and Ginsberg, 2017; Beauchaine and Thayer, 2015; Thayer et al., 2012). Here, the root mean square of successive differences (RMSSDs) between normal heartbeats was chosen as the HRV index, given its high correlation with the high frequency part of the spectral analysis, which reflects vagal activity and can be calculated with a simple procedure. From photoplethysmography (PPG), inter-beat intervals (IBIs) were derived, and HRV was extracted as the root mean square of RMSSDs by calculating each successive time difference between heartbeats in ms from IBIs and then over a short-term period of 30 s.

Perceived stress

The subjective perception of stress level was measured through the PSS-10, a test recording the perceived stress levels in the last month. Scores in the range 0–13 indicate low stress, those in the range 14–26 indicate moderate stress, and scores higher than 26 indicate high stress.

Hypnosis

The participants were asked about previous peaceful subjective experiences. Following the induction of hypnosis, the participants

were led to be absorbed in the previously agreed mental image, realizing the so-called plastic monoideism, a term introduced by James Braid in 1843 and endorsed by Franco Granone in the latter 20th century—it indicates a deep concentration in an imaginative hypnotic task engendering a powerful plastic idea perceived with psychosomatic participation—i.e., yielding both psychological and physical, measurable effects (Casiglia et al., 2019).

Statistical analysis

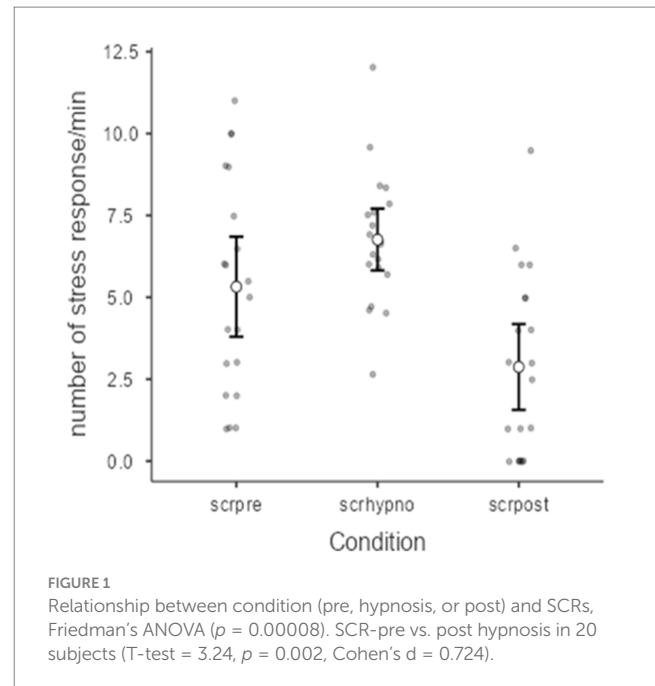
Continuous data were presented as mean $\pm$ standard deviation (SD), when normally distributed, or as the median, when non-normally distributed. The Shapiro–Wilk test was used to test normality. Categorical data were summarized using absolute and relative frequencies. To compare paired data, the t-test or the Wilcoxon matched-pairs test was applied. Pearson's or Spearman's coefficient was used to check correlations between different parameters. The normality of residuals and homoscedasticity of variance were checked before fitting ANOVA models. A repeated measures ANOVA with condition levels (“pre,” “hypno,” “post”) was used to determine whether the primary outcomes (dependent variables: physiological variables; SCRs, EDA, and HRV) significantly differed across the three conditions. The acronym SCR- Δ was used to indicate the difference between data recorded at the end and the beginning of the work shift. The primary outcome will also be explored using Bayesian analysis, as it provides several advantages over traditional frequentist methods. Bayesian analysis allows for the incorporation of prior knowledge, while it offers a more intuitive understanding of the probability of hypotheses, and is particularly useful when dealing with small sample sizes, where frequentist methods may be less reliable. Furthermore, Bayesian analysis directly estimates the probability of a hypothesis, which is more interpretable in decision-making contexts. We specify that our pre-determined comparisons were SCR-pre being higher than SCR post, and HRV in the hypnosis condition was higher compared to the other conditions. We also expected a difference according to the three conditions, with SCRs in hypnosis as well as EDA increasing from baseline.

Results

11 women and 9 men (mean = 30, SD = 7.37) were enrolled in this study.

As expected, the participants showed a huge decrease in sympathetic activity in the post compared to the pre-condition ($t = 3.24$, $p = 0.002$, Cohen's $d = 0.724$) (Figure 1). While frequentist statistics focuses on the probability of the data to give a hypothesis (p -value), Bayesian statistics calculates the probability of a hypothesis given the data (posterior probability). This provides a more intuitive understanding of how likely a hypothesis is after seeing the data, which is often more relevant for decision-making. The Bayesian paired samples T-test showed a $BF_{10} = 20.7$, error % = 0.000824, which strongly indicates the superiority of the effectiveness of the intervention in comparison to the null hypothesis (Table 1).

Figure 1 also shows the effect of condition (pre, hypnosis, or post) on the SCR variable ($\chi^2 = 18.9$; $p = 0.00008$) measured with Friedman's



ANOVA (due to the violation of the homoscedasticity of variance despite the Shapiro–Wilk normality test being respected). Table 2 also reports a post-hoc comparison showing the differences between pre and post and hypno vs. post conditions. A negative moderate correlation between SCR-hypno and PSS-10 scale was found by Pearson's test ($R = -0.51$, $DF = 18$, $p < 0.0019$) as reported in Figure 2. Although all possible correlations were searched, no other significant correlation was found.

EDA was not normally distributed. The analysis revealed a slight increase in EDA during hypnosis, followed by its marked decrease in the post condition (Wilcoxon = 50, $DF = 18$, $p = 0.0035$), while Friedman's ANOVA was significant ($p = 0.015$). Post-hoc comparison using Durbin–Conover tests showed a difference between EDA pre vs. hypno ($p = 0.003$) and hypno vs. post ($p = 0.044$) (Figure 3). No effect of the condition (pre, hypnosis, or post) on HRV was found; however, the result of ANOVA for repeated measurements was close to the significance level ($p = 0.054$).

No effect of the condition (pre, hypnosis, or post) on HR was found.

A regression model to check if pre-hypnosis SCR value could explain the final improvement (i.e., SCR- Δ) –explained less than 40% of the variance, $R^2 = 0.386$, $AIC = 99.6$, $F = 13$, $RMSE = 2.51$, $p = 0.002$. The subjective perception of stress improved in 18 out of 20 participants ($\chi^2 = 29.2$, $p = 0.00000047$, $DF = 2$).

Discussion

Dentists, as well as other health professionals, including physicians and nurses, are subjected to relevant stress in their profession. In our sample, dentists' stress levels were mild in basal conditions, both on a physiological (SCR-pre = 5.3) and a psychological level (PSS-10 = 17.6); these data confirm the previous literature about dentists' stress as well as the positive

TABLE 1 Aggregated data in all conditions, expressing mean, median, SD and range of the following variables: electrodermal activity (EDA), heart rate variability (HRV), heart rate (HR), skin conductance responses (SCRs), and Perceived Stress Scale score (PSS-10) in 20 participants submitted to a session of hypnosis.

Variable	Mean and SD	Median	Range
PSS-10	17.1 ± 8.1	15	[Min: 4—Max: 33]
SCR-pre	5.3 ± 3.3	5.2	[Min: 1—Max: 11]
SCR-hypno	6.8 ± 2.0	6.7	[Min: 2.6—Max: 12]
SCR-post	2.9 ± 2.8	2.8	[Min: 0—Max: 9.5]
HRV-pre	54.6 ± 21.5 ms	55.3	[Min: 21.6—Max: 99.4]
HRV-hypno	54.9 ± 12.7 ms	52.3	[Min: 31.6—Max: 79.5]
HRV-post	48.0 ± 14.9 ms	49.9	[Min: 27.5—Max: 78.2]
HR-pre	77.3 ± 10.6 bpm	75.1	[Min: 61.7—Max: 94.8]
HR-hypno	76.2 ± 8.2 bpm	74.2	[Min: 62—Max: 95.7]
HR-post	75.4 ± 7.8 bpm	73.5	[Min: 66.1—Max: 89.6]
EDA-pre	5.2 ± 2.8 μS	4.4	[Min: 2.3—Max: 12.5]
EDA-hypno	7.6 ± 4.8 μS	6.9	[Min: 1.2—Max: 21.6]
EDA-post	6.5 ± 4.4 μS	5.6	[Min: 1.1—Max: 21.1]

Pre, before hypnosis; Hypno, during hypnosis; post, after dehypnotization.

TABLE 2 SCR Friedman's ANOVA for repeated measures statistics and multiple comparison Nemenyi post-hoc correction.

SCR Repetead measures ANOVA (Friedman)		$\chi^2 = 18.9$	Acceptance: [0–5.9915], df = 2		$p = 0.00008^{***}$
Multiple Comparison Nemenyi post-hoc correction					
Pair	Rsum difference	Q	Lower CI	Upper Ci	p -value
SCRpre—SCRhypno	−9	2.0125	−23.8229	5.8229	0.329
SCRpre—SCRpost	18	4.0249	3.1771	32.8229	0.01231*
SCRhypno—SCRpost	27	6.0374	12.1771	41.8229	0.00005819***

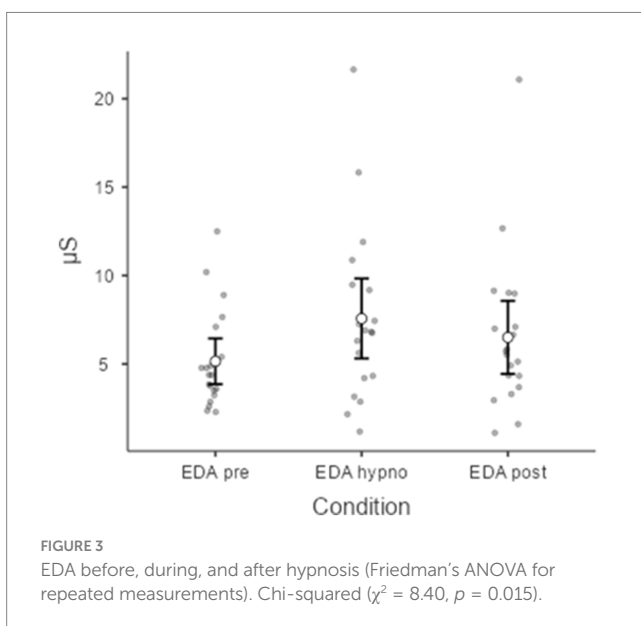
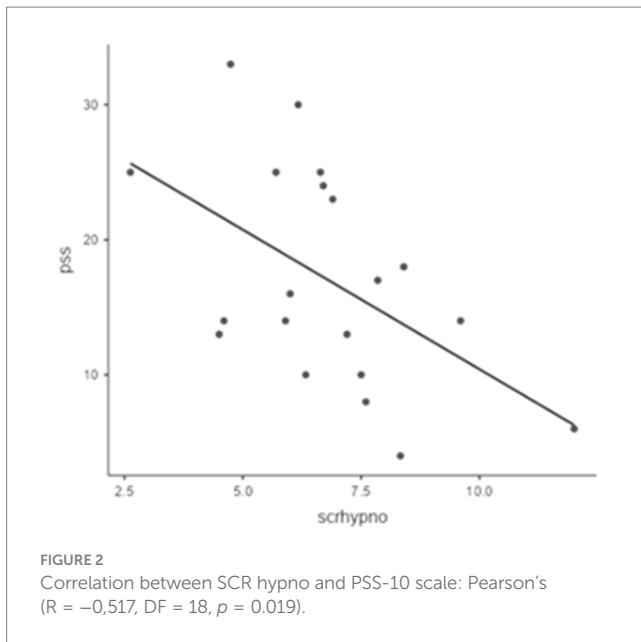
*= $p < 0.05$, **= $p < 0.01$, ***= $p < 0.001$.

effect of hypnosis in decreasing it (Myers and Myers, 2004; O'Toole et al., 2016; Cooper et al., 1988). The physiological component of the effects of hypnosis, i.e., the SCR decrease, has turned out to be even larger than the predicted one in the *a priori* power analysis. Similarly, the sample size was overestimated because the effect Cohen's $d = 0.724$ was larger than the predicted one, 0.6, i.e., even a smaller sample size could have reached the minimum threshold to show a significant effect.

To our knowledge, no similar studies have been published so far on the effects of hypnosis on dentists' stress. Interestingly, our data show an increased sympathetic tonic component associated with a decreased phasic component, i.e., an increase of approximately 25% of the former and a decrease of approximately 50% of the latter. This ostensible contradiction (i.e., the opposite deviation of two indexes of sympathetic activity) may arguably be explained in terms of challenge vs. threat. The increased sympathetic response may result from both challenge and threat, the former not being negative. Challenge is marked by an adaptive response (e.g., sports competition) where personal resources are superior or equal to the demands, while threat engenders a maladaptive approach entailing an imbalance between them. As a result, successful challenges are associated with increased catecholamine release and related increase in HR, cardiac output, and decreased total peripheral resistance, in turn rearranging the

distribution of blood flow to allow for improved circulation in the brain, heart, and muscles. Enduring threats activate the pituitary-adrenocortical axis besides the medullo-surrenal component, resulting in increased peripheral resistance and decreased cardiac output, a fact leading to worse performance. Furthermore, the subject's sympathetic activation depends on the subject's motivation and how the task is perceived (i.e., as a challenge or threat) prior to performance, allowing at least partly to predict it.

According to Blascovich and Tomaka (Shaffer and Ginsberg, 2017), an increase in tonic sympathetic activity (as defined by EDA) may occur in both challenge and threat. EDA has two components—a slow-changing tonic one—dependent on environmental conditions (such as temperature and humidity) as well as individual level of arousal—and a phasic one (SCR); the latter is fast-changing and reflects the activation of the sympathetic nervous system in response to several events, including emotional stimulation and related attentional load. The scientific literature mostly relies on EDA, but with some new promising algorithms, it is possible to deconvolute the raw EDA signal to better recognize the small peaks of the fast component. It is reasonable to argue that the phasic component may be more sensitive to challenge and transient threatening stimuli—a fact allowing it to immediately fit with changing events in real life—while the tonic one is more



relevant in hardships, especially when perceived as enduring threats. If this is the case, life's adversities can be interpreted as challenges or threats according to both environmental conditions and individual standpoint and resilience, including the capacity to improve it (Facco, 2020). Given the different speed response of the two components, the tonic one seems to be less suitable than the phasic one for an immediate reaction to stimuli.

Unlike other reports (De Benedittis, 2024; Yüksel et al., 2013), in our study, no HRV increase was found; a possible explanation is that HRV can be estimated by several indexes—e.g., SDNN, PNN50, lambda 25, LF, and HF (Hautala et al., 2010; Tulppo et al., 2005; Hayano et al., 2011; Shaffer and Ginsberg, 2017)—the meaning of which is still uncertain (e.g., the LF/HF ratio) and does not seem to closely reflect the sympathovagal balance (Billman, 2013; Rahman et al., 2011; Martelli et al., 2014).

In a previous study, 91% of dentists were stressed by anxious patients, while, unsurprisingly, hypnosis was not used in their clinical practice to manage patients and/or as self-hypnosis to relieve stress. Accordingly, only 2% of general dentists practice hypnosis, though it has proved to be time and cost-effective in invasive procedures, surgery, and in dentistry, allowing for effective management of patients' anxiety and phobia in a few minutes (Facco et al., 2021; Rosendahl et al., 2023; Mcknight-Hanes et al., 1993; Burghardt et al., 2018). In our sample, even a single 10-min session proved to be enough to relieve dentists' stress during a routine working day, suggesting that it could also be implemented as self-hypnosis (Hill et al., 2008).

The main limitations of this study are the small sample size and the only evaluation of the immediate effects of a single session of hypnosis. Second, no control group was used, and although we adopted a within-subject pre-post design in which each participant served as their control, the absence of an active or inactive control group makes it difficult to draw causal conclusions. Nevertheless, these findings offer preliminary insights into the potential mechanisms by which hypnosis may influence stress regulation in real-life professional settings and provide a rationale for future confirmatory studies using larger samples and randomized controlled designs. The aforementioned limitations, however, are balanced by a Bayesian Factor estimate >20 , with a very small error associated with the measure. This result can help mitigate the limits of frequentist tests on small sample sizes, decreasing Type I and Type II errors. This is a strong result according to the Jeffreys scale, where a value >10 indicates strong evidence for the alternative hypothesis, i.e., it is 20 times more probable that there is an effect of treatment than there is no effect (Jeffreys, 1961). Further studies on larger samples are required to check: a) the relationship between psychological, neurovegetative, and neurophysiological data (e.g., EEG and event-related potentials; Rosendahl et al., 2023; Mcknight-Hanes et al., 1993; Burghardt et al., 2018). The pre-post design of this study has not explored the duration of the effects of hypnosis over time, but suggests that a 10-min session of hypnosis may positively affect the psychophysical regulation of dentists. Further studies using more than one session or self-hypnosis are required to check whether hypnosis may allow for steady improvements and to evaluate possible effects on executive functions and resiliency.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Ethical Committee of the Department of Brain and Behavioral Sciences, University of Pavia (Prot. no. [1] 131/23). The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

LQ: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Visualization, Writing – original draft, Writing – review & editing. EF: Conceptualization, Supervision, Writing – original draft, Writing – review & editing, Resources. AR: Conceptualization, Visualization, Writing – original draft, Writing – review & editing. EP: Methodology, Writing – original draft, Writing – review & editing. AF: Investigation, Writing – original draft, Writing – review & editing. TF: Data curation, Formal analysis, Writing – original draft, Writing – review & editing. CB: Supervision, Visualization, Writing – original draft, Writing – review & editing. GZ: Methodology, Supervision, Writing – original draft, Writing – review & editing.

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Conflict of interest

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Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

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Patient-initiated violence against dental staff: a survey in faculty clinic settings

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Background: Workplace violence against healthcare personnel is an increasing concern. However, there is limited research on this issue within the dental field.

Aim: This study aimed to examine the prevalence and characteristics of patient-initiated violence against dental staff.

Methods: A cross-sectional survey design was utilized, involving a convenience sample of dental clinic staff at Hadassah Medical Center, Jerusalem, Israel. Participants filled out an anonymous questionnaire that assessed patient aggression in three categories: physical violence, verbal abuse, and reputational harm. Additionally, demographic information such as gender, age, role, and years of experience was collected.

Results: The response rate was 29%. Of the 103 respondents, 73% were females, 79% were dentists; 95% reported experiencing verbal violence, 27% physical violence, and 53% reputational harm at least once in their career. Male staff reported significantly higher rates of reputational harm compared to female staff ($p = 0.025$). Dentists experienced significantly more reputational harm than dental auxiliaries ($p = 0.004$). No significant differences were found based on clinic specialization or years of experience.

Conclusion: Dental clinic staff frequently experience high levels of verbal, physical, and reputational violence. It is essential to conduct larger, nationally representative studies in Israel to confirm these findings. Future research should examine the causes and consequences of patient-initiated violence and explore effective prevention and intervention strategies.

KEYWORDS

workplace violence, patient-initiated violence, dental staff, dentists, survey

1 Introduction

The World Health Organization defines workplace violence as the intentional use of power, either threatened or actual, against an individual or group in work-related circumstances, resulting in or likely to result in injury, death, psychological harm, maldevelopment, or deprivation (1). Violence against medical staff is a recognized global issue and a form of workplace violence. Healthcare and social service industries experience the highest rates of workplace violence injuries, being five times more likely to suffer such injuries than workers in other sectors. The overall incidence of workplace violence has increased in recent years (2). Healthcare workers are four times more likely to be absent from work due to violence directed at them (3).

Violence against medical staff leads to significant negative consequences, including lower self-esteem, heightened anxiety and stress, decreased work performance, and a decline in the

quality of patient care. Furthermore, it is linked to burnout, lower job satisfaction, compromised patient safety, increased medical errors, and higher rates of absenteeism and professional turnover (4).

Although numerous studies have documented violence against medical staff (5, 6), research on violence specifically targeting dental teams remains limited. Studies indicate that 29–80% of dentists have experienced workplace violence, primarily from patients, but also from patients' relatives, colleagues, and supervisors (7–10). Dental procedures can evoke negative emotions such as fear, pain, anger, and mistrust in patients, which may lead to violent reactions. Several factors contribute to violence against dental staff, including long wait times, appointment cancellations, high treatment costs, and perceived unsatisfactory outcomes of treatment (11).

The Israeli dental care system comprises both private and public clinics, with certain procedures subsidized under the National Health Insurance Law. Due to the lack of previous surveys on violence directed at dental staff in Israel, this study aimed to assess the extent and nature of violence experienced by dental professionals. For these preliminary results, the investigation centered on the staff of the Faculty of Dental Medicine. It also explored potential associations between clinic specialization, staff roles, years of experience, and the frequency of reported incidents of violence.

2 Materials and methods

This study utilized a cross-sectional survey design using a convenience sample of dental clinic faculty staff. A convenience sample offers easy access to participants, speeds up data collection, and is appropriate for preliminary research or experiments aimed at testing basic assumptions (12). Ethical approval was obtained from the Institutional Review Board (HMO-0280-22).

2.1 Study population

Eligible participants were dental staff members at the Faculty of Dental Medicine, Hadassah Medical Center, including dentists, dental assistants, dental hygienists, and receptionists. Inclusion criteria were: providing patient care for at least 1 year and fluency in Hebrew (reading and speaking). Individuals not meeting these criteria were excluded. Of the 350 dental staff members at the faculty, 103 participants from seven departments responded to the questionnaire, yielding a response rate of 29%. With a sample size of 103, assuming a 95% confidence level and an estimated prevalence of 50%, the margin of error is approximately $\pm 9.6\%$. While this margin of error is relatively high, it remains acceptable for generating useful preliminary insights, particularly in exploratory research (13).

2.2 Study instrument

The survey instrument, adapted from Rhoades et al. (10, 14), was translated into Hebrew using a forward-backward translation method by two independent translators fluent in both languages. Initially, a native Hebrew speaker with expertise in English translated the instrument into Hebrew. Then, a native English speaker conducted the back-translation. The back-translation was reviewed by the translators and authors, who confirmed there were no

discrepancies in wording. This anonymous questionnaire assessed patient aggression across three categories: physical violence (9 items: kicked you, grabbed you, slapped you, pushed or shoved you, threw something at you, hit you, twisted your arm or hair, damage or attempt to damage property in or around your practice, threatened you with a weapon), verbal violence (8 items: raised their voice angrily at you, insulted you, used foul language toward you, threatened to hit or throw something at you, used derogatory language regarding your gender/race/ethnicity/sexual orientation/age, called you a demeaning name, threatened to physically harm you, harassed you via the phone, Internet, or text message), and reputational harm (4 items: threatened to post nasty comments about you and/or your practice on the Internet or something similar, reported you to a licensing body or government agency (without cause), threatened to report you to a licensing body or government agency (without cause), threatened to sue you and/or your practice). Participants indicated the frequency of each experience using the following scale: "never," "not this year, but in the past," "once in the last year," "twice in the last year," and "three or more times in the last year." Demographic data, including participant's gender, age, role, and years of experience, were also collected. Both digital and paper versions of the survey were distributed to eligible participants. Anonymity was ensured by not collecting any identifying information and by storing responses using numeric codes.

2.3 Statistical analysis

For statistical analysis, participants were categorized as having experienced violence within a specific category if they reported at least one instance of that type of violence. To facilitate meaningful statistical analysis and ensure sufficient sample size within each subgroup, staff roles were grouped into three categories: (1) assistants, hygienists, and receptionists; (2) general dentists and residents; and (3) specialist dentists. This classification was informed by both the functional similarities within each group and their distinct levels of clinical responsibility, patient interaction, and authority in the dental setting. Frequency of violence exposure was condensed into three categories: (0) never, (1) not this year, but in the past, and (2) once or more in the last year. Condensing into three broader groups helps maintain sufficient numbers within each category to enable robust statistical analysis. Data was analyzed using SPSS software to examine relationships between violence type, frequency, and demographic variables. Chi-square tests or Fisher's exact tests and logistic regression were used to evaluate these relationships, with statistical significance set at $p \leq 0.05$.

3 Results

The respondent pool comprised 27% males and 73% females. Table 1 details the participants' departmental affiliation, role within the clinic and years of experience. Table 2 presents the results regarding the type and frequency of violence experienced. When asked about the location of violent incidents, 67% of respondents reported occurrences in the faculty clinic, 36% in a public clinic, and 20% in a private clinic.

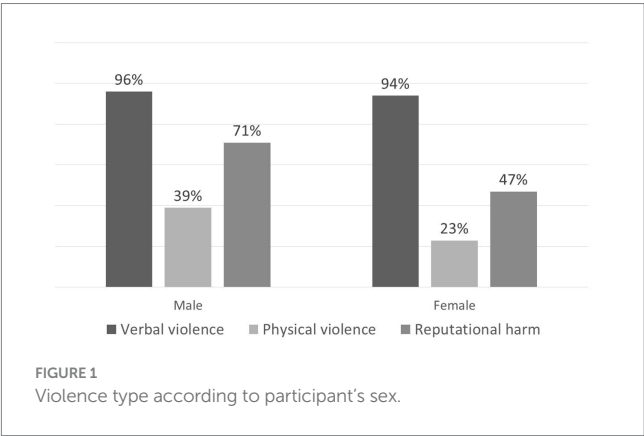
Analysis of the relationship between staff gender and the type and frequency of violence (Figure 1) revealed that male staff members reported higher rates of physical violence and reputational harm

TABLE 1 Demographic data distribution.

Department [n(%)]	Role [n(%)]	Years of experience [n(%)]
Pedodontic 30(29.1)	General dentist 4(4)	1–5 years 31(30)
Periodontic 15(14.6)	Resident dentist 44(43)	6–10 years 30(29)
Oral medicine 12(11.7)	Specialist dentist 33(32)	11–15 years 10(10)
Prosthodontic 13(12.6)	Assistant 16(15)	16–20 years 11(11)
Endodontic 10(9.7)	Hygienist 1(1)	Over 20 years 21(20)
Orthodontic 14(13.6)	Receptionist 5(5)	
Maxillofacial surgery 9(8.7)		

TABLE 2 Violence type and frequency.

Violence category	Yes		Once or more in the last year		Not this year, but in the past	
	Proportion (%)	95% Confidence Interval	Proportion (%)	95% Confidence Interval	Proportion (%)	95% Confidence Interval
Verbal violence	95%	89.1–97.9%	74%	64.5–81.3%	26%	18.7–35.5%
Physical violence	27%	19.5–36.5%	57%	47.6–66.4%	43%	33.6–52.4%
Reputational harm	53%	43.8–62.7%	42%	32.7–51.4%	58%	48.6–67.3%



compared to female staff members. Specifically, a statistically significant difference was observed in reports of reputational harm ($p = 0.025$). Analysis of the relationship between departmental affiliation and violence type and frequency (Figure 2) indicated that staff in the pedodontics department reported higher rates of physical violence compared to other departments, though this difference was not statistically significant ($p = 0.066$). Similarly, staff in the endodontic and pedodontics departments reported higher rates of reputational harm, but this difference also lacked statistical significance ($p = 0.390$). Analysis of the relationship between staff role and violence type and frequency (Figure 3) revealed that specialist dentists, general dentists and residents reported significantly higher rates of reputational harm compared to dental assistants and receptionists ($p = 0.004$). Analysis of the relationship between years of experience and the type and frequency of violence (Figure 4) showed an increasing trend in reported physical violence and reputational harm as experience increased. A linear relationship was observed between physical violence and experience (linear variables $p = 0.023$), however, this did

not reach statistical significance using Fisher's exact test ($p = 0.133$). Similarly, no statistically significant association was found between years of experience and reputational harm ($p = 0.809$). Additionally, no consistent relationship was found between years of experience and the occurrence of recent violence. (i.e., within the last year vs. in the past). To examine factors linked to patient-initiated violence, including verbal, physical, or reputational separately, a logistic regression model was fitted with role, department, gender, age, and years of experience as predictors (Table 3). The results indicate that an individual's role is an important predictor of whether they experience reputational harm, with an odds ratio of 2.112 ($p = 0.022$). This suggests that specialist dentists have more than twice the odds of experiencing reputational damage compared to auxiliary staff.

4 Discussion

The study's findings indicate a considerable occurrence of violence against staff in dental clinics. Notably, 95% of participants reported experiencing verbal violence, 27% reported physical violence, and 53% reported reputational harm at least once, either in the past year or at some point previously. The existing literature on violence against dental staff comprises studies that either focus on specific professional groups, such as dentists (9, 10, 15), dental hygienists (16, 17), or dental students (14, 18, 19), or examine the entire staff (8), as was the approach in our study. The differences in scope make it difficult to directly compare the results of various studies. The methodology used in the current study was adapted from Rhoades et al. (10, 14). In comparison to our findings, Rhoades et al. reported prevalence rates of 74% for verbal violence, 45.5% for physical violence, and 68.7% for reputational harm among dentists (10), and 86% for verbal violence, 28% for physical violence, and 36% for reputational harm among dental students (14).

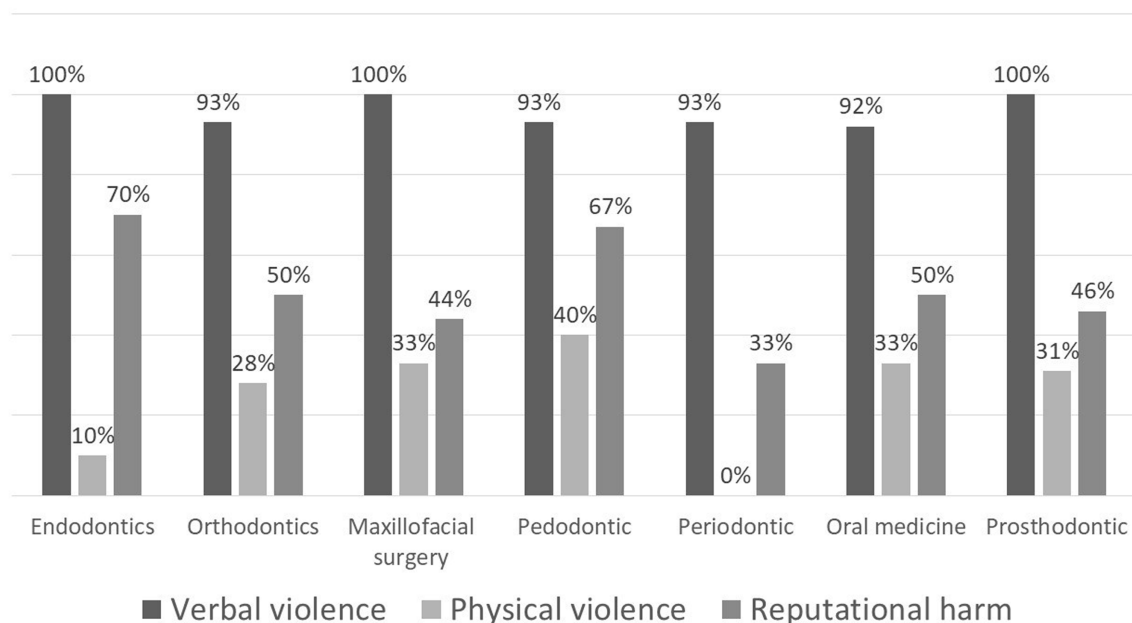


FIGURE 2
Violence type according to participant's department.

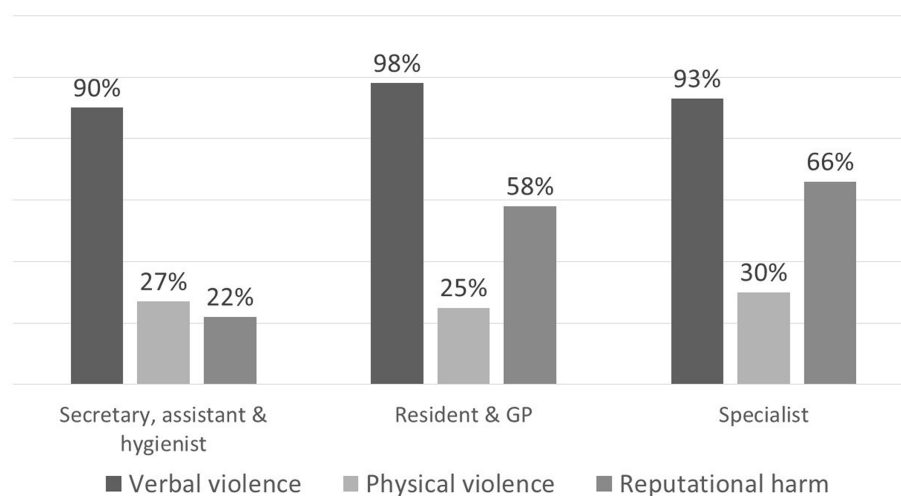


FIGURE 3
Violence type according to participant's role.

A recent systematic review and meta-analysis on the prevalence of violence against oral healthcare workers reported that verbal abuse ranged from 8.2 to 58.7%, and physical abuse ranged from 4.6 to 22%. The review also addressed sexual harassment, with prevalence rates ranging from 6.8 to 54% in nearly all included studies (11).

While the current study revealed a significant difference in reported reputational harm, with dentists experiencing higher rates compared to auxiliary staff, Azodo et al. (8) found no such difference in the overall prevalence of violence between these groups. This discrepancy may be attributed to methodological variations, since the current questionnaire's distinct categorization of physical, verbal, and reputational violence. The observed difference in our study was limited to reputational harm, a form of violence likely to

be disproportionately directed towards dentists compared to assistants and receptionists. Dentists bear direct responsibility for diagnosis, treatment planning, and clinical outcomes. This central role places them at the forefront of patient interactions and expectations. When patients are dissatisfied, they may attribute blame to the dentist, who is seen as the decision-maker. This makes dentists more likely targets of reputational harm, as patients may express frustration through complaints or social media criticism. In contrast, assistants and receptionists typically serve in supporting roles and have limited influence over clinical decisions, making them less likely to be held personally accountable for patient dissatisfaction. This structural dynamic within the dental care team likely contributes to the observed differences in reputational harm reported across roles. The grouping

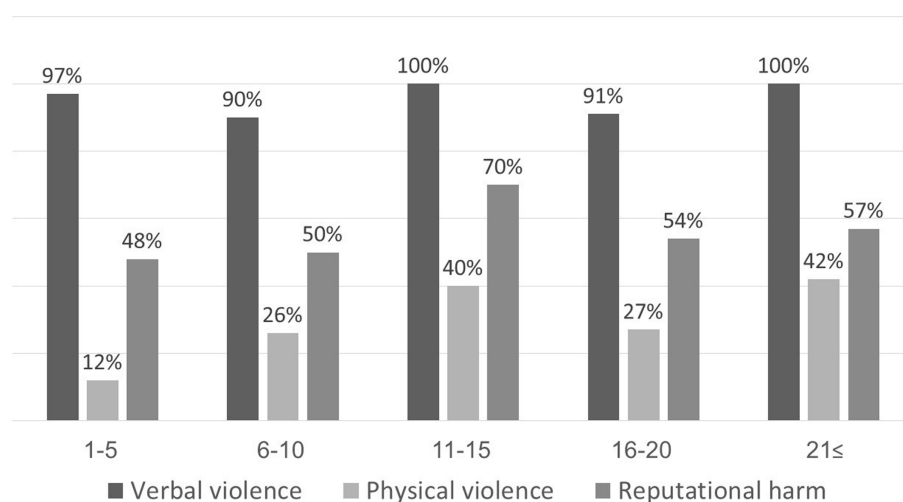


FIGURE 4
Violence type according to participant's years of experience.

TABLE 3 Logistic regression models predicting each type of patient-initiated violence: verbal, physical, and reputation damage.

Type of patient-initiated violence	Predictor	Odds ratio (OR)	p-value	95% CI (lower–upper)
Verbal	Intercept	0.028	0.537	0.000–2291.713
	Role	0.804	0.796	0.154–4.200
	Department	1.044	0.877	0.604–1.805
	Gender	1.468	0.771	0.111–19.491
	Age	1.252	0.185	0.898–1.745
	Experience	0.381	0.275	0.067–2.158
Physical	Intercept	0.412	0.687	0.006–30.786
	Role	0.778	0.455	0.402–1.504
	Department	1.023	0.867	0.787–1.328
	Gender	0.507	0.225	0.169–1.518
	Age	1.025	0.610	0.932–1.128
	Experience	1.177	0.635	0.601–2.305
Reputation	Intercept	0.362	0.638	0.005–25.108
	Role	2.112	0.022	1.114–4.007
	Department	0.888	0.334	0.699–1.129
	Gender	0.554	0.277	0.191–1.606
	Age	1.046	0.354	0.951–1.150
	Experience	0.757	0.399	0.397–1.444

approach may mask subtle differences between, for instance, dental hygienists and receptionists within the auxiliary category, or between residents and general dentists. However, the classification strikes a balance between analytical feasibility and professional relevance, making it suitable for identifying general trends while acknowledging some granularity is lost.

Our survey results indicate that male staff members reported higher rates of physical violence and reputational harm compared to female staff members. This finding is consistent with a research report conducted among community health workers in Israel (20), which also

reported higher rates of physical violence against men and comparable rates of verbal violence between genders. However, Rhoades et al. (10), in a study of dentists, found no association between gender and reported experiences of violence. In Israeli society, similar to many cultures, male healthcare professionals are frequently viewed as authority figures. This perception can lead patients to express their dissatisfaction or frustration toward male staff. Additionally, males are generally more likely to display and report aggressive behaviors and may adopt more direct or assertive communication styles. Such styles can be perceived by patients as dismissive or authoritarian, potentially escalating tensions during

clinical interactions. Furthermore, males may be more likely to interpret and report certain negative encounters as reputational damage, rather than as emotional or indirect aggression (21, 22).

Our findings indicate a higher incidence of physical and reputational violence reported in the pediatric dentistry clinic compared to other departments. However, these results should be interpreted cautiously due to the disproportionately higher response rate from the pedodontics department, which was two to three times that of other departments. This overrepresentation may skew the findings by giving disproportionate weight to experiences unique to the pediatric dentistry department. While the data suggest a potential difference in violence exposure compared to other departments, the uneven response rates limit our ability to draw definitive conclusions or generalize these findings across the broader dental staff population. Furthermore, pediatric dentistry in Israel, being nationally funded, experiences a significantly increased workload and high patient demand, which may further differentiate its working conditions from those in other specialties. To accurately identify trends in violence against dental staff across different specializations, a larger study with equitable representation from all departments is necessary.

It is crucial to investigate further implications of the findings. Exposure to workplace violence has been consistently associated with decreased job satisfaction, increased burnout, workforce attrition, and psychological distress among dental healthcare providers. Moreover, it may compromise the quality of patient care (4). Providers may experience reduced focus, diminished empathy, all of which can undermine clinical performance and communication. This may erode trust between patients and providers, an essential component of effective dental care. Therefore, the findings underscore the need for institutional policies that proactively address workplace violence, including training, reporting mechanisms, and psychological support.

This study has several limitations. First, the response rate was relatively low (29%), with a final sample size of 103 participants. Although low, the expected response to an online questionnaire has been described as 25–30% (23). Such a response rate introduces a risk of nonresponse bias, whereby the dentists who chose to participate may differ systematically from those who did not, potentially in their experiences, perceptions, or willingness to disclose incidents of patient-initiated violence. This could lead to an overestimation or underestimation of the true prevalence or impact of such experiences in the broader dental workforce. Second, the small sample size drawn from a single medical center in Israel, limits the statistical power to detect subtle differences or associations and restricts the generalizability of the findings. It also limits the ability to conduct meaningful subgroup analyses within the sample. This study served as an initial exploration of patient-initiated violence in dental clinics. The results should therefore be interpreted with caution and considered exploratory. Third, the use of convenience sampling and voluntary participation may have further compounded selection bias, as dentists with strong opinions or personal experiences related to patient-initiated violence may have been more motivated to respond. Future research in this area would benefit from employing strategies to improve response rates, such as multiple follow-up contacts, offering participation incentives, or using mixed methods approaches. Additionally, larger, randomly selected samples would enhance the representativeness and reliability of findings on this important occupational health issue. Furthermore, the study did not explore specific details of violent incidents, including their triggers, the effects on staff members (such as physical injury or

psychological trauma), or how they were resolved. Future research should focus on these details to better comprehend the context of violent events and develop effective intervention strategies.

In conclusion, dental clinic staff frequently experience high levels of verbal, physical, and reputational violence. It is essential to conduct larger, nationally representative studies in Israel to confirm these findings. Future research should examine the causes and consequences of patient-initiated violence and explore effective prevention and intervention strategies.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Institutional Human Subjects Ethics Committee of Hadassah Medical Organization. The studies were conducted in accordance with the local legislation and institutional requirements. The ethics committee/institutional review board waived the requirement of written informed consent for participation from the participants or the participants' legal guardians/next of kin because answering the questionnaire considered as consent to participate.

Author contributions

AF-N: Conceptualization, Writing – original draft, Methodology, Supervision, Project administration, Writing – review & editing, Formal analysis. OG: Data curation, Writing – review & editing, Investigation, Formal analysis. AS: Writing – review & editing, Methodology, Conceptualization. EH: Writing – review & editing, Methodology, Conceptualization. MM: Investigation, Conceptualization, Supervision, Writing – review & editing, Formal analysis, Methodology, Writing – original draft.

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Mask-wearing behavior patterns among dental patients in post-pandemic China: a cross-sectional study

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Background: The present study investigated the demographic characteristics of individuals who wear masks when visiting the Dental Department of a public Hospital in Beijing, China, 2 years after the Chinese government relaxed mask mandates following the COVID-19 pandemic.

Methods: A cross-sectional study was conducted at the Dental Department of China–Japan Friendship Hospital. Patients visiting the Clinic of the Stomatology Center were observed. Data on mask-wearing status, age, gender, outdoor temperature, and weather conditions were recorded. Statistical analyses included chi-squared tests and binary logistic regression to identify predictors of mask use.

Results: Among 1,009 patients, 46.3% wore masks. Females exhibited significantly higher mask-wearing rates than males (62.0% vs. 19.6%, OR = 6.457, $P < 0.001$). The increase of age positively influenced the mask-wearing rates (OR 1.010, $P = 0.046$). Lower temperatures (0–19°C) correlated with higher mask wearing rates (56.2–57.0%) versus warmer groups (20–39°C, 38.6–42.0%, $P < 0.001$), with each degree increase reducing likelihood by 2.3% (OR = 0.977; $P = 0.007$). Significantly elevated mask-wearing rates were observed during foggy weather conditions.

Conclusion: Nearly half of patients continue to wear masks when visiting the Dental Department in the post-pandemic era. The mask wearing behavior was influenced by gender, age, and environmental factors such as outdoor temperature and weather. Females and older individuals showed higher adherence, while colder temperatures and foggy weather correlated with increased mask use.

KEYWORDS

mask-wearing, post-pandemic, cross-sectional study, infectious disease, aerosol

Introduction

Started from the COVID-19 pandemic, wearing mask became one of the most visible and widely adopted strategies among the numerous preventive measures implemented to mitigate the spread of the virus (1). Governments worldwide instituted mandates requiring the public to wear masks in the early stages of the pandemic, especially in indoor spaces and crowded environments (2). Consistent mask use reduced infection rates, and contracting SARS-CoV-2 may subsequently alter masking behavior in high-risk settings (3). Over time, as the global situation improved and the pandemic was brought under control, mask mandates were

relaxed. However, the behavior of mask-wearing, once a public health necessity, continues to be an important indicator of individual and collective health awareness, even in the post-pandemic era (4).

The treatment procedures in dental Clinics often involve close contact with patients, aerosol-generation, and prolonged mouth opening. Additionally, splatters occurring during oral surgery procedures, could be also contaminated by respiratory pathogens, which make these environments potential hotspots for infectious disease transmission (5, 6). During the pandemic, dentists globally faced significant anxiety and fear. Many dental departments modified services to provide only emergency care per guidelines or closed indefinitely (7, 8). Notably, even as COVID-19 incidence declines, persistent transmission risks for other airborne pathogens including influenza viruses and *Mycoplasma pneumoniae* still persist in public environments (9). Given the unique characteristics of dental Clinics and the evolving nature of post-pandemic public health behaviors, it is of significance to explore how mask-wearing habits have persisted, or declined, within these specialized clinical environments.

Previous research has examined various factors that influence dental clinic visiting as well as mask-wearing behaviors, including gender, age, education level, smoking habits, and occupation (10–12). So far, few recent literature have examined the mask-wearing status in post-COVID-19 era. The survey reported by Lertsakulbunlue et al. (13) highlighted that the sustaining mask-wearing behavior in rural older adult populations in Thailand was significantly mediated by motivation and social norms. Additionally, post-COVID studies also suggested that psychological factors such as self-perceived facial attractiveness and social anxiety influenced the willingness to wear a mask (14, 15).

The present study aimed to evaluate current mask-wearing behavior and analyze influencing sociodemographic and environmental factors—such as age, gender, weather conditions, and outdoor temperature—among patients visiting the Dental Department of a public Grade A hospital in Beijing, China. The study was conducted 2 years after the relaxation of mandatory COVID-19 restrictions. This research would contribute to the understanding of how public health interventions, such as mask-wearing, are influenced by socio-demographic factors, and will provide valuable insights for healthcare providers and policymakers in shaping ongoing infection control strategies.

Methods

The present study was conducted at China-Japan Friendship Hospital, Chaoyang District, Beijing, China. Patients visiting the Maxillofacial Clinic of the Stomatology Center during July 1st, 2024 to December 1st, 2024 were observed by one independent doctor (Junfei Zhu). The mask-wearing status of the patients was observed and recorded at the time they stepped into the Clinic room. The mask-wearing status, age, and gender were recorded. Additionally, outdoor temperature and weather conditions were documented using data from the mobile application *Moji Weather*. The inclusion criteria comprised patients who have scheduled an appointment for the day and presented for treatment. The persons who accompanied the patients to the Clinic were not included.

The scope of the Maxillofacial Clinic primarily focuses on tooth extraction, including impacted wisdom teeth, residual teeth, and loose

teeth, as well as minor surgeries involve small cysts, tumors, abscesses, and wounds.

A preliminary investigation was conducted prior to the present study, in which 100 patients were observed. Among them, 48 patients wore masks, while 52 did not. Based on this data, the estimated mask-wearing rate was determined to be 48% ($P = 0.48$).

Using this estimate and assuming a margin of error (δ) of 0.05 and a standard normal critical value ($Z_{\alpha/2}$) of 1.96, following formula was applied:

$$n = \frac{Z_{\alpha/2}^2 P(1-P)}{\delta^2}$$

Substituting the given values, the minimum required sample size was calculated to be $n = 384$.

The statistical analysis was performed using SPSS version 27.0. The Chi-squared test was employed to compare mask-wearing rates across different categories, including gender, age, underlying health conditions, weather, and outdoor temperatures, a P value <0.05 was considered statistically significant, and a P value <0.01 was considered highly significant. Binary logistic regression was used to analyze the influence of different included categories on mask-wearing behavior. The results of the regression analysis are presented as odds ratios (ORs) with 95% confidence intervals (CIs). Also, a P value <0.05 was considered to be statistically significant.

Results

The present study spanned 184 days. A total of 1,009 patients were observed in the present study, including 629 females and 380 males, with ages ranging from 5 to 90 years. Among them, 865 were healthy, while 144 had systemic disorders, including cardiovascular and cerebrovascular diseases ($n = 75$), diabetes mellitus ($n = 26$), a history of allergies ($n = 14$), and other disorders ($n = 28$). The highest recorded outdoor temperature was 36°C, and the lowest was 3°C. During the study period, 500 patients visited the clinic on cloudy days, 323 on sunny days, 112 on foggy days, and 74 on rainy days (Table 1).

Of the 1,009 patients, 541 did not wear a mask, while 468 wore a mask. The overall mask-wearing rate was 46.3%. Most of the patients who wore masks chose surgical masks ($n = 414$), 30 patients wore N95 masks, and 24 patients wore other kinds of masks such as cloth masks, anti-dust masks and UV protection masks (Figure 1).

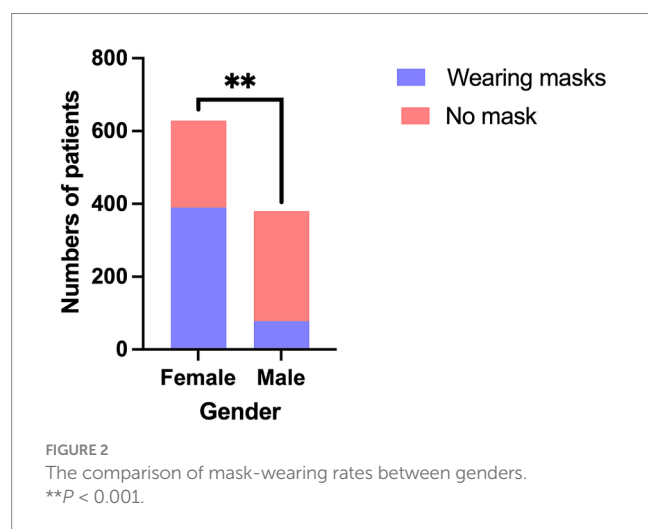
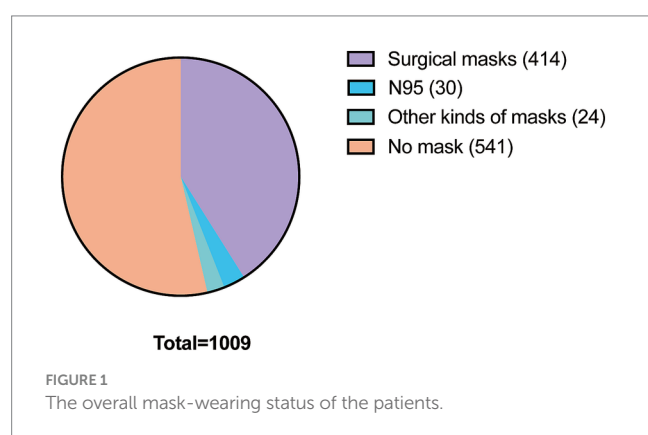
The mask-wearing rate among females was significantly higher than that of males (62.0% vs. 19.8%; $\chi^2 = 163.868$; $P < 0.001$) (Figure 2).

Age groups were categorized based on the guidelines provided in *Basic Epidemiology*, a book published by the World Health Organization (WHO), which recommends four age categories: 0–14, 15–44, 45–64, and ≥ 65 years (16). The 0–14 age group had the highest mask-wearing rate (61.9%), while the 15–44 age group had the lowest rate (44.2%). However, no statistically significant difference in mask-wearing rates was observed between the groups ($\chi^2 = 7.497$; $P = 0.058$) (Figure 3).

Patients with any systemic disorders, including cardiovascular and cerebrovascular diseases, diabetes mellitus, a history of allergies, and other conditions, were grouped into one category. The mask-wearing rate among patients without systemic disorders was 46.4%, while the

TABLE 1 Total characteristics.

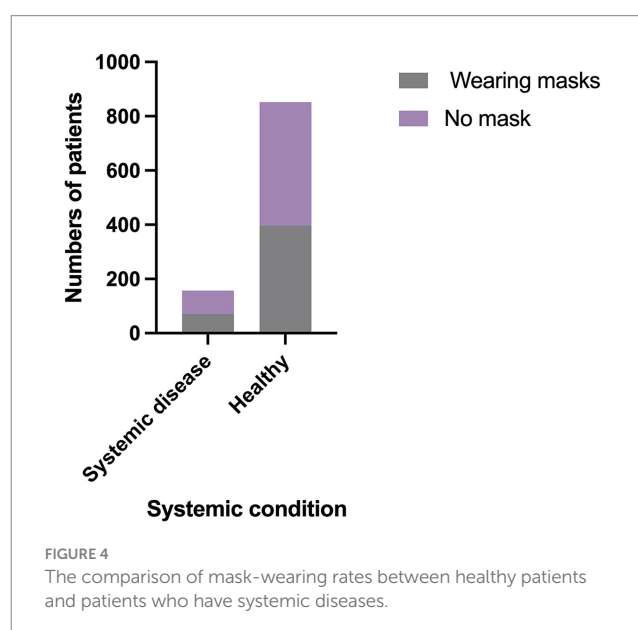
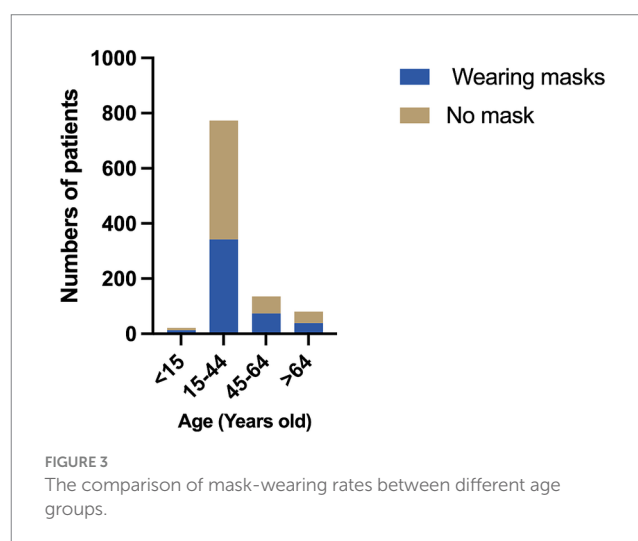
Gender		Age		Systemtic condition		Temperature		Weather		Diagnoses	
Male	380	<15	21	Healthy	865	0–10 °C	163	Cloudy	500	Wisdom tooth	638
Female	629	15–34	619	Systematic disorders	144	11–20 °C	218	Foggy	112	TMD	152
		35–64	289			21–30 °C	412	Rainy	74	Other tooth need to be extracted	122
		>64	154			31–40 °C	216	Sunny	323	Mass or tumor	52
										Oter diagnoses	43



rate among those with systemic disorders was 46.5%. No statistically significant difference was found between the two groups ($\chi^2 = 0.001$; $P = 0.97$) (Figure 4).

The outdoor temperature was divided into four 10°C groups: 0–9°C, 10–19°C, 20–29°C, and 30–39°C. The mask-wearing rates among patients in these groups were 56.2, 57.0, 42.0, and 38.6%, respectively. Notably, the two lower-temperature groups (0–9°C and 10–19°C) had significantly higher mask-wearing rates compared to the warmer groups (20–29°C and 30–39°C) ($\chi^2 = 24.554$; $P < 0.001$) (Figure 5).

The mask-wearing rates of patients in different weather conditions were as follows: 43.0% on cloudy days, 58.0% on foggy days, 50.0% on rainy days, and 46.7% on sunny days. The mask-wearing rate on foggy



days was significantly higher than on cloudy days ($\chi^2 = 8.823$; $P = 0.032$) (Figure 6).

The result of binary logistic regression showed females compared with male were more likely to wear masks (OR 6.457; 95%CI 4.769–8.744; $P < 0.001$); the increase of age positively influenced the mask-wearing rates (OR 1.010; 95%CI 1.000–1.020; $P = 0.046$); The increase

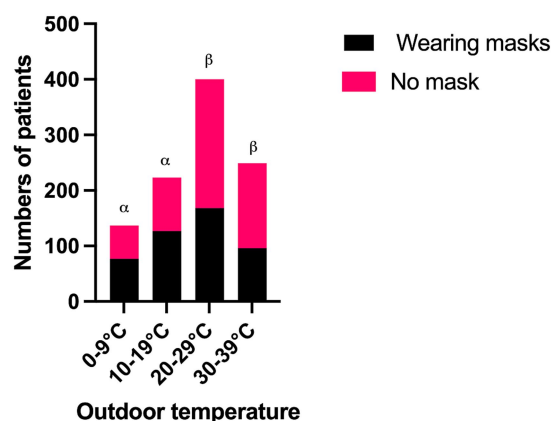


FIGURE 5

The comparison of mask-wearing rates between different groups of outdoor temperature. α , β : $P < 0.05$ between the groups of α and β .

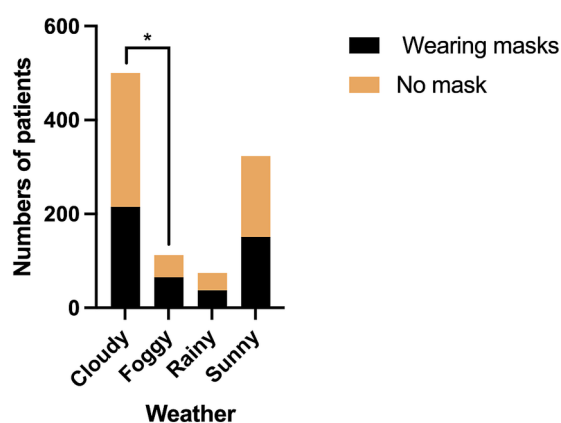


FIGURE 6

The comparison of mask-wearing rates between different groups of weather. * $P < 0.05$.

TABLE 2 The results of binary logistic regression.

OR (95% CI)		P
Gender		
Male	1.000	
Female	6.457 (4.769–8.744)	<0.001**
Age	1.010 (1.000–1.020)	0.046*
Systemic disease	0.971 (0.624–1.512)	0.897
Temperature	0.977 (0.961–0.994)	0.007**
Weather		
Sunny	1.000	
Cloudy	0.930 (0.677–1.278)	0.656
Foggy	1.208 (0.735–1.988)	0.456
Rainy	1.210 (0.693–2.112)	0.503

* $P < 0.05$; ** $P < 0.01$.

of outdoor temperature negatively influenced the mask-wearing rates (OR 0.977 95%CI 0.961–0.994; $P = 0.007$) (Table 2).

Discussion

During the COVID-19 pandemic, extensive research was conducted on mask-wearing behaviors, examining various influencing factors such as age, gender, educational background, and other demographic characteristics (1, 17, 18). However, studies exploring mask-wearing habits in the post-pandemic era remain limited. Recent research has begun to address this gap. For instance, Lertsakulbunlue et al. (13) investigated mask-wearing behaviors among older adult individuals in rural Thailand through surveys and qualitative interviews. Their findings highlight that motivation and social norms are key determinants of continued mask usage in the post-COVID period. Additionally, Cha et al. (15) examined the influence of self-perceived facial attractiveness on mask-wearing intentions. The study suggests that, while masks primarily served as a protective measure during the pandemic, they have increasingly become a tool for self-presentation in the post-pandemic era. These studies provide valuable insights into the evolving psychological and social drivers of mask usage beyond health concerns.

The present study is the first to explore post-COVID mask-wearing behaviors in a first-tier city in China. China-Japan Friendship Hospital is a grade A class 3 Hospital in China. The current Hospital policy for mask-wearing includes recommending that all patients wear masks while in the Hospital, and mandating that all dental healthcare workers wear masks, protective suits and protective face masks throughout their work process. Based on preliminary investigation and previous studies (10, 19), the hypotheses of this study were that nearly half of the observed population would wear masks, and that the mask-wearing rate would be influenced by gender, age, outdoor temperature, and weather. The results are consistent with these hypotheses.

Masks in dental settings are essential to block harmful aerosols (like saliva, blood, and germs) released during procedures such as drilling or cleaning. They protect both staff and patients by preventing cross-contamination—stopping germs from passing between mouths, noses, or eyes (20). As observed, 46.3% of dental patients continued to wear masks in the post-pandemic era, suggesting that while the majority had stopped, a significant proportion still adhered to mask-wearing practices, especially in the high risk area like a Dental Clinic. This aligns with previous studies showing that mask-wearing remains important even after mandates were lifted due to lingering concerns about airborne disease transmission (21). Additionally, past research has emphasized that the persistence of such behaviors is influenced by both individual health concerns and societal norms (22). A study in Hong Kong used an online survey to explore why people kept wearing masks after the removal of the mandatory mask. The results showed that personal attitudes toward masks were the strongest predictor, followed by subjective norms and perceived self-efficacy (23). The analysis reported by Kawase et al. (24) suggested that emphasizing self-protection as a motivation for mask-wearing remained a consistently effective strategy throughout the pandemic, even as its duration extended. Promoting masks successfully encouraged sustained behavioral change among individuals over time.

The observed gender difference aligns with previous researches suggesting that women are generally more health-conscious and more likely to engage in preventive behaviors, including mask-wearing (19, 25). Psychological and sociocultural factors may also contribute to this

disparity (26). Women may perceive greater personal or societal expectations regarding health protection and are often more engaged in caring for others, further reinforcing their likelihood to wear masks (27).

The binary logistic regression analysis demonstrated that advancing age was positively associated with higher mask-wearing rates. However, the Chi-squared test comparing age groups revealed a marginally non-significant result ($P = 0.058$), which could be explained by the limited sample size and the method of age-group categorization. The higher mask-wearing rate among younger children could be attributed to parental influence, as caregivers may ensure that children wear masks in public environments (28). As reported by Zhang et al. (29) during the pandemic, the strategy of sheltering combined with mask-wearing for individuals aged 50–64 years old was most effective, decreasing attack rate, Hospitalizations, and deaths by over 82%, indicating the importance of mask-wearing behaviors in aged population. In the present study a slight increase in mask-wearing rate with older age groups could be observed, which may be due to heightened health concerns and vulnerability to respiratory diseases, especially among older adult individuals who are at higher risk of severe illness (30).

The inverse relationship between outdoor temperature and mask-wearing rates is a notable finding. Patients in colder temperature groups (0–9°C and 10–19°C) exhibited significantly higher mask-wearing rates (56.2 and 57.0%, respectively) compared to those in warmer groups (42.0% at 20–29°C and 38.6% at 30–39°C; $P < 0.001$). Binary logistic regression further corroborated this trend, showing that each degree increase in temperature reduced the likelihood of mask-wearing by 2.3% (OR = 0.977; $P = 0.007$). This aligns with studies suggesting that thermal discomfort in warmer climates discourages prolonged mask use due to perceived breathability challenges and physical irritation (31). Conversely, colder temperatures may enhance mask acceptance, as masks can provide incidental benefits such as protecting asthmatics against the effects of exercise and cold air (32).

However, the sharp decline in mask use above 20°C suggests that temperature thresholds influence behavior. This could reflect cultural or regional norms in Beijing, where winter air quality concerns (e.g., particulate pollution) and seasonal influenza may compound health motivations for mask use, whereas summer heat dominates comfort priorities (33, 34).

Weather conditions also influenced mask-wearing behavior. The elevated mask use during foggy weather likely stems from associations between fog and air pollution in urban China, where residents often link reduced visibility to poor air quality and respiratory risks (35). Basic preventive strategies, such as dietary supplementation of vitamins, and mask wearing outdoors seem to be sufficient to minimizing the adverse impact of daily exposure to fog and haze (36). The pre-pandemic studies also showed that air quality alerts independently drive mask-wearing, even absent infectious disease threats (37).

While this study provides valuable insights into post-pandemic mask-wearing behaviors, several limitations should be acknowledged. First, the study's single-site design in Beijing limits generalizability to rural areas or regions with differing climatic or cultural norms. Secondly, self-reported health conditions and systemic disorders were not verified through medical records, potentially introducing misclassification bias. Further, the analysis did not account for air quality indices (e.g., PM_{2.5} levels), which may confound the observed relationships between the present included factors and mask-wearing. Additionally, daily temperature averages might conceal intraday fluctuations affecting real-time masking decisions. Future studies should integrate real-time environmental monitoring and multi-site sampling to address these gaps.

In conclusion, the present study highlights the persistence of mask-wearing behavior among dental patients in post-pandemic Beijing, with nearly half continuing to use masks despite relaxed mandates. Gender emerged as the strongest predictor, with women three times more likely to wear masks than men. Age, and environmental factors—notably colder temperatures and foggy weather—also significantly influenced the adherence of mask wearing. This study offers several clinical implications for dental institutions and policymakers: First, mask dispensers at clinic entrances could be maintained year-round, especially targeting male patients. Second, patient reminders should be seasonally adjusted—emphasize mask benefits more proactively in warmer months when compliance drops sharply. Moreover, public health campaigns linking masks to broader protective benefits (e.g., against pollution or fog) should be developed to sustain compliance with mask-wearing beyond the pandemic context. Future multi-center studies across diverse populations and settings are warranted to validate these findings and track longitudinal trends in mask-wearing behavior. Additionally, different perspectives, such as the psychological and behavioral drivers for mask-wearing willingness are also worthy to be explored.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

Ethics statement

Ethical approval (2025-KY-228) was obtained from the Ethical Review Board of China-Japan Friendship Hospital. The Informed consent was waived for all the patients in the present study.

Author contributions

JZ: Methodology, Writing – review & editing, Conceptualization. FL: Writing – original draft. XY: Validation, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The authors declare that Gen AI was used in the creation of this manuscript. The Deep seek was used to exam the grammar.

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