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ORIGINAL ARTICLE

COVID-19 Pandemic Onset and its Impact on a Pediatric Dental Outpatient Clinic: A University-Based Study

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ABSTRACT

Objective: To evaluate the impact of the COVID-19 pandemic on dental care provided at a university-based pediatric dental outpatient clinic. **Material and Methods:** This was an observational. The monthly numbers of dental procedures were obtained from clinical records. For comparison purposes, three intervals were set: pre-pandemic (March 2019 to February 2020), first year (March 2020 to February 2021), and second year (March 2021 to February 2022) after the COVID-19 pandemic onset (n = 12 in each). The significance level was set at 5%. **Results:** 1,813 patients were treated, and 6,457 dental procedures were performed. There was no productivity between April 2020 and February 2021. When comparing the pre-pandemic interval and the second year, it was observed that there was a lower monthly number of dental procedures, estimated at -71% (95%CI = -43%, -85%). This reduction was observed in preventive, restorative, endodontic, surgical, and orthodontic/orthopedic dental procedures. However, there was a reduction in the ratio between restorative and surgical (-41%, 95%CI = -4%, -65%) and preventive and surgical (-43%, 95%CI = -4%, -66%), as well as an increase in the ratio between surgical and endodontic (130%, 95%CI = 38%, 291%) dental procedures. **Conclusion:** The performance of dental procedures at this oral health service was significantly reduced after the COVID-19 pandemic onset.

Keywords: Dental Care for Children; Pediatric Dentistry; COVID-19.

Introduction

In March 2020, the World Health Organization (WHO) declared the COVID-19 pandemic globally. The outbreak began in China in December 2019 in the city of Wuhan. Due to the transmissibility potential of the virus (SARS-CoV-2), the other countries were quickly reached [1,2]. In the field of health, the COVID-19 pandemic onset significantly increased the pressure on health systems and services; considering the high demand for hospitalizations to deal with the disease and the need to temporarily reorganize the health care assistance, recommending urgent actions to face the pandemic setting [3,4].

In Dentistry, the provision of dental care was significantly affected by the COVID-19 outbreak. In the first instance, the risk of transmission and viral infection related to the dental environment was assessed, considering its routines and procedures. Then, urgent dental care was prioritized, and interventions and elective procedures were postponed [5,6]. Furthermore, the population faced the fear of the disease and the need to comply with sanitary measures that involved social distancing, which negatively influenced the demand for health services, including those related to oral health [7,8].

Considering the COVID-19 and Dentistry interface, the scientific community was concerned about the impact of the pandemic context on children's oral health worldwide, as well as the provision of dental care for this age group. It was observed that there could be a significant limitation in the capacity of health services to provide adequate oral care for children in the context of restrictions imposed by the COVID-19 outbreak, as well as a delay in the search for these services by avoiding seeking these services when there were demands to be addressed, which can negatively affect oral health in the short and long term [9-11].

Moreover, concern about children's oral health, in addition to issues related to oral health services, was driven by the negative impact of the COVID-19 pandemic on the routine and habits of eating and oral hygiene during the lockdown. The evidence differed between populations and study methods, but an increase in the consumption of ultra-processed foods with high sugar content and a reduction in the amount of daily tooth brushing was observed [12,13]. Consequently, added to the limitations of oral health services, children may have a greater need for dental treatments in the future, especially those who have not received adequate dental care or are in socioeconomic vulnerability and depend on public health services [14,15].

Therefore, it is reasonable to understand that there is a need to investigate the impact of the COVID-19 pandemic on dental care for children in different oral health services, seeking to describe and measure the changes caused by the pandemic context in the performance of dental procedures and children's oral health needs. Then, this study aimed to evaluate the impact of the COVID-19 pandemic on dental care provided at a university-based pediatric dental outpatient clinic. It was hypothesized that (H_1) there was a reduction in the monthly number of dental procedures carried out in the first and second year after the COVID-19 pandemic onset, as well as (H_2) a decrease in the ratio between preventive and therapeutic dental procedures (restorative, endodontic and surgical).

Material and Methods

Study Design and Ethical Clearance

This was an observational, longitudinal, retrospective, and quantitative study [16]. The STROBE checklist was used to structure the study report [17]. The study protocol was approved by the Research Ethics Committee (Opinion No. 6.205.629) and was carried out in accordance with research guidelines applicable to studies involving humans.

Data Collection

Data were collected from clinical charts of patients treated at the Pediatric Dentistry Clinic of the School of Dentistry of Ribeirão Preto, University of São Paulo. In this public oral health service, all dental care in pediatric dentistry and special needs dentistry specialties were considered, including undergraduate and postgraduate clinics. These clinics receive patients referred from other healthcare services (both public and private) or through walk-ins. To assess the impact of the COVID-19 pandemic, a control pre-pandemic interval (March 2019 to February 2020) was designed to be compared with the first (March 2020 to February 2021) and the second (March 2021 to February 2022) year after the COVID-19 pandemic onset. Given the short timeframe, the intervals were evaluated by months (n = 12 per interval), similar to other approaches [18].

The main outcome (primary variable) was the monthly number of dental procedures. In addition to the quantitative, as a secondary outcome, the dental procedures were characterized according to the type as preventive, restorative, endodontic, surgical, orthodontic/orthopedic, prosthodontic, or others. In addition, the number of patients, their age, and the number of dental procedures per patient were recorded and whether they lived in the same city where the University was located (resident). Moreover, the ratio between the types of dental procedures was also examined to investigate changes between COVID-19 pre-pandemic and pandemic intervals.

Considering data collection from clinical charts, those not presenting all the variables listed will not be eligible for the study. The data was collected through the researchers' access to the patient management system, applying filters to reach the clinical charts of patients. A systematic procedure was adopted in each clinical chart to record the variables, transporting the data to a spreadsheet for tabulation and processing prior to data analysis.

Data Analysis

Statistical analysis of the data was carried out using the Jamovi, version 2.3.15 (Sydney, Australia) statistical package, adjusting the significance level at 5% ($\alpha = 0.05$), as well as considering $P < 0.05$ as statistically significant. The variables were expressed by medians and their interquartile ranges (IQR), in addition to absolute and relative frequencies and 95% confidence intervals (95%CI). In addition to the descriptive analysis, a negative binomial regression (generalized linear model) was used to compare the number of dental procedures between the COVID-19 pre-pandemic (reference level) and pandemic intervals, considering Quasi-Poisson distributions (overdispersion) and the maximum likelihood estimation in the logarithmic link-function (Log-likelihood ratio).

Results

Overall, 1,813 patients were treated during the study timeframe, 1,315 (72.5%) in the pre-pandemic interval and 498 (27.5%) in the second year after the COVID-19 pandemic onset. There was no productivity between April 2020 and February 2021 (first year). For this timeframe, the median of the patient's age was 7 years (IQR = 4). However, considering the pre-pandemic interval, it was 8 years (IQR = 4), decreasing to 7 (IQR = 4) in the second year after the COVID-19 onset. In addition, regarding the number of dental procedures per patient, the median was 3 (IQR = 3). However, considering the pre-pandemic interval, it was 3 (IQR = 3), decreasing to 2 (IQR = 3) in the second year after the COVID-19 onset.

Table 1 shows the frequency of age groups and the number of dental procedures per patient and residence. The age group 5-9 years was the most frequent in both intervals, and the performance of 0-3 dental procedures per patient and patients residing in the same city where the University is located. It is also worth noting the increase in the frequency of age groups 10-14 and 15 or more years, as well as the decline in the

frequency of patients who underwent 4-9 and 10 or more dental procedures when comparing the pre-pandemic interval and the second year after the COVID-19 pandemic onset.

Table 1. Frequency of age groups, number of dental procedures per patient, and residence.

Variables	Pre-Pandemic Interval		Second Year After COVID-19 Pandemic Onset	
	N	%	N	%
Age				
0-4	198	15.0	55	11.0
5-9	829	63.0	298	59.8
10-14	206	15.7	113	22.7
15 or more	82	2.2	32	6.4
Dental Procedures per Patient				
0-3	766	58.2	368	73.9
4-9	487	37.0	118	23.7
10 or more	62	4.7	12	2.4
Residence				
Residents	837	63.6	339	68.0
Non-residents	478	36.3	160	32.1

Moreover, during this timeframe, 6,457 dental procedures were carried out between March 2019 and February 2020, considering 4,848 (75.1%) in the pre-pandemic interval, 196 (3%) during the first year, and 1,413 (21.9%) in the second year after the COVID-19 pandemic onset. Among the types of dental procedures, 2,628 (40.8%) were preventive, 1,688 (26.1%) were restorative, 564 (8.7%) were surgical, 236 (3.6%) were endodontic, 124 (1.9%) were orthodontic/orthopedic and 16 (0.2%) were prosthodontic, as well as 1,201 (18.6%) were classified as "others." Table 2 presents the monthly average numbers of dental procedures, and Table 3 presents the comparison between the pre-pandemic interval and the second year after the COVID-19 pandemic onset, considering the types of dental procedures. The first year was excluded from this analysis, and the 196 dental procedures reported were carried out in March 2020, before the onset.

Table 2. Monthly average numbers of dental procedures.

Types of Dental Procedures	Pre-Pandemic Interval	Second Year After COVID-19 Pandemic Onset
All	493 (365)	121 (132)
Restorative	114 (100)	30 (40)
Endodontic	15 (14)	3 (3)
Surgical	32 (25)	14 (16)
Orthodontic/Orthopedic	4 (11)	1 (1)
Prosthodontic	0 (1)	0 (0)
Preventive	175 (183)	44 (60)
Others	68 (91)	16 (10)

(): Interquartile Range.

Table 3. Comparison of the monthly numbers of dental procedures.

Types of Dental Procedures	Estimate	Pre-Pandemic Interval Limits		p-value
		Lower	Upper	
All				
Intercept	218	159	309	<0.001*
2nd year	0.29	0.15	0.57	<0.001*
Restorative				
Intercept	58.9	41.7	86.7	<0.001*
2nd year	0.32	0.15	0.66	0.002*

Endodontic				
Intercept	7.44	5.72	9.71	<0.001*
2nd year	0.24	0.14	0.41	<0.001*
Surgical				
Intercept	21.4	15.7	30.1	<0.001*
2nd year	0.49	0.25	0.94	0.031*
Orthodontic/Orthopedic				
Intercept	2.59	1.44	4.79	0.002*
2nd year	0.08	0.02	0.27	<0.001*
Prosthodontic				
Intercept	0.62	0.24	1.83	0.342
2nd year	0.45	0.06	3.48	0.436
Preventive				
Intercept	88.6	60.3	138	<0.001*
2nd year	0.29	0.13	0.68	0.004*
Others				
Intercept	36.6	27.3	50.5	<0.001*
2nd year	0.21	0.11	0.39	<0.001*

*Statistically significant.

Regardless of the interval, there was a marked variability in the monthly numbers. The months of July, December, and January had lower numbers in both intervals. It was possible to observe that only the performance of prosthodontic dental procedures did not reduce in the second year after the COVID-19 pandemic onset. Reductions were estimated at -71% (95%CI = -43%, -85%) for all types of dental procedures, -68% (95%CI = -34%, -85%) for restorative, -76% (95%CI = -59%, -86%) for endodontic, -51% (95%CI = -6%, -75%) for surgical, -92% (95%CI = -73%, -98%) for orthodontic/orthopedic, -71% (95%CI = -32%, -87%) for preventive, and -79% (95%CI = -61%, -89%) for others types of dental procedures.

At last, Table 4 also shows the comparison of the monthly numbers of dental procedures, now considering the ratio between types of dental procedures, patient's age, number of dental procedures per patient, and residence. It was observed that, when comparing the pre-pandemic interval and the second year after the COVID-19 pandemic onset, there was a significant reduction in the ratio between restorative and surgical (-41%, 95%CI = -4%, -65%) and between preventive and surgical dental procedures (-43%, 95%CI = -4%, -66%), as well as an increase in the ratio between surgical and endodontic dental procedures (130%, 95%CI = 38%, 291%). Moreover, there was a decrease in the number of dental procedures per patient (-24%, 95%CI = -18%, -30%) and an increase in the patient's age (15%, 95%CI = 9%, 22%). It is important to highlight that extractions were the majority among surgical and dental procedures, corresponding to 354 (96.2%) in the pre-pandemic period and 168 (93.3%) in the second year after the COVID-19 pandemic onset.

Table 4. Comparison of the monthly numbers of dental procedures.

Types of Dental Procedures	Estimate	Pre-pandemic interval Limits		p-value
		Lower	Upper	
Restorative *versus* Endodontic				
Intercept	7.79	6.47	9.36	<0.001*
2nd year	1.33	0.92	1.93	0.127
Restorative *versus* Surgical				
Intercept	3.00	2.31	3.81	<0.001*
2nd year	0.59	0.35	0.96	0.036*
Surgical *versus* Endodontic				
Intercept	3.03	2.32	3.89	<0.001*
2nd year	2.30	1.38	3.91	0.002*
Preventive *versus* Restorative				

Intercept	1.40	0.95	1.95	0.067
2nd year	0.87	0.42	1.76	0.694
Preventive *versus* Endodontic				
Intercept	11.9	9.05	15.8	<0.001*
2nd year	1.15	0.66	2.01	0.632
Preventive *versus* Surgical				
Intercept	4.36	3.35	5.62	<0.001*
2nd year	0.57	0.34	0.96	0.035*
Dental Procedures per Patient				
Intercept	3.24	3.12	3.37	<0.001*
2nd year	0.76	0.70	0.82	<0.001*
Patient's Age				
Intercept	8.52	8.28	8.77	<0.001*
2nd year	1.15	1.09	1.22	<0.001*
Residents *versus* Non-Residents				
Intercept	2.04	1.50	2.70	<0.001*
2nd year	0.96	0.53	1.72	0.892

*Statistically significant.

Discussion

This study evaluated the impact of the COVID-19 pandemic on dental care provided at a university-based pediatric dental outpatient clinic. Returning to the hypotheses, H_1 was accepted since dental procedures were suspended during the first year, and a significantly lower monthly number of dental procedures was carried out in the second year after the COVID-19 pandemic onset compared to the pre-pandemic interval. Among the types of dental procedures, this difference was not observed among prosthodontic ones (due to the low monthly numbers in both intervals), affecting the other types.

However, H_2 was partially accepted since only the ratio between preventive and surgical dental procedures was reduced in the second year compared to the pre-pandemic interval (indicating that the numbers of the first have decreased in relation to the second). In addition, there was a reduction in restorative over surgical and an increase in surgical over endodontic dental procedures. Despite significance, the decrease in surgical dental treatments occurred at a lower magnitude than the others (which can be seen in the reduction estimates as the lowest among the types of dental procedures). Furthermore, as expected, the number of dental procedures per patient reduced after the COVID-19 pandemic onset (accompanying the general reduction). However, there was a slight increase in the age of patients treated (especially in the age groups 10-14 and 15 or more).

The suspension of dental care during the first year of the COVID-19 pandemic resulted from guidelines directed at higher education institutions, including dental schools, considering the exposure and protection of students and lecturers to COVID-19-related risks. Once academic activities were suspended, dental care provided by undergraduate and postgraduate students was suspended in all specialties [19]. In addition to dental education, this suspension directly affected the population's access to dental specialties through university-based dental services, which often allows access to dental treatments not reached in other services, especially by underserved populations [9,20]. The importance of these specialized dental services for the population can also be seen by the number of patients who do not live in the city where the University is located, considering both intervals (almost ⅓ of them).

Indeed, the impact of the COVID-19 pandemic onset on this Brazilian university-based dental service must be added to the other oral health services. For example, a reduction in pediatric outpatient dental procedures in the Brazilian Unified Health System (SUS) has already been demonstrated. It is essential to consider that dental care provided during the first year of the COVID-19 pandemic was not suspended [21],

which differs from this education-linked oral health service. Despite providing free oral health care, the evaluated university-based dental service is not managed by the SUS (Ministry of Health), although the teaching and learning environments involving health care adhere to its sanitary standards (e.g., COVID-19-related aspects in dental settings) [19]. Therefore, it is reasonable to understand that the educational context has introduced a distinct perspective.

However, a reduction in restorations and endodontic and surgical treatments in primary teeth was observed within SUS [21], similar to the outcomes of this study. In addition, another study demonstrated that the number of dental procedures in the SUS reduced after the COVID-19 pandemic onset. However, it was observed that surgical and dental procedures showed the most minor reduction, while aerosol generators and preventive procedures showed the most significant [22], similar to this study's outcomes. Both studies point to worsening oral health conditions in the future [21,22].

This context can be even more worrying for children with disabilities, as they already face limitations in accessing oral health services and receiving effective dental care. Since public health systems and services were already facing highly increased demand due to the COVID-19 pandemic, meeting other demands was challenging, and those related to individuals with disabilities were neglected in some contexts, including oral health. Unmet demands during the COVID-19 pandemic will undoubtedly be difficult in the coming years [23,24]. The inclusion of Special Needs Dentistry clinics in this study considered the frequency of disabled pediatric patients at this university-based outpatient clinic, a specialized service for people with disabilities.

Moreover, when dental care resumed in 2021, this Brazilian university-based dental service observed significantly lower monthly dental procedures. Among the hypotheses that may justify this outcome, it is imperative to consider the changes caused by the COVID-19 pandemic in the dental routine for pediatric patients, such as new biosafety trends in dental settings to enhance the protection of students and lectures (more rigorous) and new workflows to schedule the pediatric patients, including prior health status assessment (signs and symptoms of contagious diseases) and other requirements [20,25]. In addition, since the suspension lasted a year, it is reasonable to hypothesize that referrals from other oral health services were progressively redirected, which reduced demand. This hypothesis needs further investigation.

Nevertheless, the COVID-19-related concern about the worsening of the oral health status of pediatric patients, among other factors, is subsidized by the pandemic impacts on oral health services [21,25]. In this university-based pediatric outpatient clinic, the increase in the ratio of surgical and dental procedures (especially tooth extractions) may be related to this concern, as it was observed concerning preventive, restorative, and endodontic dental procedures, acting as preliminary evidence that before-and-after clinical studies must confirm.

As an important limitation, once secondary data were evaluated, it is important to point out that there was no influence or control over the completion of clinical charts, as an information bias. In addition, no distinction was made between children with and without special needs. Then, the students and lecturers recorded the dental procedures for each pediatric patient exclusively during their clinical activities. Furthermore, the performance of dental procedures acted as a proxy measure for oral health needs, and primary data may help address the oral health status of pediatric patients in the post-COVID-19 pandemic interval.

Conclusion

Dental procedures performed significantly less well after the onset of the COVID-19 pandemic in this university-based pediatric dental outpatient clinic, affecting most types of dental procedures. This reduction occurred immediately (first year) and late at the COVID-19 outbreak (second year). However, there was an

increase in surgical and dental procedures compared to preventive, restorative, and endodontic ones in the second year.

Authors' Contributions

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PNF	https://orcid.org/0000-0001-8802-6480	Formal Analysis, Visualization, and Supervision.
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All authors declare that they contributed to a critical review of intellectual content and approval of the final version to be published.

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None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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