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Original Article

## Pattern of pediatric emergency dental care during COVID-19 pandemic in Saudi Arabia

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## ABSTRACT

**Objective:** At the beginning of the COVID-19 pandemic, it was recommended to provide emergency dental care and avoid aerosol-generating procedures (AGPs) when possible. This study aimed to determine how Saudi Arabian pediatric patients utilized emergency dental services at the national level at the beginning of the COVID-19 pandemic and what situations required an AGP.**Methods:** Data was collected from all Ministry of Health dental facilities in Saudi Arabia between March and May 2020. All pediatric dental patients who received emergency dental care during the COVID-19 lockdown were included in this study.**Results:** The majority of the 1,544 pediatric dental patients who received emergency dental care during this period received treatment for caries (77.9 %). AGPs were predominant in the treatment of urgent dental conditions (51.5 %). About 64 % of cases with pulpal inflammation and 52.4 % with abscesses underwent an AGP.**Conclusion:** Emergency and urgent dental conditions were the main reason for seeking dental care during the pandemic (75.8 %), while only 24.2 % of cases were considered non-urgent. Despite the recommendations, AGPs were required for some urgent conditions to relieve the associated pain, and this comprised 46.8 % of dental treatment provided.

## 1. Introduction

Oral pathogens can negatively affect a child's well-being, especially when they progress into dental abscesses or cellulitis (Agostini et al., 2001). It has been documented that untreated oral infection could cause brain abscesses, pneumonia, or other complications (Asikainen & Alaluusua, 1993; DeStefano et al., 1993; Li et al., 2000). In turn, it might jeopardize the child's general health (Li et al., 2000). The American Dental Association (ADA) defines dental emergencies as potentially life-threatening conditions requiring immediate treatment to stop current tissue damage or to relieve pain or infection (American Dental Association, 2021). This definition underscores the seriousness of dental emergencies (Agostini et al., 2001). Studies have shown that the most

prevalent dental problems in children are caries, abscesses, and trauma (Agostini et al., 2001; Zou et al., 2018). Therefore, it is crucial to understand the severity of these emergencies and develop an appropriate management plan, especially during disasters (Almaghlouth et al., 2020; Beauquis et al., 2021).

In addition, dental clinics are considered a possible place for cross-infection (Ather et al., 2020; Coulthard, 2020). Routine dental procedures, involve the use of rotating instruments that generate large amounts of aerosols from the blood and saliva of patients (Abdelkarim-Elafifi et al., 2021; Peng et al., 2020). These aerosols remain in the dental clinic until they settle on a surface or are inhaled (Sabino-Silva et al., 2020). Therefore, during the COVID-19 pandemic, health organizations worldwide, including the Centers for Disease Control and Prevention

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(CDC) and the ADA (American Dental Association, 2020). ADA recommended limiting dental services to emergency visits and postponing all non-essential dental health care to reduce the exposure of patients and dental personnel to the risk of cross-infection (Peng et al., 2020; Veena et al., 2015). The dentist is required to rely on their professional judgment to decide the appropriate treatment method, especially when using aerosol-generating procedures (AGPs) (Almaghouth et al., 2020; Coulthard, 2020). The national collaborative effort in the Kingdom of Saudi Arabia (KSA) occurred across all sectors consequent to COVID-19 outbreak. One of those efforts is to postpone the use of all dental clinics. At that time, the Saudi Ministry of Health (MOH) offered free emergency dental care regardless of residency status.

Several recent studies regarding the COVID-19 pandemic have been carried out in KSA. One of those studies compared the impact of the COVID-19 pandemic on pediatric dental practice by comparing the patient flow before and after the pandemic in an academic institution (Alamoudi et al., 2022). Another study discussed the practice of dentists and their awareness of the utilization of infection control methods during COVID-19 (Tarakji et al., 2021). Further, Labban et al. assessed dentists' knowledge, attitude, and mental situation during the pandemic (Labban et al., 2021). However, none of those studies reported the actual utilization of pediatric dental patients' emergencies during COVID-19 across KSA. The present study aims to fill this gap by describing pediatric patients' utilization of emergency dental services at the national level during the COVID-19 pandemic in KSA.

## 2. Methods

### 2.1. Study design

This prospective study was conducted between March and May 2020; this period corresponds to the period when routine dental services were suspended. Data regarding emergency dental care provided to pediatric dental patients during this period were collected prospectively from all MOH dental facilities as part of the National Registry for emergency dental care. The study complies with the Declaration of Helsinki as approved by the Institutional Review Board (IRB) at King Fahad Medical City (approval number 20-240E). This nationwide study was also registered at Weqaya, Saudi Center for Disease Control and Prevention (registration number 2020051115). Informed consent was obtained from participants.

At the beginning of the COVID-19 outbreak, the MOH protocol for dental services was to provide only emergency/urgent management (Ministry of Health, 2020a; Ministry of Health, 2020b). The ADA distinguishes between emergency and urgent dental care. Dental emergencies include "uncontrolled bleeding, cellulitis that potentially compromises the patient's airway, and trauma involving facial bones that potentially compromise the patient's airway," while urgent dental care is defined as "the management of conditions that require immediate attention to relieve severe pain and/or risk of infection and to alleviate the burden on hospital emergency departments" (American Dental Association, 2021). The General Directorate of Dentistry in MOH established an online National registry platform to record emergency dental services offered during the pandemic. Data entry was piloted prior to the instigation of data collection.

### 2.2. Data collection

All dental patients (up to the age of 14 years) who received emergency dental care during the COVID-19 lockdown at MOH were included in this study. Fig. 1 illustrates the flow of patients and data collected for the study. Pediatric patients aged 6 years and older were asked to identify the pain severity using the Numeric Rating Scale 11 (NRS-11) (Ferreira-Valente et al., 2011; Ruskin et al., 2014).

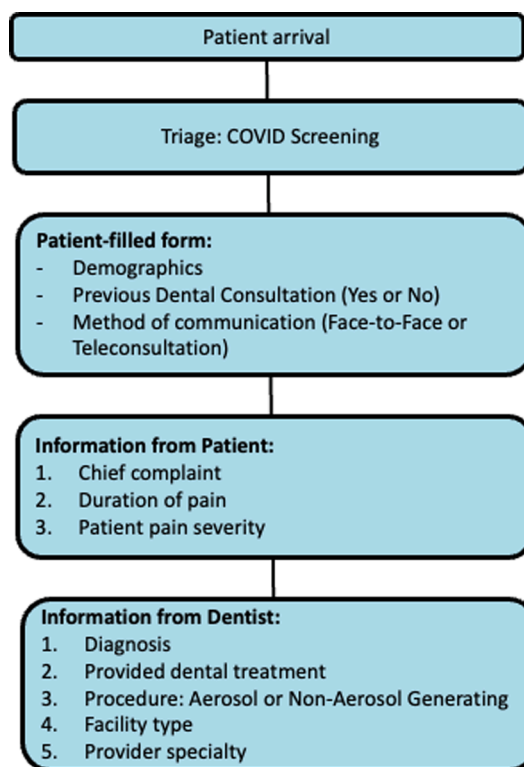


Fig. 1. Flow of patients and data collected for the study.

### 2.3. Statistical analyses

The provision of aerosol versus non-aerosol dental procedures was considered the main dependent variable. Statistical analyses were done using IBM SPSS Statistics (Version 24; Armonk, NY: IBM Corp.). Bivariate analyses were done using the chi-square tests and Mann-Whitney U tests. The pain score and duration were not considered normally distributed according to the Kolmogorov-Smirnov test (P value < 0.001). Odds ratios were calculated for the odds of using AGPs. Logistic regression models were performed to examine the variables associated with the provision of AGPs. A multiple regression model was performed to predict pain intensity. Alpha was set at 0.05.

## 3. Results

In all, 1,544 pediatric dental patients received dental care at MOH facilities during the COVID-19 pandemic. Table 1 presents the characteristics of those pediatric dental patients, and the emergency dental care services they received. The mean age of pediatric dental patients was  $8.3 \pm 3.2$  years (range: 1–14 years). The gender distribution of the participants was nearly equal. Only 4.5 % had used teleconsultation services before coming to the dental health facility.

Urgent dental conditions were the main reason for seeking dental care (73.5 %). There were no significant differences in the number dental services sought by gender. In comparisons of urban versus rural regions, dental services were more likely to be provided by general dental practitioners in urban regions compared to rural regions (Odds Ratio [OR]: 1.7, 95 % CI: 4.2–7.5). Primary care centers provided the most urgent dental treatment (51.2 %), followed by specialized dental centers (41.4 %) and hospitals (7.4 %). Urban residents were more likely to be treated in hospitals than in other health facilities. In contrast, rural residents were more likely to seek treatment in a dental center (OR: 20.2, 95 % CI: 6.4–64.5) or a primary care center (OR: 4.9, 95 % CI: 1.5–15.8) than a hospital. However, the use of teleconsultation prior to visiting the dental facility was similar between urban and rural regions.

**Table 1**  
 Characteristics of pediatric patients and emergency dental care services during the COVID-19 pandemic (N = 1,544).

	Total	Gender		KSA region		P-value
	% (n)	% (n)	Male	Female	Urban	
<b>Age (years)</b>						0.03*
0–3	5.2 % (81)	64.1 % (52)	35.8 % (29)	80.2 % (65)	19.8 % (16)	
3–6	26.4 % (407)	53.3 % (217)	46.7 % (190)	80.8 % (329)	19.2 % (78)	
6–12	56.1 % (866)	48.4 % (419)	58.7 % (447)	80.0 % (693)	20.0 % (173)	
12–14	12.3 % (190)	50.0 % (95)	50.0 % (95)	71.1 % (135)	28.9 % (55)	
<b>Nationality</b>						0.03*
Saudi	98.6 % (1220)	50.2 % (612)	49.8 % (608)	75.6 % (922)	24.4 % (298)	
Non-Saudi	1.4 % (17)	1.6 % (10)	1.1 % (7)	52.9 % (9)	47.1 % (8)	
<b>Contact with COVID-19</b>						0.2
No	99.7 % (1540)	50.6 % (780)	49.4 % (760)	79.2 % (1220)	20.8 % (320)	
Yes	0.3 % (4)	75.0 % (3)	25.0 % (1)	50 % (2)	50 % (2)	
<b>Travel history</b>						0.6
No	99.8 % (1541)	50.7 % (781)	49.3 % (760)	79.2 % (1220)	20.8 % (321)	
Yes	0.2 % (3)	66.7 % (2)	33.3 % (1)	66.7 % (2)	33.3 % (1)	
<b>Fever</b>						0.5
No	99.1 % (1530)	50.5 % (773)	49.5 % (757)	79.1 % (1210)	20.9 % (320)	
Yes	0.9 % (14)	71.4 % (10)	28.6 % (4)	85.7 % (12)	14.3 % (2)	
<b>Cough</b>						0.08
No	99.3 % (1533)	50.8 % (778)	49.2 % (755)	79.0 % (1211)	21.0 % (322)	
Yes	0.7 % (11)	45.5 % (5)	54.5 % (6)	100 % (11)	0 %	
<b>Shortness of breath</b>						0.5
No	99.9 % (1542)	50.8 % (783)	49.2 % (759)	79.1 % (1220)	20.9 % (322)	
Yes	0.1 % (2)	0 %	100 % (2)	100 % (2)	0 %	
<b>Type of facility</b>						<0.0001*
Hospital	7.4 % (114)	60.5 % (69)	39.5 % (45)	97.4 % (111)	2.6 % (3)	
Specialized Dental Center	41.4 % (639)	49.9 % (318)	50.2 % (321)	64.6 % (413)	35.4 % (226)	
Primary dental center	51.2 % (791)	50.1 % (396)	49.9 % (395)	88.2 % (698)	11.8 % (93)	
<b>Provider specialty</b>						<0.0001*
General practitioner	60.4 % (732)	60.4 % (732)	60.4 % (732)	60.4 % (732)	11.3 % (83)	
Specialist/Consultant	39.6 % (479)	39.6 % (479)	39.6 % (479)	39.6 % (479)	41.8 % (200)	
<b>Teleconsultation</b>						0.8
No	95.5 % (1475)	51.1 % (753)	48.9 % (722)	79.2 % (1168)	20.8 % (307)	
Yes	4.5 % (69)	43.5 % (30)	56.5 % (39)	78.3 % (54)	21.7 % (15)	
<b>Degree of urgency</b>						0.3
Emergency	2.0 % (16)	44.4 % (16)	55.6 % (20)	88.9 % (32)	11.1 % (4)	
Urgent	74.8 % (586)	51.6 % (586)	48.4 % (549)	78.9 % (896)	21.1 % (239)	
Non-urgent	23.1 % (181)	48.5 % (181)	51.5 % (192)	79.1 % (294)	20.9 % (79)	

\*P- value of chi-square tests comparing urban versus rural regions.

Most cases were due to caries (77.9 %), while 3.6 % were due to trauma. The most common dental conditions among pediatric patients seeking emergency dental care during the pandemic were pulpal involvement (40 %) and abscess of dental origin (29.6 %)- as shown in Fig. 2A. Cases of pulpal inflammation and abscesses, however, were least common among the 0–3-year-old age group (4.1 %). Dental trauma was most common in the 6–12-year age group (47.3 %), followed by the 0–3-year age group (27.3 %). The majority of dental trauma cases were among males (60 %), and most trauma cases were among urban children (80 %). The top three types of treatment provided were initial pulpal involvement treatment (37.6 %), extraction (22.7 %), and prescription of medications (22.8 %; Fig. 2B).

AGPs were most common in urgent dental treatment (51.5 %), followed by non-urgent dental services (35.3 %) and emergency dental services (11.1 %). An AGP was used in around 64 % of pulpal inflammation cases and 52.4 % of abscess cases. Pediatric dental patients who received dental care due to trauma (OR: 11.9, 95 % CI: 4.3–33.2) or swelling (OR: 1.7, 95 % CI: 1.4–2.2) were more likely to be treated using non-AGPs. Dental treatment in hospitals had twice the odds of using non-AGPs compared to other facilities (OR: 2.1, 95 % CI: 1.4–3.2). Table 2 summarizes adjusted ORs from the multiple logistic regression models predicting aerosol-producing procedures while controlling for possible confounders (logistic regression model P value < 0.001). Urgent (OR: 8.8) and non-urgent dental conditions (OR: 4.6) had significantly higher odds of needing AGP than emergency dental conditions. Fig. 3 shows the proportion of aerosol versus non-aerosol procedures in dental services according to dental diagnosis. The top three dental

conditions that required AGPs were traumatic occlusion (100 %), pulpal inflammation (63.5 %), and abscesses (52.4 %).

The mean pain intensity (NRS-11) reported by pediatric dental patients above the age of 6 years was 7 (1.5). Both female and male pediatric patients reported similar pain intensity. The mean NRS-11 was lower for the group aged 6–12 years (NRS 6.9) compared to older age groups (NRS 7.2). Age was weakly associated with pain intensity (correlation coefficient 0.1, P value < 0.001). Rural pediatric patients reported significantly higher pain intensity than those living in urban regions (Table 3). Parents reported mean pain durations of 4.2 (4.6) days before seeking emergency dental care. No significant differences in gender or region were observed for pain duration.

#### 4. Discussion

This descriptive study aimed to elaborate on the utilization of emergency dental services by pediatric patients during the COVID-19 pandemic in Saudi Arabia. About 77.9 % of emergency dental complaints were due to caries. Children aged 6–12 years old were the most common age group to seek dental emergency services. Moreover, nearly one quarter of children sought dental services for non-urgent complaints. Pediatric dental patients in hospitals were more likely to be treated using non-AGPs than in other facilities. In addition, they presented with high pain intensity (mean NRS-11 score = 7).

The most common emergency dental conditions encountered were pulpal inflammation and dental abscess, this finding is similar to previous studies (Guo et al., 2020; Ladrillo et al., 2006; Naidu et al., 2005).

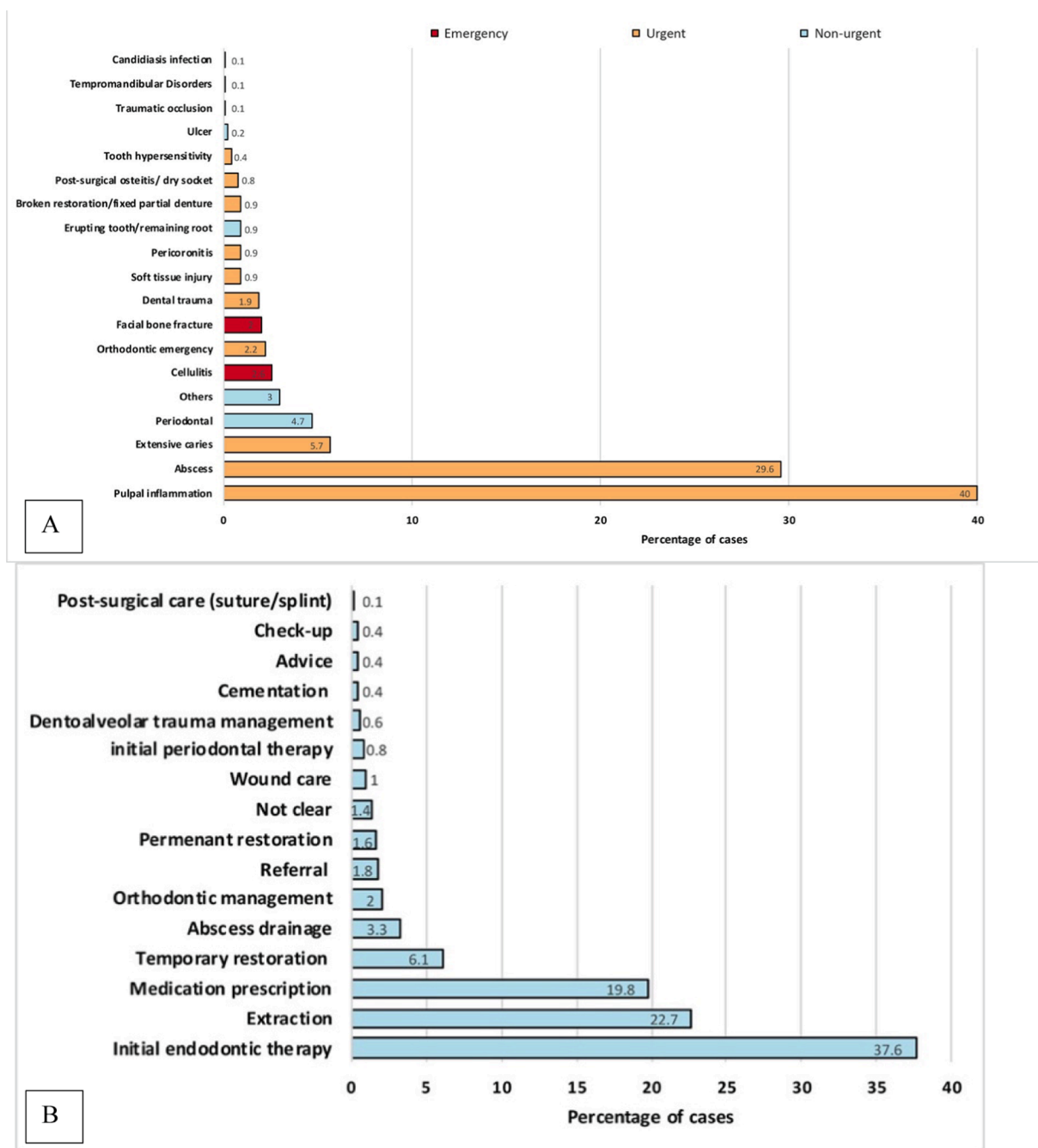


Fig. 2. Frequency of dental conditions (A) and dental treatment received (B) by pediatric dental patients during the COVID-19 pandemic (N = 1,544).

In contrast, a 2-year study in Taiwan showed that dental trauma was the most common dental emergency among children, with pulpal-associated problems being the second most common reason (Jung et al., 2016). Furthermore, the present study found the frequency of children who presented with a history of trauma (3.6 %) was much less than previous studies (Mahmoodi et al., 2015; Martens et al., 2018; Naidu et al., 2005). This current finding is parallel to a recent study that presented reduced cases of dental trauma during the COVID-19 pandemic period, which could be due to the decrease in outdoor activities (Guo et al., 2020).

In the current study, different age groups sought dental emergency services for different reasons. It was found that 6- to 12-year-olds were the age group that most frequently sought emergency dental treatment due to pulpal inflammation or dental abscess. Martens et al. reported similar results, that emergency care was utilized most by children in the 6–12-year age group (Martens et al., 2018). Moreover, in this study,

about one-half of dental trauma cases were in the 6–12-year age group, followed by the 0–3 age group for about a quarter of the cases. Whereas previous studies reported the most frequent age group to present with dental trauma was under five years (Jung et al., 2016; Martens et al., 2018; Zeng et al., 1994). Another study reported that trauma cases peak between 0 and 9 years, accounting for 50 % of trauma cases (Mahmoodi et al., 2015). As expected, dental trauma cases in this study occurred in male children in 60 % of the cases. Previous studies have consistently reported that dental trauma is more likely to occur in boys than girls (Hall et al., 2016; Jung et al., 2016; Martens et al., 2018).

When comparing utilization according to type of facility, we found significant differences among primary dental centers, specialized dental centers, and hospitals. The proportion of pediatric patients who visited the hospitals was only 7.4 %, compared to specialized dental centers (41.4 %) and primary dental centers (51.2 %). This was anticipated since

**Table 2**  
Aerosol versus non-aerosol procedures for urgent dental services provided to pediatric patients during COVID-19 in Saudi Arabia.

	Non-aerosol % (n)	Aerosol % (n)	P-value	Adjusted Odds Ratio (95 % CI)
<b>Age (years)</b>			0.002*	
0–3	64.1 % (50)	35.9 % (28)		Reference
3–6	49.0 % (197)	51.0 % (205)		2.0 (1.2–3.2)
6–12	57.3 % (367)	42.7 % (273)		1.4 (0.9–2.3)
12–14	48.5 % (195)	51.5 % (207)		2.1 (1.3–3.5)
<b>Type of facility</b>			0.001*	
Hospital	69.3 % (79)	30.7 % (35)		Reference
Specialized Dental Center	50 % (312)	50 % (312)		2.3 (1.5–3.5)*
Primary Dental Center	53.3 % (418)	46.7 % (366)		2.1(1.3–5.5)*
<b>Degree of urgency</b>			0.001*	
Emergency	88.9 % (32)	11.1 % (4)		Reference
Urgent	48.5 % (550)	51.5 % (585)		8.8 (3.1–25.1)*
Non-urgent	64.7 % (227)	35.3 % (124)		4.6 (1.6–13.1)*

P-value of chi-square tests.

Adjusted odds ratio from logistic regression model.

\*Indicates statistical significance.

primary health care centers are located in each district and are thus more accessible than hospitals. Notably, dental care at emergency departments in hospitals is usually limited to medication prescriptions for dental pain and abscesses (Cyrkin et al., 2020; Mallineni et al., 2020).

In the present study, the specialty of the clinician differed significantly between rural and urban regions, with general dentists responsible for most emergency dental treatment in urban areas. One explanation may be that urban areas have more primary care centers

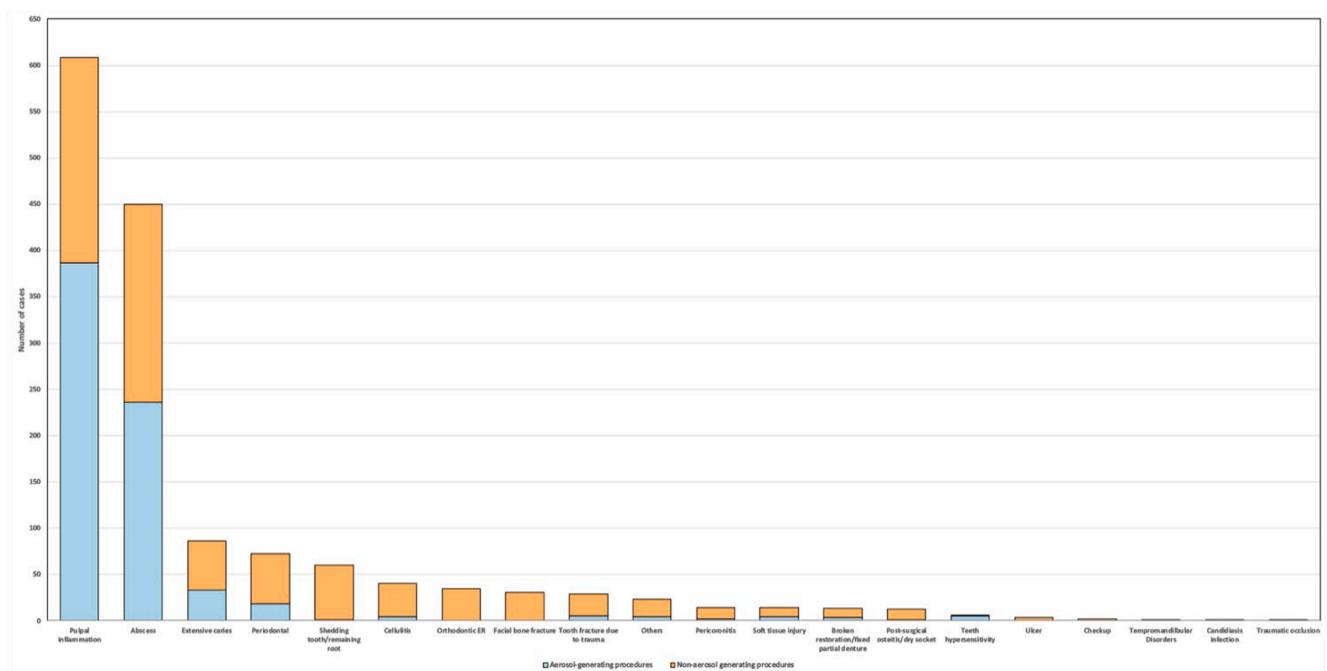
than rural areas, and the main workforce in primary care centers is comprised of general practitioners. Also, hospitals have more general dentists than specialists or consultants. Another explanation could be that in urban regions, general dentists in specialized dental centers and hospitals provide care work under the supervision of dental consultants, while dental clinics in rural regions usually have only one dental care provider.

One-quarter of the children in the present study presented with non-urgent complaints, while a recent study carried out in China reported that non-urgent cases comprised 5.4 % of dental emergency visits during this pandemic (Guo et al., 2020). This finding parallels several previous retrospective studies, which reported that of all dental emergencies, non-urgent conditions made up 16.3 %–59.9 % (Agostini et al., 2001; Cyrkin et al., 2020; Martens et al., 2018; Yang et al., 2021). This pattern of dental emergency clinic utilization for non-emergency conditions could reflect the attitude and desire of parents for immediate dental care (Prasad et al., 2019). According to Jung and coworkers, the use of non-urgent cases in dental emergencies might indicate “abuse of the health care system” (Jung et al., 2016). It is noteworthy that 78.8 % of those non-urgent cases were treated in urban cities, where general dental practitioners worked most. Taken together, the notion of developing a validated screening approach for identifying actual emergency cases is

**Table 3**  
Pain threshold based on 1,544 pediatric patients who received emergency dental care during COVID-19 pandemic.

	Mean ± SD	Median	P-value	B (95 % CI for B)
<b>Age (years)</b>			0.01*	
6–10	6.9 ± 1.4	7		Reference
10–14	7.1 ± 1.4	7		0.05 (0.01–0.09)*
<b>Gender</b>			0.2	
Male	7.1 ± 1.4	7		Reference
Female	6.9 ± 1.4	7		–0.1 (–0.3–0.03)
<b>KSA Region</b>			>0.000.1*	
Urban: >1 M	6.8 ± 1.4	7		Reference
Rural: < 1 M	7.5 ± 1.5	7		0.7 (0.5–0.9) *

B: Standardized coefficient of multiple regression, CI: Confidence Interval.  
\*: Significance according to the Mann-Whitney U test.



**Fig. 3.** Proportion of aerosol-generating procedures versus non-aerosol procedures based on the dental condition presented for pediatric emergency dental care during COVID-19.



crucial.

In the present study, all pediatric patients presented with high pain intensity (mean NRS-11 score = 7). Also, parents waited about 4 days before seeking urgent dental care. This finding is comparable with a study that reported the same mean pain score, but a waiting time of 6 days before seeking dental emergency care (Haug & Marthinussen, 2019). Interestingly, in Ohio an 18-day delay in seeking child dental care was reported (Thikkurissy et al., 2012). All pediatric patients in the present study reported the presence of pain. Martens et al. found that only 96.7 % of pediatric dental emergency cases reported pain (Martens et al., 2018). This slight difference could be expected since the population is discouraged from seeking dental care unnecessarily during the COVID-19 outbreak.

This national study offers several strengths. One strength is prospective data collection through the national database registry. Another strength is showing how pediatric patients utilize emergency dental care in the Saudi main healthcare sector, which typically provides 60 % of healthcare services at the national level (Almalki et al., 2011). Categorizing dental conditions in accordance with ADA guidelines allows comparison with international standards is another strength.

The present study has several limitations. The use of a self-reported scale with pediatric patients, the NRS-11, might be viewed as one limitation. Another limitation is the possibility of misclassification bias in the diagnosis of dental conditions since the dental care provider was responsible for data entry in each facility. However, one could argue that dental conditions here were reported under broad categories and pre-data collection training was provided. Therefore, this type of bias is not worrisome. Furthermore, the utilization of teleconsultation for emergency dental conditions could not be fully evaluated as data for cases managed solely by teleconsultation were unavailable for the present study. Understanding the pattern of pediatric emergency dental care utilization could be the basis for planning for the future. The generalizability of the results of the present study may be limited to contexts with similar healthcare settings – provision of free dental care – with similar caries prevalence.

## 5. Conclusions

The present study concluded that emergency and urgent dental conditions were the main reasons for seeking dental care during the pandemic (75.8 %). Emergency dental care provided during the COVID-19 outbreak was mainly to children who suffered from pain due to pulpal inflammation, dental abscess, and trauma. Participants reported high pain intensity before seeking dental care during this outbreak. Despite the recommendations, AGPs were inevitable in many urgent dental conditions to relieve the associated pain and comprised 46.8 % of the provided dental treatment. Nearly one-fourth of the participants utilized dental care for non-urgent conditions, which warrants further research.

## CRedit authorship contribution statement

**Dalia E. Meisha:** Conceptualization, Data curation, Writing – original draft, Visualization, Formal analysis, Methodology. **Amal Al-Khotani:** Conceptualization, Data curation, Writing – original draft, Methodology. **Sultana A. Alhurishi:** Conceptualization, Data curation, Writing – original draft, Methodology. **Moatazbellah M. Alruwaithi:** Writing – review & editing, Project administration. **Saud M. Orfali:** Writing – review & editing, Methodology, Project administration. **Haila A. Al-Huraisi:** Conceptualization, Data curation, Writing – original draft, Methodology, Project administration.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

the work reported in this paper.

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