The impact of the COVID-19 pandemic on undergraduate and graduate dental courses in Brazil

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Abstract.
BACKGROUND: The COVID-19 pandemic has raised challenges in adapting to teaching and learning methods in dental education.
OBJECTIVE: This study aimed to evaluate the impact of the COVID-19 pandemic on the academic activities of undergraduate (UDG) and graduate (GD) dental students in Brazil. Additionally, students' perceptions and attitudes toward teaching activities during this period were analyzed.
METHODS: A nationwide cross-sectional survey was conducted with a sample of Brazilian UDG and GD dentistry students. Data were collected in 2020 through an online, self-administered, and anonymous questionnaire, which comprised 26 questions related to demographic data, activities of the college, family and individual student income, and attitudes and perceptions about e-learning during the pandemic. The data were tabulated and analyzed using descriptive statistics.
RESULTS: The sample included 1,166 students (779 UDG and 387 GD). Among these, 425 (54.6%) UDG and 270 (69.8%) GD students remotely participated in teaching activities, of which 42.6% of the UDG considered their performance in e-learning to be bad or very bad and 49.8% of the GD regarded it as good or excellent. The survey also showed that 354 (45.4%) UDG and 102 (26.4%) GD expressed a desire to discontinue the course following the outbreak of the pandemic. Among the GD, 225 (58.4%) said that their experiments were completely interrupted.
CONCLUSIONS: This study reveals the poor perception and performance of dental students regarding e-learning. Additionally, the findings suggest a negative impact of the pandemic on dental education in Brazil. Effective measures should be taken to mitigate these significant consequences.

Keywords: Dental education, e-learning, online education

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1. Introduction

According to recent estimates, the closure of educational institutions due to the pandemic has affected half of the students across the world—around 890 million in 114 countries [1]. Additionally, a ban on face-to-face learning implemented in several countries may disrupt the educational process [1]. Regarding dental education in Brazil, most current data show that the country has 506 dentistry colleges [2], comprising over 125,585 undergraduate students [3]. In postgraduate schools, recent data revealed that 9,300 master's and PhD students enrolled in 104 graduate programs [4]. Following the discontinuation of face-to-face activities, some institutions continued their operations virtually, totally, or partially, while others experienced a complete disruption of their teaching activities. This situation has proved to be challenging for universities and professors as they advance educational processes in undergraduate and graduate courses [5]. In dentistry, the key challenge is to postpone direct patient care, which is an essential component of the curriculum [6]. Virtual sessions are not capable of replicating face-to-face experiences with patients [7, 8]. Furthermore, mandatory curricular internship activities in public services have been suspended in Brazil [8].

Brazil is regarded as an upper middle-income country, with gross domestic product *per capita* of US$ 9,130 [9]. Thus, the impact of the pandemic on the economy has raised concerns. A survey showed that four out of ten Brazilians reported a loss of purchasing power since the outbreak of the pandemic [10]. With the adoption of social inclusion policies, many students from Brazilian public and private universities come from low-income families. Accordingly, owing to huge costs associated with dentistry courses, it is imperative that students take up a job to finance their education or remain financially dependent on their families. Considering the current situation due to the pandemic, it is reasonable to hypothesize that there has been an increase in dropout rates in dentistry courses in Brazil [8].

The ongoing pandemic has disrupted the lives of people across the globe, and the rapid spread of the disease has created a wave of uncertainty and anxiety regarding the future. In general, university communities suffer from high levels of stress [11]. Regarding postgraduate programs, it is estimated that the pandemic could have numerous implications for courses, tasks, seminars, and thesis defenses. The students are concerned about being at a disadvantage compared to their counterparts who have not been affected by a problem of this magnitude [12].

Although there is an absence of official data on teaching activities in dentistry during the pandemic in Brazil, it has become imperative for schools to develop e-learning plans expeditiously. However, such activities require adequate training that most Brazilian teachers lack. Moreover, the sudden commencement of online education could trigger anxiety and stress among both students and teachers [8]. The impact on income and the fear of losing a job can also generate stress.

Therefore, the aim of this study was to evaluate the consequences of the pandemic on the academic activities of undergraduate and graduate dental students in Brazil, as well as analyze students' perceptions and attitudes regarding teaching activities during this period.

2. Methods

The study was approved by the Research Ethics Committee (protocol 31721020.3.0000.5208) and complied with the Declaration of Helsinki. It involves a nationwide cross-sectional survey of Brazilian undergraduate and graduate dentistry students (masters and PhD).

Data were collected from June 15 to July 15, 2020, during the ongoing pandemic, through an anonymous, self-administered questionnaire hosted online (Google Forms, Google®). The sample size was calculated using Epi Info software (CDC, USA), based on data from the latest surveys on higher education in Brazil, which showed 125,585 dental undergraduate [3] and 9,300 graduate [4] students. Thus, a minimum sample of 382 undergraduates and 369 graduate students was estimated to ensure a 95% confidence level and a 5% margin of error.

The inclusion criteria were self-declared students enrolled in undergraduate and graduate dentistry courses in Brazil, who submitted their informed consent form before participation in the study. Students were recruited through e-mail, WhatsApp®, and social media (Instagram® and Facebook®). The questionnaire contained 26 questions related to demographic data, college activities, student income, attitudes, and perceptions about e-learning activities during the pandemic. The questions were written in Portuguese, the native language of Brazil, and were translated into English for the article presentation. The research instrument was designed to investigate

students' perceptions of e-learning, their attitudes during this period of adaptation to the modified teaching method, and the impact of the pandemic on their families and individual income. Additionally, the impact on projects developed by graduate students was also evaluated. The answers were idealized using a five-point Likert scale, with excellent, good, regular, bad, and very bad for questions assessing students' performances in remote teaching activities. For the questions that assessed students' behavioral aspects and their preferences when comparing remote and face-to-face activities, the possible responses were strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree.

Before filling the online questionnaire, all participants were informed that their identities would be completely anonymous and non-traceable, and that their participation was voluntary and could be withdrawn or renounced at any time. Moreover, a brief description of the study, as well as its objectives, risks, and benefits were available for all participants. All volunteers in the online survey submitted their informed consent forms before participation.

The responses for the variables were tabulated and analyzed using IBM SPSS Statistics software (version 20.0; IBM Corporation, Armonk, NY, USA). Descriptive analysis was performed for all variables; data are presented as percentages and numbers.

3. Results

Of the 1,166 students who participated in the study, 779 (66.8%) were from undergraduate courses, and 387 (33.2%) were from graduate courses. Females accounted for a major proportion of the sample ($n = 919$; 78.3%), and the mean age was 24.8 (range, 18–60 years). Among the respondents, 454 (58.3%) undergraduate and 102 (26.5%) graduate students resided in the northeast region of the country. Additionally, 405 (52%) undergraduate and 324 (83.7%) graduate students belonged to a public institution. Most of them, 492 undergraduates (63.2%) and 237 graduates (61.6%), reported a drop in their family income due to the pandemic. Among undergraduate students, the majority ($n = 697$; 89.5%) asserted that their families were responsible for the monthly payments (private schools) and/or purchased instruments for practical activities of the course (public or private), compared to graduate students ($n = 135$; 35.1%). Among the latter, 139 (36.1%) denied that it was the responsibility of the family, and 111 (28.8%)

had no cost of studies. Most of the undergraduate students ($n = 627$; 80.5%) did not work to finance their education, while most of the graduate students (214; 55.3%) had to work to pay their college fees. Notably, 135 (63%) graduates and 118 (77.6%) undergraduates who worked to pay their college fees reported that their individual income decreased during the ongoing pandemic (Table 1).

Regarding teaching activities following the need for social distancing and isolation, most (425 [54.6%] undergraduate and 270 [69.8%] graduate students) continued with educational activities remotely (e-learning) (Table 1). For those who participated in remote classes, the content taught was mostly theoretical for both undergraduates ($n = 417$; 94.1%) and graduates ($n = 279$; 97.6%). Only 26 (5.9%) undergraduate students and seven (2.5%) graduate students participated in both theoretical and practical activities remotely. Among the students who took part in remote classes, when asked how they considered their performances in relation to e-learning activities, 198 (42.6%) undergraduates categorized it as bad or very bad, and 172 (37.0%) evaluated it as regular. Conversely, 158 (49.8%) graduate students stated that their e-learning performance was good or excellent. Additionally, 279 (60%) undergraduate students who participated in remote classes stated that their performance was worse or much worse than that of face-to-face activities. Among graduates, 146 (46.8%) said they were neither better nor worse, and 133 (42.6%) added that they had performed worse or much worse. With regard to preference, 427 (86.8%) undergraduate and 210 (63.4%) graduate students strongly disagreed or disagreed that they preferred remote over face-to-face activities (Table 2).

Taking into account the intention to interrupt the course following the outbreak of the pandemic, 425 (54.6%) undergraduate students stated that they did not intend to do so, although many ($n = 354$; 45.4%) considered this a possibility. Meanwhile, most graduate students ($n = 285$; 73.6%) did not consider discontinuing the course. In fact, a few students blocked or canceled their enrolment in the course following the pandemic. The reason for blocking enrolment can be attributed to the lack of sufficient funds to cover the payments (Table 3).

During the pandemic, most undergraduate and graduate students ($n = 1,042$; 89.4%) participated in online courses/events related to dentistry. Additionally, they had access to entertainment in the form of movies, television series, and similar media platforms ($n = 872$; 74.8%), with most of them ($n = 980$;

Table 1
Sociodemographic characteristics of dental students and economic impact caused by the Covid-19 pandemic

Variables	Undergraduate students n (%)	Graduate students n (%)
Gender	n = 779	n = 387
Female	616 (79)	297 76.8
Male	163 (21)	90 23.2
Region of the country where the student lives	n = 779	n = 385
North	85 (6.5)	09 (2.3)
Northeast	454 (58.3)	102 (26.5)
Midwest	89 (11.4)	13 (3.3)
Southeast	155 (19.9)	172 (44.6)
South	30 (3.9)	90 (23.3)
The institution you study is:	n = 779	n = 387
Public	405 (52)	324 (83.7)
Private	374 (48)	63 (16.3)
Has your family income been reduced because of the COVID-19 pandemic?	n = 779	n = 385
Yes	492 (63.2)	237 (61.6)
No	287 (36.8)	148 (38.4)
Considering tuition fees (private schools) and / or purchase of instruments (public and private) for clinical and laboratory activities, are your family responsible for the cost of your college?	n = 779	n = 385
Yes	697 (89.5)	135 (35.1)
No	64 (8.2)	139 (36.1)
I have no costs related to my course	18 (2.3)	111 (28.8)
If you work to pay for your studies yourself, has your individual income been reduced because of the COVID-19 pandemic?	n = 779	n = 387
Yes	118 (15.1)	135 (34.9)
No	34 (4.4)	79 (20.4)
I do not work to pay for my studies	627 (80.5)	173 (44.7)
After the beginning of the COVID-19 pandemic and the need for social distance, your college:	n = 779	n = 387
Continued with remote educational activities (e-learning)	425 (54.6)	270 (69.8)
Activities were totally suspended	354 (45.4)	117 (30.2)

84.0%) agreeing or strongly agreeing that they spent more time on their cell phones than they did previously. The majority (n = 675; 57.9%) read books with content not related to dentistry. However, 299 (38.4%) undergraduate and 195 (50.4%) graduate students stated that they had studied the content of the college/graduate school to prepare themselves when face-to-face activities resume (Table 3).

Among the effects of the pandemic on postgraduate schools, most students (n = 225; 58.4%) reported that their experiments were completely interrupted and 96 (24.9%) indicated partial disruption. Regarding the research project, 163 (42.3%) students reported that they may not need adjustments, while 150 (39%) said that the project should be modified, and 72 students (18.7%) stated that another study design should be developed. The results also showed that most graduate students (n = 219; 56.9%) reported a delay in thesis defense due to the pandemic, while 166 (43.1%) did not experience schedule changes (Table 4).

In Brazil, based on academic achievements, postgraduate courses are classified as excellent (Concept

7 or 6), very good (Concept 5), good (concept 4), or regular (Concept 3). Courses with Concepts 1 and 2 were disqualified. An overview of graduate students who participated in this survey shows that most of them (n = 140; 38.6%) were from graduate programs classified as good; 127 (35%) from very good; 87 (23.9%) from excellent; and 9 (2.5%) from regular. Of these graduate students, most were scholarship holders financed by the Federal (n = 207; 53.8%) or State (n = 40; 10.4%) research agencies. However, 138 graduate students (35.8%) had no scholarships.

4. Discussion

Many studies have been conducted on the teaching and practice of dentistry during the ongoing pandemic, addressing future perspectives of care, biosafety, and infection control in clinical teaching environments. To the best of our knowledge, this is the first study to assess the direct impact of the pandemic on the lives, projects, academic schedules, attitudes, and perceptions of dental students.

Table 2
Students' perception of remote teaching (e-learning)

Variables	Undergraduate students n (%)	Graduate students n (%)
If your college continued its teaching activities remotely (e-learning), what content was taught?	$n = 779/443$	$n = 387/286$
Theoretical classes only	417 (53.5/94.1)	279 (72.0/97.6)
Theoretical and practical classes	26 (3.4/5.9)	7 (2.0/2.4)
Activities at my college were totally suspended	336 (43.1)	101 (26.0)
How did you consider your performance in e-learning activities?	$n = 779/465$	$n = 387/317$
Excellent	13 (1.7/2.8)	21 (5.4/6.6)
Good	82 (10.6/17.6)	137 (35.4/43.2)
Regular	172 (22.0/37.0)	114 (29.5/36.0)
Bad	111 (14.2/23.9)	24 (6.2/7.6)
Very bad	87 (11.2/18.7)	21 (5.4/6.6)
Activities at my college were totally suspended	314 (40.3)	70 (18.1)
Compared to face-to-face activities, my performance with remote activities (e-learning) was:	$n = 779/465$	$n = 387/312$
Much Better	10 (1.3/2.1)	8 (2.1/2.6)
Better	37 (4.7/7.9)	25 (6.4/8.0)
Neither better nor worse	139 (17.9/29.9)	146 (37.7/46.8)
Worse	160 (20.5/34.4)	105 (27.1/33.6)
Much worse	119 (15.3/25.6)	28 (7.3/9.0)
Activities at my college were totally suspended	314 (40.3)	75 (19.4)
I prefer remote teaching activities over face-to-face activities.	$n = 779/492$	$n = 387/331$
Strongly disagree	335 (43/68.1)	89 (23/26.9)
Disagree	92 (11.8/18.7)	121 (31.3/36.5)
Neither agree nor disagree	35 (4.5/7.1)	78 (20.1/23.6)
Agree	16 (2/3.2)	36 (9.3/10.9)
Strongly agree	14 (1.8/2.8)	7 (1.8/2.1)
Activities at my college were totally suspended	287 (36.9)	56 (14.5)

Considering social inequities and the poor availability of resources to deal with this situation, many Brazilian universities have suspended their face-to-face activities, with some institutions continuing to teach in virtual learning environments (e-learning). However, others are assessing the best ways to resume classes, taking into consideration this entire context. In Brazil, only one local-based study evaluated the quality of life of dental undergraduate students at the beginning of social isolation due to the pandemic [13].

Dentistry is among the professions that face a high risk of COVID-19 transmission, both for specialists and patients. This factor makes it even more difficult to return to face-to-face classes, especially in clinical teaching activities. Thus, distance learning has spread extensively. However, distance activity cannot replace the experience of direct contact with a patient [6, 7]. In dentistry courses in Brazil, in addition to clinical academic activities, curricular internships have also been suspended, affecting several students' academic schedules [8]. Most of the participants in this study stated that their educational institution continued with distance learning activities, with most of the curriculum covering only theoretical classes.

Meanwhile, 45.4% of undergraduate and 30.2% of graduate students faced a total suspension of teaching activities. In this scenario, students who are experiencing changes to the teaching method are concerned about facing learning disadvantages compared with students who have not experienced a crisis like this [12]. For this reason, many students are insecure in managing patients post pandemic because of the absence of practical training with direct contact with patients [14]. Moreover, the pandemic may have had a major impact on the future of students, especially regarding the challenges of completing academic activities and taking the final exam [15].

Although distance learning is already well established in some educational institutions and studies have highlighted its effectiveness in the learning process [16, 17], most students may not be receptive to this method. In this study, the majority of students stated that they preferred face-to-face activities compared to e-learning. Regarding academic achievement, among students who are participating in online classes, most undergraduate students considered their performance to be bad or very bad. In contrast, most graduate students regarded their performance as excellent or good. When compared to

Table 3
Students' perceptions about the course and attitudes during the COVID-19 pandemic

Variables	Undergraduate students n (%)	Graduate students n (%)
After the start of the pandemic, did you feel like stopping the course?	n = 779	n = 387
Yes	354 (45.4)	102 (26.4)
No	425 (54.6)	285 (73.6)
Did you, in fact, cancel your course enrollment after the pandemic began?	n = 779	n = 387
Yes	4 (0.5)	2 (0.5)
No	775 (99.5)	385 (99.5)
During the pandemic I participated in online courses/events related to dentistry.	n = 779	n = 387
Yes	676 (86.8)	366 (94.6)
No	103 (13.2)	21 (5.4)
During the pandemic I consumed a lot of entertainment on movie platforms, series, and the like.	n = 779	n = 387
Strongly disagree	35 (4.5)	17 (4.4)
Disagree	54 (6.9)	60 (15.5)
Neither agree nor disagree	85 (11.0)	43 (11.1)
Agree	276 (35.4)	133 (34.4)
Strongly agree	329 (42.2)	134 (34.6)
During the pandemic I read books of general content, not related to dentistry.	n = 779	n = 387
Yes	451 (57.9)	224 (57.9)
No	328 (42.1)	163 (42.1)
During the pandemic I studied dentistry contents to be more prepared when activities return.	n = 779	n = 387
Strongly disagree	86 (11.0)	18 (4.7)
Disagree	124 (16.0)	36 (9.3)
Neither agree nor disagree	161 (20.6)	76 (19.6)
Agree	299 (38.4)	195 (50.4)
Strongly agree	109 (14.0)	62 (16.0)
During the pandemic I spent more time on my cell phone than usual (pre-pandemic period).	n = 779	n = 387
Strongly disagree	14 (1.8)	4 (1.0)
Disagree	45 (5.8)	30 (7.7)
Neither agree nor disagree	63 (8.1)	30 (7.7)
Agree	258 (33.1)	149 (38.6)
Strongly agree	399 (51.2)	174 (45.0)

face-to-face activities, most students indicated that the e-learning experience was worse or much worse. Some information may help elucidate these worrying findings. Due to social distancing and isolation accompanying the pandemic, many Brazilian dental schools have immediately migrated their teaching to e-learning platforms [8]. In Brazil, most dental professors are untrained to implement remote education. Given this reality, higher education institutions must provide protocols and training for teachers to deal with online teaching challenges and students' learning difficulties in this changed environment [18]. We must also consider the unfavorable context of the crisis triggered by the pandemic, which results in fear and anxiety [19]. This could contribute to students' negative perceptions of e-learning. Additionally, the affective component represented by the presence of the teacher and colleagues may be an important learning factor during face-to-face activities [20, 21]. Future studies are essential to better comprehend these data. Nevertheless, dental schools must consider these issues to develop effective strategies for improving the experience and perception of students toward e-learning. The poor perception of remote education associated with low academic achievement could be discouraging and negatively impact student training. This environment may also contribute to increasing dropout rates.

An earlier survey revealed that many Brazilians experienced loss in family income, either due to a reduction in wages or unemployment, because of the pandemic [10], which was confirmed by our findings. This is particularly concerning for dental education in Brazil. Dentistry is an expensive program, and most Brazilian undergraduate students depend on their families to meet their expenses. Moreover, many undergraduate and graduate students who worked to pay for their education reported a reduction in their income. These data reveal that the risk of increased dropout in dentistry courses in Brazil is veritable, particularly among undergraduates. Thus, administrations of higher education institutions, both public and private, should be cognizant of the situation to carefully monitor the students and consider strategies

Table 4
Impact of COVID-19 pandemic on the graduate students' projects

Variables	Graduate students *n* (%)
Owing the COVID-19 pandemic, your experiments were	*n* = 385
Totally interrupted	225 (58.4)
Partially interrupted	96 (24.9)
There was no impairment to the experiments	64 (16.6)
Owing the COVID-19 pandemic, your research project	*n* = 385
It will not need adjustments	163 (42.3)
It must be adjusted	150 (39.0)
I will have to design another project	72 (18.7)
Owing the COVID-19 pandemic, the date of thesis defense	*n* = 385
There will be delay	219 (56.9)
The schedule will not be changed	166 (43.1)

for minimizing the negative consequences of the pandemic. Furthermore, additional credit lines can be used from public funding.

Students have been greatly affected by the pandemic, and most of them are in an age group that is extremely susceptible to disturbances in sleep, mood, anxiety, and depression [22–24]. This may explain why many undergraduate and graduate students expressed an intention to interrupt the course since the beginning of the pandemic. However, in effect, only a few suspended it. In addition to their studies, students who hold multiple roles tend to have higher levels of personal stress and pressure [25]. Considering the ongoing pandemic, it is important to highlight that educational institutions should anticipate a possible increase in school dropout rates. Regarding the learning behaviors of these students during the pandemic, it is imperative to emphasize the significance of continuing online education for acquiring skills and knowledge, maintaining performance, and ensuring good care of patients [26, 27]. Most subjects in this study stated that they participated in online meetings and lectures related to dentistry. Moreover, many indicated that they are also studying university content to be more prepared when face-to-face activities resume.

In our study, the students stated that they spent more time on their cell phones during the pandemic than they did previously. Additionally, it was also possible to verify that they had sufficient access to entertainment through films, series on television, and other media platforms. Linjawi et al. [28] found that, although students reported acceptable levels of skills with digital resources, they preferred to use such tools for personal use rather than for educational purposes. This scenario is extremely complex. In this context, the excessive use of cell phones for personal purposes can be an additional distracting factor, explaining, at least in part, the students' poor cognizance regarding e-learning. This resulted in their perception of worse academic performance when compared to face-to-face teaching.

Brazil excels in global dental research and is the second country in the world in terms of the number of articles published [29]. Additionally, there is an assembly of high-impact studies in all areas of dentistry. The impact of the pandemic on graduate students and consequently in postgraduate courses can negatively influence Brazilian dental research, since postgraduate courses are responsible for almost all scientific research in the country. Most graduate students affirmed that their experiments were completely or partially interrupted because of the pandemic. Because of the pandemic, most respondents reported that they would be required to adjust or develop another study design, resulting in a delay in thesis defense.

Although this is the first major study to evaluate the impact of the pandemic on dental education, some limitations should be considered. All data collected are self-reported, which are subject to two types of bias—recall and social desirability bias—that is, the tendency to underreport socially undesirable attitudes and behaviors. In this study, a recall bias may explain the minor disagreement between the number of students who reported the complete suspension of their teaching activities and those who commented on their experiences regarding remote education during the pandemic. Some students may have considered previous experiences with e-learning before the pandemic or even based their responses on how they would feel if they had experienced e-learning. Such disagreements were minimal and did not influence the relevance of the data. Additionally, the web-based convenience sample may result in selection bias, with a given population being over- or under-represented. However, because of the COVID-19 pandemic, all Brazilian dental schools were closed during data collection. Thus, considering the current situation, this was the only viable method for such surveys. Online recruitment has become an important strategy in the pandemic scenario because sanitary measures prevent traditional research approaches, and people have been spending more time on social media. Moreover, online recruitment is effective and provides a large sample in a short time [30].

5. Conclusion

This study highlights the most impactful academic consequences of dental undergraduate and graduate teaching. There was a poor perception and performance of dental students regarding e-learning. The findings suggest a significant impact of the pandemic on dental education. The extent of this impact can only be measured in the future. How are universities, including dental schools, planning to deal with schedule delays, financial difficulties, and the possible negative emotions of students? This study provides important information about the current scenario of dental education in Brazil in the context of the COVID-19 pandemic and its impact on the lives of both undergraduate and graduate students. The data may aid university managers and professors on the urgent measures required to mitigate the impact on dental education, particularly in low- and medium-income countries.

Conflict of interest

The authors declare no conflict of interest.

Data availability statement

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

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