

COVID-19 pandemic and impact on dental education: perception of Brazilian dental students

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Aim: The aim of the present study is to assess the perception of undergraduate students on the impact of the COVID-19 pandemic on Brazilian dental education. **Methods:** This cross-sectional study was conducted using an online questionnaire hosted in Google Forms platform and publicized on Instagram® and Facebook®. The questionnaire was available between July 8-27, 2020. Absolute and relative frequencies were obtained for variables of interest using Pearson's chi-squared and considering 95% confidence intervals. Prevalence of learning resource variables according to self-reported skin color, educational institution, and Brazilian region were presented using equiplots. **Results:** A total of 1,050 undergraduate dental students answered the questionnaire. Most students reported being in full-distance learning mode. Among the undergraduate students, 65.4% reported perceiving a very high impact in dental education, and 16.6% of students reported not being able to follow distance learning. In addition, 14% reported not having a personal laptop or desktop to study with, with this condition being more prevalent among non-white than white individuals. **Conclusion:** We conclude that Brazilian dental students perceived a high impact of COVID-19 on dental education, as well as one-sixth of the students reported not having adequate resources to continue with distance learning. It is important that different policies are developed at the institutional and governmental levels to reduce the impact of the pandemic on dental education.

Keywords: Education, dental. Students, dental. Dentistry. COVID-19. Pandemics.



Introduction

Coronavirus Disease 2019 (COVID-19) emerged in December 2019 in Wuhan, China, as pneumonia cases of an unknown cause¹. After drawing the attention of international authorities and the World Health Organization (WHO), there were an increasing number of cases in different countries. Then in March 2020, the WHO determined that the world was experiencing a pandemic². More than 10 million cases and 244,737 deaths by COVID-19 were recorded in Brazil between February 2020 (first case reported of COVID-19) and February 2021³. This scenario led the country to occupy the third place in the ranking of countries with the most confirmed cases of COVID-19, being considered one of the epicenters of the pandemic³.

Many countries in the world, including Brazil, experienced episodes of exponential growth in the number of cases, hospitalizations and overload of health systems³ between March and December 2020 due to the high infection rate, enhanced by transmission via oral and nasal secretion mainly in direct contact^{4,5}, and the absence of a vaccine and/or specific treatment against the SARS-CoV-2 virus for most of world's population. Thus, different measures of individual and collective protection against contagion were instituted, such as social distancing, hygiene of hands, objects and surfaces and the use of masks in order to mitigate the infection spreading in different populations^{1,4,6}. In this context, one of the fields most susceptible to exposure to the virus is dentistry, increasing the risk of contagion for professionals and patients^{5,7}. Most dental procedures require proximity to the patient, in addition to the fact that aerosols and droplets are present during various dental procedures^{5,8}. Moreover, Brazil is one of the countries with the largest number of professionals in the dental field, around 350,000⁹, and the COVID-19 pandemic introduced important impacts for public and private dentists in the country¹⁰.

There were 412 public and private dental schools in Brazil until 2019, totaling approximately 100,000 students⁹. In addition to the impacts reported by professionals, dental education has been facing several other challenges in this period¹¹. An undergraduate dental clinic requires professors to supervise students and the model followed in most of institutions is a dental clinic with simultaneous assistance¹². Moreover, the need for provisional closure of clinical activities in educational institutions tends to interfere in dental training, mainly due to the need for practical activities¹². Therefore, the possibility of distance learning resources can partially supply the pedagogical need. However, internet access is not yet a reality for all Brazilian students¹³, which can be a barrier to e-learning, in addition to depending on the type of interactive learning of teachers and also on the relationship of students with technology¹⁴. To the best of our knowledge, no study has assessed the impact of the COVID-19 pandemic in the Brazilian dental education. Thus, the aim of the present study is to assess the impact of the COVID-19 pandemic on Brazilian dental education through the perception of undergraduate students.

Methods

This study was reported following SURGE (the SURvey Reposting GuidelinE)¹⁵ and the STROBE (STrengthening the Reporting of Observational studies in Epidemiology) Statement¹⁶ for cross-sectional studies.

Study design

This study protocol was approved by research ethics committee of the Faculty of Medicine - Federal University of Pelotas (#4121205/2020). This cross-sectional study was conducted using an online questionnaire developed and pre-tested with questions that aimed to evaluate the impact of the COVID-19 pandemic on Brazilian dental education¹⁷.

Questionnaire development and pre-testing

The self-administered questionnaire used in this study was developed based on previous findings in the literature considering adversities faced by dental professionals and students related to access to technology and previous experience of distance learning^{10,12}. After ethical approval, the questionnaire was hosted online on the Google Forms platform and submitted to a pre-test carried out with 12 graduate dental students in order to assess the clarity, writing, organization and internal consistency of questions. Students were instructed to answer the questionnaire, record the time to complete, and then fill in a clarity scale for each question from 1 (not clear) to 5 (very clear)¹⁰. After the evaluation, 6 questions with a rating ≤ 3 were discussed among the researchers and were edited later. The questions together obtained an average clarity score of 4.78 (0.49). In addition, the mean response time to complete the questionnaire was 12 (2.2) minutes. The present study did not aim to validate the questionnaire used in this study.

Questionnaire content

The questionnaire should be accessed from the link in the invitation to participate in the study. The questionnaire was introduced on the first page, where the participant was informed about the study objective, the average response time and contact of the researchers involved. The participants had to read the Informed Consent Term and agree to participate in the study by selection of an affirmative answer "Yes" in order to access the following pages and questionnaire sections.

The final questionnaire was composed of 41 mandatory and closed-ended questions in five sections. The sections covered the following themes: student characteristics (n=10); dental education during the COVID-19 pandemic (n=17); knowledge about COVID-19 (n=4); biosafety and dental care (n=7); alcohol consumption and psychological symptoms (n=3). The options "I'd rather not say" and "does not apply" were available on all questions.

Setting, participant recruitment and survey administration

Participants were recruited through online resources without assuming a convenience sample¹⁷. The final questionnaire hosted on the Google Forms platform was available on the Instagram® social network (Facebook, Menlo Park, CA) together with images and informative texts about the study content, eligible participants, average response time and ethical approval. The link which hosted the questionnaire was made available in Instagram in the @ensino.odonto_covid19 bio, a professional profile specifically created for the study. In addition, the researchers involved acted directly in sharing content of the research profile and content and inviting professors and students at dental schools around the country to share the research link with their colleagues through feed and stories posts in their personal profiles on Instagram®, Twitter® and

Facebook®. Responses were collected between July 8-27, 2020 and the project's profile had a maximum of 1,389 followers¹⁷. In addition to the social network approach, e-mails with information and a link to access the survey were sent to 250 coordinating departments of Brazilian dental schools across the country¹⁷. Of these, 121 institutions responded to the e-mail (48.4% response rate)¹⁷.

Participants and sample size

Participants were undergraduate dental students in public or private Brazilian dental schools. Considering ~100.000 undergraduate students in public and private dental schools in Brazil⁹, we estimated that 500 responses would be necessary to obtain a 95% confidence interval, admitting 30% losses and unknown prevalence (50%).

Variables

Considering the students' characteristics section, the variables included gender (female or male), self-reported skin color (white vs non-white - Brown, Black, Yellow and Indigenous), residence area (rural or urban). Age was collected in years and categorized into ranges of 17-19 years, 20-25 years, 26-31 years, 32 years or more. Additionally, the variable Brazilian regions was obtained from the categorization of Brazilian states following the classification of the Brazilian Institute of Geography and Statistics - IBGE (North, Northeast, Midwest, Southeast and South)¹⁸.

Variables associated with the context of dental education during the Covid-19 pandemic collected were the type of institution (public, private or other), undergraduate stage (semester) categorized as initial stage (up to the fourth semester), intermediate stage (fifth to seventh semester) and final stage (eighth to tenth semester), and the learning methodology used in the dental school during the pandemic ("full distance learning", "partial distance learning", "no activities").

The students self-reported impact on dental education was collected through the question "How do you consider the impact of Covid-19 pandemic on dental education?", with answers ranging in a five-point scale from 0 "no impact" to 4 "very high impact". Additionally, data were collected regarding the students' access to infrastructure to follow the classes including "adequate resources for distance learning", "internet access", "smartphone", "laptop", "desktop", all dichotomized as "yes" or "no" questions. Moreover, when a computer was available, the number of persons sharing the computer was collected ("None", "One", "Two", "Three or more").

Data analysis

The data were imported from the Google Forms platform in spreadsheet format to Microsoft Excel software. All analysis was performed in the Stata 15.0 software program (StataCorp. CollegeStation, TX, USA). Absolute and relative frequencies were obtained for variables of interest using Pearson's chi-squared test with 5% significance level and 95% confidence intervals. The options "I'd rather not say" and "does not apply" were treated as missing data. In addition, prevalence of learning resource variables according to self-reported skin color (white and non-white), educational institution (public and private) and Brazilian region (South, Southeast, Midwest, Northeast, North) were presented using equiplots (<http://www.equidade.org/equipplot>).

Results

A total of 1,050 undergraduate dental students answered the questionnaire online and were considered part of the final sample. Among the participants, most were female (70.5%), aged 20 to 25 years (64.2%) and with self-declared skin color as white (66.2%). A majority of the students reported living in urban area (95.5%) and in the South region of Brazil, followed by the Northeast and Southeast regions (Table 1).

Table 1. Descriptive analysis of the sample according to student characteristics (n = 1,050).

Student characteristics (N)	n (%)	CI 95%
Gender (1 048)		
Female	739 (70.5)	67.7-73.2
Male	309 (29.5)	26.8-32.3
Age (1 050)		
17 – 19 years	150 (14.3)	12.3-16.5
20 – 25 years	674 (64.2)	61.2-67.0
26 – 31 years	162 (15.4)	13.4-17.7
32 years or more	64 (6.1)	4.8-7.7
Skin Color (1 046)		
White	682 (65.2)	62.3-68.0
Brown	243 (23.2)	20.8-25.9
Black	106 (10.1)	8.4-12.1
Yellow	12 (1.2)	0.6-2.0
Indigenous	3 (0.3)	0.1-0.9
Residence area (1 044)		
Rural	47 (4.5)	3.4-5.9
Urban	997 (95.5)	94.1-96.6
Brazilian region (1 048)		
North	51 (4.9)	3.7-6.4
Northeast	247 (23.5)	21.1-26.2
Midwest	68 (6.5)	5.1-8.2
Southeast	222 (21.2)	18.8-23.8
South	460 (43.9)	40.9-46.9

Table 2 shows a similar distribution of students between public and private institutions and that the majority of students were at the intermediate stage of their graduate course (41.5%). Additionally, considering the learning methodology during the pandemic, most students reported being in full distance learning mode (48.9%). Among the undergraduate students, 65.4% reported having perceived a very high impact on their dental education. In Table 3 it is possible to observe that 16.6% of students reported not being able to follow distance learning, 19.7% of students reported not having a laptop, and 84.7% not having a desktop. In addition, only 1.3% have no access to internet and 0.4% declared no access to a smartphone. Most of those who owned a computer (37.5%) reported not sharing with another person.

Table 2. Descriptive analysis of the sample according to dental education characteristics in the pandemic (n = 1,050).

Dental education and pandemic (N)	n (%)	CI 95%
Institution (1 050)		
Public	536 (51.0)	48.0-54.1
Private	506 (48.2)	45.2-51.2
Other	8 (0.8)	0.4-1.5
Undergraduate stage (semester) (1 050)		
Initial stage (1 st - 4 th semester)	333 (31.7)	29.0-34.6
Intermediate stage (5 th - 7 th semester)	436 (41.5)	38.6-44.5
Final stage (8 th - 10 th semester)	281 (26.8)	24.2-29.5
Teaching methodology during the pandemic (1 041)		
Full distance learning	509 (48.9)	45.9-51.9
Partial distance learning	255 (24.5)	22.0-27.2
Without activities	277 (26.6)	24.0-29.4
Impact of the pandemic on dental education (1 041)		
No impact	7 (0.7)	0.3-1.4
Low impact	10 (1.0)	0.5-1.8
Intermediate impact	95 (9.1)	7.5-11.0
High impact	248 (23.8)	21.3-26.5
Very high impact	681 (65.4)	62.5-68.3

Table 3. Descriptive analysis of the sample according to students' resources for distance learning (n = 1,050).

Students' resources for distance learning (N)	n (%)	CI 95%
Absence of any resources for distance learning (1 050)		
No	876 (83.4)	81.0-85.6
Yes	174 (16.6)	14.4-18.9
Internet access (1 050)		
No	14 (1.3)	0.8-2.2
Yes	1036 (98.7)	97.8-99.2
Have a smartphone (1 050)		
No	4 (0.4)	0.1-1.0
Yes	1046 (99.6)	99.0-99.9
Have a laptop (1 050)		
No	207 (19.7)	17.4-22.2
Yes	843 (80.3)	77.8-82.6
Have a desktop (1 050)		
No	889 (84.7)	82.4-86.7
Yes	161 (15.3)	13.3-17.6
People sharing the computer (958)		
None	359 (37.5)	34.5-40.6
One	175 (18.3)	15.9-20.8
Two	254 (26.5)	23.8-29.4
Three or more	170 (17.7)	15.4-20.3

Data on two variables about adequate resources for distance learning and computers (laptop or desktop) are presented by Brazilian region, educational institution, and self-declared skin color in Figures 1 and 2. Among students, 14% reported not having a personal laptop or desktop to study, being more prevalent among non-whites than whites (18.1% vs 11.9%, respectively, $p < 0.001$) (Figure 2). In addition, it is possible to observe a gap in the prevalence of absence of personal computer to study between regions, varying from 10.5% and 12.1% in northeast and southeast to 19.1% and 21.6% in Midwest and North regions, respectively. An absence of resources for distance learning was more frequently reported by participants classified as non-white (19.0%), studying in private institutions (18.0%) and living in Midwest Brazilian region (19.0%); however, no statistical significance was observed ($p > 0.05$) (Figure 1).

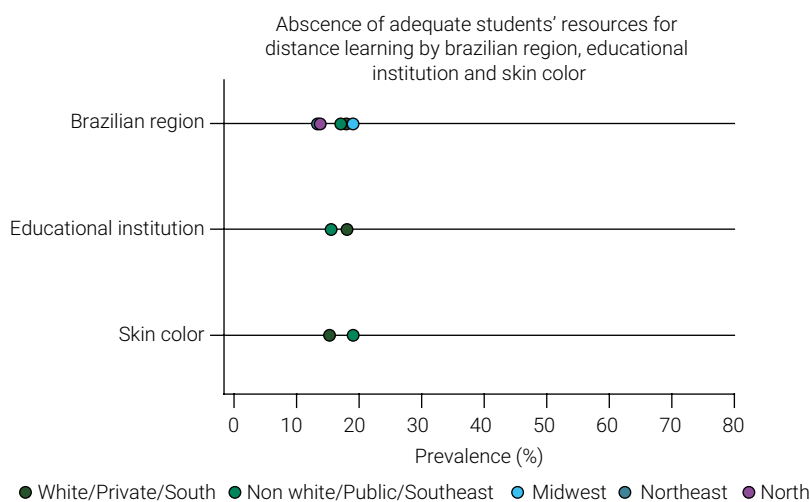


Figure 1. Equiplot of prevalence about absence of adequate student resources for distance learning by Brazilian region, educational institution and skin color (n = 1,050).

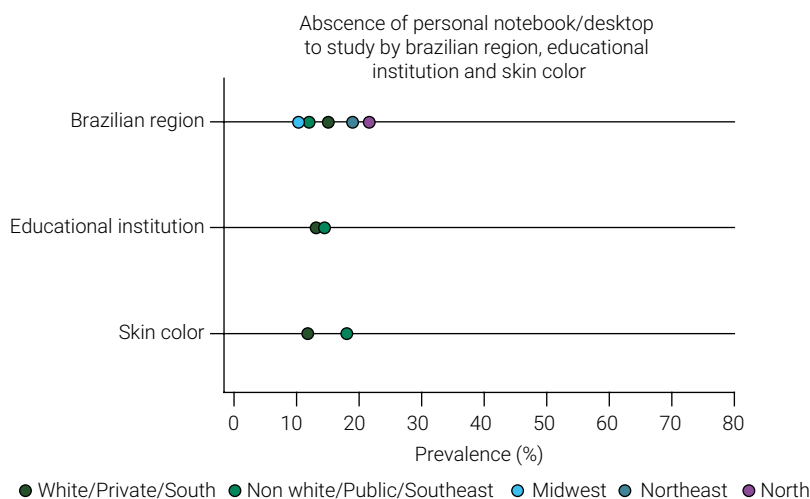


Figure 2. Equiplot of prevalence about absence of personal laptop/desktop to study by Brazilian region, educational institution and skin color (n = 1,050).

Discussion

The results obtained by this study are a source of concern, mainly because dental students reported a high impact from the COVID-19 pandemic. Additionally, our findings shed some light on the fact that a significant number of students present important limitations to follow distance learning, with inequalities in distribution. About one sixth of students reported not having adequate resources for distance learning, and an important part reported being in full or partial learning distance mode. Among dental students, 19.7% reported not having a laptop, and more than 80% not having a desktop; of those who have these resources, more than 60% share with at least one person. Additionally, not having a laptop or desktop to study was significantly more prevalent among students who self-declared non-white, which comprises racial and ethnic minorities in Brazil, such as blacks, browns and indigenous.

Although some dental schools had already adopted the system of e-learning before the pandemic¹⁹, most of essential courses had to adhere to the Remote Emergency Education (REE) modality to meet the pedagogical needs required after the COVID-19 pandemic and social distancing measures. Medical schools in Brazil similarly also suspended face-to-face theoretical and undergraduate activity practices¹³. In the present study, most students were only studying by distance learning methods, totally (48.9%) or partially (24.5%), as well as most institutions worldwide^{12,20-23}. The REE may have contributed to the fact that majority of dental students reported a high impact of the COVID-19 pandemic on their education. Still, many institutions completely suspended their activities at times during 2020, and the impact for these students is assumed to be even greater. As dentistry is a very practical course, the absence of clinics and laboratories directly affect student performance and clinical skills development^{12,20,21}. This is one of the greatest challenges for dental education because although some face-to-face classroom lectures were replaced by e-learning, distance methods cannot replace clinical practice^{12,24}.

The great impact on activities reported by students in this study may also be due to feelings arising from students such as insecurity, fear, anguish, and stress, as well as a difficulty in virtual learning by some undergraduate students²⁵. A study carried out through an online questionnaire applied in April 2020 at a private dental school in the Northeast region in Brazil observed one of the most affected domains of dental student quality of life was the psychological domain²⁶. Other studies carried out in different regions and countries, such as North America^{12,27}, Indonesia²⁰, Jordan²¹ and New Zealand²² using online surveys had similar results, with undergraduate dental students reporting fear from COVID-19, anxiety and depressive symptoms due to social distancing situations, family economic issues and return to face-to-face activities. The context of the COVID-19 pandemic in a middle-income country, routine changes promoted by social distancing, socioeconomic and family environment factors may intensify students' stress^{17,24}.

The COVID-19 pandemic is disproportionately affecting the most vulnerable strata in different societies, especially in low- and middle-income countries, which already have important inequalities in living conditions, health and education, such as Brazil²⁸. As found in the present study, although most also have the necessary resources, a

significant portion of students (16.6%) still do not have resources for distance learning classes. According to data from the National Continuous Household Survey, in 2018, almost 46 million of the included Brazilian households do not have an internet connection²⁹. Internet access for learning is not yet a reality for all students¹³. It is therefore necessary to consider students who do not have sufficient resources for distance learning classes and who are in a situation of social vulnerability²⁸. Differences in the access to a personal computer was also found considering Brazilian regions, where it was observed that students from the North and Midwest regions presented less access to a desktop or laptop to study. It is also worth mentioning that, although it is possible to watch classes by a mobile device, the presence of a computer is absolutely necessary to perform e-learning activities. North and Midwest regions are less economically developed in Brazil compared with the Southeast³⁰. Thus, differences between regions can be explained by socioeconomic differences, calling attention to the need for digital inclusion actions mostly directed at these vulnerable regions. Emergency e-learning maintains inequalities and provides a window into the colonial process of social exclusion of the ethnicity and racial minority population in Brazil^{31,32}.

A statistically significant difference was found in the present study, showing inequality in the access to a personal computer between whites and blacks/browns. In addition, it is observed that most respondents in this study are white, even though the majority of Brazilians self-declared black or brown. Racial inequalities in different outcomes are well described in the literature and occurs as a result of structural racism³². Structural racism is an oppressive manifestation through interconnected systems, with racial discrimination occurring from the space of the individual, employment, residential location, education, health care, justice, reflecting on the history, culture and institutions present in our society³³. This historical racial discrimination generates a marginalized population, with worse housing conditions, lower income and fewer opportunities for professional advancement, and in turn makes it impossible or delays access of blacks/browns to more modern technologies in relation to whites³³. Consequently, whites are more likely to finish high school than blacks/browns and thus they are also more likely to enter and complete an undergraduate course, as there is racial disparity in access, training and resources available in different schools, corroborating the majority of university students interviewed who declared themselves whites³⁴.

In view of the reduction of these inequalities, Brazilian Universities went through a huge expansion at the end of 2000s and at the beginning of the last decade. As part of this expansion, racial quotas were implemented in public institutions, allowing black/brown people an increase in possibilities to access all careers, including those with more prestige in society, where dentistry can be included³⁵. Federal universities increased policies directed to offer home, transport and food for this group to guarantee the permanence of students in situations of vulnerability³⁵. At this moment, it is also necessary that digital inclusion actions should be promoted, allowing all students to have adequate conditions to follow on-line courses. A survey which studied digital inclusion in the poorest sectors of the population found that while the percentage of white people with a computer exceeds the average (9.0%), and that of mixed race is equal to it, the black population has a level equivalent to half the average³⁶. Brazilian

data showed that only 55% of black people used computers at least once in their lives, demonstrating the differences in access to technology in the country²⁹.

This study presents some limitations that should be discussed. Although the sampling method is not representative, the dental community is very present on social networks, where more than 1000 students answered the questionnaire, alleviating this limitation. In addition, with limitation, we can point out that the sample was not from the region of the country where most dentistry courses are concentrated, which may have impacted the representativeness and generalization of our results for the country. By the online application method, attendance by the participant is prevented when the participant does not understand a question, there is exclusion of people who do not usually use social networks or do not have access to the internet, in addition to not knowing the circumstances in which the questionnaire was answered. Thus, the results regarding access to devices for e-learning could be overestimated since students with difficulty to access the internet had less chance to answer the questionnaire. As a strength, the use of the social networking tool is a good option in times of social isolation where contact between people has been avoided, as well as being important to emphasize the educational inequalities that occur due to the pandemic. Moreover, knowledge of the dental education context in the COVID-19 era is necessary in order to understand the limitations and losses caused by the period and to outline strategies to qualify and reduce the impacts, mainly in a middle-income country.

The COVID-19 pandemic caused many challenges related to education to arise, both for educational institutions and for students and teachers. However, distance learning resources can meet the orientation of social distancing and at the same time preserve the connection and support to academics¹³. However, it is necessary that the distance learning discipline has some criteria to be attended, such as organization, planning, technological availability to meet the needs of the students, demands and training of teachers. Furthermore, the need to maintain healthy students, teachers and staff with the presence of individual protection equipment, knowledge about the disease and adequacy of work spaces and routines in a context of theoretical and practical activities is highlighted²³. Public policies aimed at Democratizing Higher Distance Education should not only take into account the increase in the number of courses and vacancies, but also variables that impact the access, permanence and conclusion of the course of these students, such as individual characteristics and regional inequalities in the country³⁵. Providing classes without these adjustments puts the teaching proposal in a safe and correct way at risk in the current pandemic scenario of COVID-19.

In this study, we concluded that Brazilian dental students reported a high impact of COVID-19 on their dental education, and one sixth of the students reported not having adequate resources to continue with distance learning. In addition, self-declared non-white students reported more than whites not having a laptop or computer, which is an important obstacle in being able to follow class activities. The social inequalities that already exist among students are accentuated in a pandemic moment, and thus it is important that different policies are developed at institutional and governmental levels to reduce the impact of the pandemic on dental education, providing assistance to students to guarantee internet access and availability of electronic devices.

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Declaration of Conflicting Interests

The authors report that there are no direct or indirect conflicts of interest involving associations with commercial entities that supported the work reported in the submitted manuscript, associations with commercial entities that might have an interest in the submitted manuscript, financial associations involving family members and other relevant non-financial associations.

Data availability

Datasets related to this article will be available upon request to the corresponding author.

Author Contribution

Dias CA contributed to conception, design and drafted the manuscript. Sartori LRM drafted the manuscript. Karam SA and Cumerlato CBF analysis and interpretation of the data. Fernandez MS, Silva NRJ and Bielavski CH participated in the elaboration of the questionnaire and data collection. Silva AER, Castilhos ED and Correa MB contributed to critically revised the manuscript. All authors gave final approval and agreed to be accountable for all aspects of the work.

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