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Changes in paediatric dental clinic after reopening during COVID-19 pandemic in Wuhan: A retrospective study

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Keywords: COVID-19; Paediatric oral & maxillofacial surgery; Public Health

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Abstract

Objectives: Affected by COVID-19 pandemic, The Department of Paediatric Dentistry of School and Hospital of Stomatology, Wuhan University was closed in late January, 2020, and resumed on April 20. Our study aimed to explore the effects of COVID-19 pandemic on paediatric dental services which may assist global paediatric dentists to build confidence and make appropriate policies under the pandemic.

Design: A retrospective study was performed. Medical records of patients were retrieved but without any private information, including patient name, ID number and address.

Participants: All data of the patients from April 20 to July 31 in 2020 and 2019 was extracted and analyzed including demographics, dental diagnosis, and treatment methods. A total of 18,198 patients were included in the study.

Results: During this period, no medical staff or patient was infected with COVID-19 due to dental services. A total of 6,485 this year but 11,713 during the same period last year visited the department. Compared with 2019, gender distribution did not change, but age distribution changed with an increase under 6-year-old. The diagnoses including caries, retained primary teeth, malocclusion, deep pits and fissures changed significantly, while pulpitis, apical periodontitis, tooth trauma, early loss of primary teeth, supernumerary teeth showed little change. Aerosol Generating Procedures were adopted less frequently overall in this period.

Conclusions: The reopening of paediatric dental services is proceeding steadily with significant changes in the characteristics of the patients and treatment procedures.

Strengths and limitations of this study

1. Strength: Our measures and success to prevent and control the COVID-19 transmission at the paediatric dental clinic may help global paediatric dental healthcare workers build confidence to make appropriate policies and provide high-quality dental services during the evolving COVID-19 pandemic.

2. Limitation: This paper only analyzed and shared the patients and treatment procedures of a specific department in our hospital, which may not be applicable to some countries or areas with different pandemic situations.

Introduction

In December 2019, COVID-19 emerged in Wuhan and has spread rapidly across the globe and become a major public health challenge for countries around the world.[1] The COVID-19 pandemic leads to a high fatality rate up to 5.5%.[2,3] A novel highly infectious Corona RNA virus (named SARS-Cov-2) is responsible for the COVID-19, which can transmit via droplets or direct contact with infected people or contaminated surfaces.[4] Due to the transmission routes of COVID-19, many high-contact professions including dentistry have been severely affected.[5] Dental healthcare professionals work in close proximity to patients. And most dental procedures are AGPs (Aerosol Generating Procedures) which can cause a large number of droplets and aerosols, such as use of a high-speed or low-speed handpieces, ultrasonic instruments, and water-air syringes.[6-9] The unique characteristics of dentistry made the standard protective measures not sufficient to prevent the spread of COVID-19, especially when patients are in the incubation period, or unaware they are

infected.[7] Therefore, among healthcare personnel, dentists are at an elevated risk of exposure to COVID-19. This risk is even more serious in paediatric dentistry, because affected children frequently present asymptomatic, mild, or moderate clinical manifestations.[10-12] To prevent and control transmission of COVID-19, Wuhan city was locked down on January 23. On the second day, Hubei province activated level 1 response to public health emergencies. Then all elective treatments to dental patients in Wuhan city were postponed and only emergency dental care can be sought.[13,14]

The Department of Paediatric Dentistry in WHUSS (School and Hospital of Stomatology, Wuhan University) is the main center for the routine treatment and care for children's dental diseases in Wuhan. This department provided dental care to around 36,000 children last year. From January 24 to April 19, 2020, clinical procedures of this department were completely stopped. During this period, online consultations and oral health instructions were provided, and severe dental emergencies were recommended to the General and Emergency Department in WHUSS, which was the only available department in WHUSS special for emergency dental services.[14] Although it is important to provide treatment for children who present with urgent or emergency dental complaints, dental non-emergencies that failed to receive immediate intervention were at an increased risk to develop infection and even subsequent urgent or emergent complications. Therefore, the contradiction between the huge paediatric demands and the limited dental service increased after closure of the Department of Paediatric Dentistry.[6,9,13] After being imposed a lockdown for as long as 76 days, Wuhan city has successfully contained the spread of this virus. On April 8, all travel restrictions in and out of Wuhan was removed.[15] On April

20, the Paediatric Department of WHUSS was reopened and aimed to improve children's oral health care.

Similar to Wuhan in China, paediatric dental treatments have been completely stopped or significantly decreased in several affected countries.[6,16-18] Paediatric Dentistry is essential children's health care. During this evolving and unprecedented COVID-19 pandemic period, it is an important issue to get a balance between prevention of potential exposure to SARS-CoV-2 infection and minimization of the harm to patients from postponed dental care.[16,18] New protocols and measures are needed as dental professionals return to normal practice after weeks or months of confinement in many countries. Some articles have discussed the management of dental practice during the COVID-19 pandemic,[3,5,6] but few articles explored the situation and changes after the recovery of dental clinics based on large sample data.

In this study, we collected the data of the patients from April 20 to July 31 this year and the corresponding period in 2019 to analyze the impact of the COVID-19 pandemic on the children's dental care. We also shared our experience on restructuring the patient pathway and workflow of healthcare personnel.

Methods

Inclusion and exclusion criteria

The information of the patients who visited the Department of Paediatric Dentistry, WHUSS from April 20 to July 31 in 2020 and the corresponding period in 2019 were retrieved, and

compared (All private information was not been extracted, including patient name, ID number and address). Any medical record had one or even more information missing was excluded.

Patient and Public Involvement

The study protocol was approved by the Ethics Committee of WHUSS (No. 2020-B70). Reporting of the study follows the STROBE guidelines. Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research

Workflow of the dental practice personnel

In order to ensure safety after reopening of the hospital, a series of measures have been applied among medical staff which mainly included: nucleic acid testing for all before reopening, personal protection training for employees, adequate provision of personal protective equipment, and a complete clinic management system. Please refer to the supplementary materials for details.

Patient pathway for paediatric dental services

During the pandemic, WHUSS and Paediatric Dentistry formulated protocols to prevent nosocomial infections of COVID-19. These measures include: online appointment system, medical history collection of COVID-19, body temperature monitoring, provision of nucleic acid reports, et al. Please refer to the supplementary materials for details. The questionnaires for COVID-19 are shown on Appendix Table 1 and 2.

Data collection and management

Data collection included number and demographic information of visited children (age and gender), their diagnosis, and treatment options provided by dentists. Data associated with COVID-19 was obtained from the government.[19]

All data was classified according to specific standards. Age was divided into 4 groups: 0-3 years old, 4-6 years old, 7-12 years old, 13 years old and above. For the diagnosis of children, nine common diseases were listed while some uncommon diseases such as traumatic ulcer, central cusp, gingivitis were grouped into Other. Treatments were divided into Oral Health Consultation group (They received a comprehensive oral examination and oral health instruction without any dental procedures) and Oral Health Consultation & Treatment group. The latter group was further divided into AGP Treatment Group and Non-AGP Treatment Group according to whether any AGP procedure was used.

Figure drawing and statistical analysis

The data was entered into Excel 2019 (Microsoft corporation, Redmon, Washington, USA) and imported into SPSS 25.0 (IBM Corporation, Armonk, New York, USA) for statistical analysis. Figures were drawn by Excel. Pearson chi-square test was used to verify the difference of categorical variables. Significance levels were set as $P<0.05$ using any test.

Results

The overall recovery process of the department of paediatric dentistry in WHUSS

From April 20 to July 31, a total of 2 medical staff experienced fever symptoms. Their test reports on nucleic acid of SARS-Cov-2 were both negative and were diagnosed as influenza instead of COVID-19. As of July 31, no medical staff or patient had contracted COVID-19 due to medical services.

The trend of COVID-19 pandemic in Wuhan (January 23 to July 31, 2020) is shown in Figure 1. The number of daily visits from the reopening day to July 31, 2020 (the blue line) and during the corresponding period in 2019 (the orange line) were retrieved. The daily visits in 2019 were at a comparably stable level and pattern. In 2020, the number of visits remained very low in the early recovery stage (late April), and gradually increased in the first fifteen days of May. Since late May, the number of the patients reached a relatively stable level, around 60%-80% of the same period in 2019.

Changes in the basic information of the children visiting WHUSS

To further understand the possible changes of the patients' characteristics, basic information of the children who visited the Department of Paediatric Dentistry in WHUSS was obtained. Table 1 shows their gender and age distribution. No significant difference was found in the gender distribution between 2019 and 2020. But a significant difference was seen in the age distribution with an increase of the children under 6 years old (0-3 and 4-6 years old groups) but a decrease of the elder children in 2020.

Changes in the diagnoses of the children visiting WHUSS

The disease diagnoses of the visited children in 2020 are shown in Table 2. Comparison among the four months within 2020, the diagnosis of Retained Primary Teeth declined month by month. However, compared to the total patients in 2019, the COVID-19 pandemic has led to a significant increase of Retained Primary Teeth. Meanwhile, significant impacts of COVID-19 on the proportion of Dental Caries, Malocclusion, and Deep Pits & Fissures were also seen, with an increase in the first diagnosis but decreases in the latter two. The detailed diagnoses for patients in 2019 are shown in Appendix Table 3.

Changes in the treatment operations

In order to analyze the impact of COVID-19 on the implement of dental treatment operations, the data were further collected and shown in Table 3. On the whole, a higher proportion of children left the hospital after receiving oral health consultations only in 2020. But from April to July, the proportion of children undergoing treatment operations was increasing while in 2019 the ratio between these two groups was stable. By comparing the same month of 2019 and 2020, it can be found that there were significant differences in April, May, and June, but there was no significant difference in July.

Considering the high risks of AGP for COVID-19 transmission, the Oral Health Consultation & Treatment group was classified into two groups according to whether any AGP was used (Table 4). Comparison between 2019 and 2020 showed that the proportion of AGP operations dropped and non-AGP treatment increased in 2020. Among April to July in 2020, the proportion of AGP treatment showed an obvious increase month by month,

but still at a lower level than the corresponding month of 2019.

Paediatric dental clinic provides all oral health care for children and adolescents which includes extensive procedures. Some representative treatment methods were selected and percentages of these treatment methods were calculated. The average number of teeth treated during a single visit was also displayed in Appendix Figure 1.

Discussions

After Wuhan City experienced the COVID-19 pandemic attack, a huge impact has been brought to the medical industry including dental care service. To explore the changes of paediatric dental services during the pandemic, the information of children who visited the Department of Paediatric Dentistry of WHUSS including gender, age, diagnoses, and treatment options they received was extracted. By comparing with the same period last year, we found that the COVID-19 pandemic had an impact on the policies of dental hospitals and clinics, the distribution of children's age and oral diseases, as well as the treatment operations to the patients.

After the Department of Paediatric Dentistry of WHUSS resumed outpatient service on April 20, both the hospital and the department took a series of measures to prevent COVID-19 infections and ensure the safety of medical staff and patients. These measures included: changes in the appointment system from a combination of on-site and online to online only; Strict verification of identification information before entering the hospital and clinic area; Collection of epidemiological information related to COVID-19 of each patient;

and Perfect classified diagnosis and treatment system et al.[20-23] All the above measures and workflow for dentists, pathway for patients (Supplemental Materials and Methods) ensured the recovery process of the Department of Paediatric Dentistry of WHUSS to be promoted steadily, and created a feat of zero COVID-19 infection in our department during the pandemic.

Regarding the number of visits, the average daily visits at the end of April 2020 was less than 20, while the number last year was over 80. This might be due to the fact that there were fewer dentists at work in the first week. With the increase of dentists at work, the number of visits also gradually increased. In the early first half of May, the average daily visits reached nearly 50, returning to 60% of the same period last year. Starting from late May, the number of visits has gradually tended to be stable. The average number of daily visits in May and June was around 60. Although failing to fully return to the level of the same period last year, the number of daily visits showed a steady increase. Therefore, under the premise of transmission control, we were trying to provide paediatric dental services to more patients during the period investigated.

The COVID-19 pandemic did not change the gender distribution of the patients, but significantly influenced their age distribution. A significant increase can be seen in the children at younger ages (0-6 years old), which may be attributed to the following aspects. Some parents complained that due to the community blockade, children stayed at home all day and felt upset by losing outdoor activities, and candies were sometimes used to make them happy. In addition, compared to be at school, the children were easier to access foods and eat more frequently at home.[24] Coupled with poor self-control and poor oral

cleaning, young children were more prone to dental diseases.[25,26] The above factors may also contribute to the higher percentage of Dental Caries diagnosis in 2020 than 2019.

From late January to April 19, WHUSS only reserved emergency department and provided emergency oral treatment services.[14] If children underwent an urgent situation (including apical periodontitis, pulpitis, dental trauma et al.), timely treatments were able to be accessed in the emergency department. This may explain why percentages of apical periodontitis, pulpitis, and overall dental trauma during the investigated period showed no significant changes compared to 2019. And as a non-urgent condition, retained primary teeth and dental caries increased greatly in the first two months in 2020.

Comparing the data between the same month in two years, a decrease for dental trauma could be found in 2020 (April to June), which may be attributed to reduced outdoor activities. Although community blockade was canceled at the end of March, educational institutions especially kindergartens and elementary schools did not return to work at that time. To avoid the possibility of infection, most children were required to stay at home and go out less frequently by their caregivers.[26,27] In Wuhan, China, summer vacation usually starts from early July. It can be found that for 2019, the percentage of dental trauma in July also reduced greatly. Over the years, during the summer vacation, playground activities have been reduced which decreased the danger for dental trauma. At the same time, more parents will bring their children to the hospital to treat malocclusion and receive pit and fissure sealing treatment. Therefore, some diagnoses and also treatments fluctuated to a certain extent in July 2019. However, due to the COVID-19 pandemic, there were relatively few fluctuations in 2020.

For dentists, COVID-19 pandemic has caused major changes in their treatment concepts, breaking the original routines.[5-7] Especially in late April when the outpatient service just recovered, more than half of the children did not receive any operation in the initial appointment, while this data stabilized at about 28% last year. In addition, some parents or caregivers were also worried about the risk of COVID-19 infection by AGP, so they refused to receive any treatment for their children but dental health consultation. With the resumption process proceeding in an orderly manner, the concerns of both dentists and parents decreased, so more dentists and parents were willing to receive AGP till the end of July.

Many current guidelines recommend minimizing the use of AGP,[7,9,28,29] but non-AGP operations cannot solve some common dental diseases, such as endodontic treatments for pulpitis. Taking into account the complexity of children's oral diseases and their limited ability of oral hygiene control, failing to intervene in time will worsen the diseases and eventually make more complicated treatments necessary. In the end of April after reopening, we tried a small number of AGP operations (10 cases). Gradually, we have expanded the proportion of such attempts, reaching nearly 30% in May, which was increased month by month, finally reaching a level similar to the same period last year in July. Nevertheless, since the global pandemic has not yet been eliminated, the possibility of a recurrence of COVID-19 in Wuhan cannot be ruled out. Some medical staff hold the view that preventive measures must also be paid attention to such as fluoride anti-caries treatment.[30] The application of fluoride can effectively prevent dental caries, which will reduce the probability of these children suffering from dental caries in the future and reduce

their visits to the hospital.[25]

As a retrospective report, we have extracted and classified the data of the 4 months since the reopening of dental healthcare work in the Paediatric Dentistry of WHUSS. In-depth comparisons were conducted from three aspects, namely: comparison within 2019, comparison within 2020, and comparison between 2019 and 2020. In 2019, the data was mostly stable, and the dentists' treatment choice was directly determined by the patient's disease diagnosis, with no extra factors to worry about. The only fluctuation came from the summer vacation in July as discussed above. However, in 2020, a large amount of changes happened. When dentists just returned to work on April, most of them tried to avoid AGP operations while parents also refused to take their children to hospital when it was not urgent enough regarding the danger of hospital environment. In this exploratory period, the attitudes of dentists and patients were relatively conservative. At the end of May, Wuhan City carried out nucleic acid tests on all citizens, which gave both dentists and patients incentives. The numbers of dentists at work, visited patients, patients treated and patients receiving AGP have all increased. This phenomenon was more significant from May to June. When entering July, after the first three months of exploration, the concepts of both dentists and patients have become stable. This month-to-month change has begun to shrink, approaching the degree compared with the same month in 2019. The overall reopening process has achieved phased success.

Conclusion

The COVID-19 pandemic has indeed brought an impact on children's dental care. Under this attack, lower visit number as well as younger age distribution can be found. And AGP operations were used less frequently. Our department resumed medical service at the end of April, without any example to follow. Through the efforts of various departments of the hospital, plans and medical procedures have been formulated. Looking back at our reopening process, it cannot be perfect enough, but it is still satisfactory. Our experience may help global paediatric dental healthcare workers build confidence and make appropriate policies for resuming high-quality dental services during COVID-19 pandemic.

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Interests statement

The authors declare no potential conflicts of interest with respect to the authorship and/or publication of this article.

Author contributions

J. Yang, contributed to design, data acquisition and analysis, drafted manuscript and critically revised manuscript.

G. Yang, contributed to design, interpretation, drafted manuscript and critically revised

manuscript.

R. Jin contributed to design, drafted manuscript and critically revised manuscript.

G. Song contributed to conception, data acquisition and critically revised manuscript.

G. Yuan contributed to conception and design, analysis and interpretation, drafted manuscript and critically revised manuscript.

All authors gave their final approval and agreement to be accountable for all aspects of the work.

Data sharing statement

Data including detailed medical record without any private information is available upon reasonable request through email by corresponding author: yuanguohua@whu.edu.cn.

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Table 1. Gender and age distribution of the children who visited the Department of Paediatric Dentistry in WHUSS from April 20 and July 31 in 2019 and 2020.

	2020 (n=6485)	2019 (n=11713)
Gender [a]		
Male	3429 (52.88%)	6280 (53.62%)
Female	3056 (47.12%)	5433 (46.38%)
Age [b*]		
0-3 years old	718 (11.07%)	593 (5.06%)
4-6 years old	2745 (42.33%)	4152 (35.45%)
7-12 years old	2839 (43.78%)	6229 (53.18%)
13 years old and above	183 (2.82%)	739 (6.31%)

a: There is no significant difference of the gender of the children between 2019 and 2020 using Pearson Chi-square test ($\chi 2=0.918$, $P=0.338>0.05$).

b*: The age distribution between 2019 and 2020 was significantly different with an obvious increase of the children under 6 years old (0-3 and 4-6 years old group) and a decrease of the children above 7 years old in 2020 using Pearson Chi-square test ($\chi 2=435.590$, $P<0.001$).

Table 2. The changes in the patients' diagnoses from April 20 and July 31 in 2020. Nine common diagnoses were listed in the table. Other uncommon diagnoses were classified as "Other".

	Apr 2020	May 2020	Jun 2020	Jul 2020	Total in 2020	Total in 2019
Caries	49	586	577	836	2048	3388
a b*	(30.82%)	(31.19%)	(31.97%)	(31.64%)	(31.58%)	(28.93%)
Pulpitis	8	151	171	257	587	1144
a b	(5.03%)	(8.04%)	(9.47%)	(9.73%)	(9.05%)	(9.77%)
Apical Periodontitis	36	412	407	596	1451	2620
a b	(22.64%)	(21.93%)	(22.55%)	(22.56%)	(22.37%)	(22.37%)
Retained Primary Teeth	30	286	184	236	736	1010
a* b*	(18.87%)	(15.22%)	(10.19%)	(8.93%)	(11.35%)	(8.62%)
Malocclusion	13	159	145	229	546	1128
a b*	(8.18%)	(8.46%)	(8.03%)	(8.66%)	(8.42%)	(9.63%)
Tooth Trauma	5	68	68	104	245	711
a b	(3.14%)	(3.62%)	(3.77%)	(3.94%)	(3.78%)	(6.07%)
Early Loss of Primary teeth	5	52	49	74	180	322
a b	(3.14%)	(2.77%)	(2.72%)	(2.80%)	(2.78%)	(2.75%)
Deep Pits and Fissures	3	26	28	45	102	255
a b*	(1.89%)	(1.38%)	(1.55%)	(1.70%)	(1.57%)	(2.18%)
Supernumerary Teeth	4	57	47	72	180	312
a b	(2.52%)	(3.03%)	(2.60%)	(2.73%)	(2.78%)	(2.66%)
Other	6	82	129	193	410	823
a* b	(3.77%)	(4.36%)	(7.15%)	(7.31%)	(6.32%)	(7.03%)
Total	159	1879	1805	2642	6485	11713

a: Comparison among the four months within 2020.

b: Comparison of the patients' diagnoses between the total period in 2020 and 2019.

The asterisks (*) represent significant difference using Pearson Chi-square test ($P<0.05$). The monthly diagnoses in 2019 were shown in supplemental material.

Table 3. All visits were grouped into Oral health consultation group and Oral health consultation & Treatment group according to whether treatment operation(s) was adopted.

Time a* b c*	Total visits	Oral health consultation only (Percentage)	Oral health consultation & Treatment (Percentage)	P value
April 2020	159	81 (50.94%)	78 (49.06%)	P<0.001*
April 2019	1129	332 (30.92%)	797 (69.08%)	
May 2020	1879	581 (34.46%)	1298 (65.54%)	P=0.006*
May 2019	3205	876 (27.48%)	2329 (72.52%)	
June 2020	1805	622 (29.41%)	1183 (70.59%)	P<0.001*
June 2019	3111	898 (27.33%)	2213 (72.67%)	
July 2020	2642	726 (28.87%)	1916 (71.13%)	P=0.511
July 2019	4268	1204 (28.21%)	3064 (71.79%)	

a*: A significant difference was seen among the four months within 2020 (Pearson Chi-square test, $\chi 2=54.989$, P<0.001).

b: There is no significant difference among the four months within 2019 (Pearson Chi-square test, $\chi 2=2.660$, P=0.447>0.05).

c*: There is a significant difference between the total amount (Apr 20 to July 31) of each group in 2019 and 2020 using Pearson Chi-square test ($\chi 2=15.097$, P<0.001).

Table 4. The patients treated by dental procedures were classified into two groups according to whether any AGP was used.

Time a* b c*	Treated patients	AGP treatment (Percentage)	Non-AGP treatment (Percentage)	P value
Apr 2020	78	10 (12.82%)	68 (87.18%)	P＜0.001
Apr 2019	797	504 (63.23%)	293 (36.76%)	
May 2020	1298	383 (29.51%)	915 (70.49%)	P＜0.001
May 2019	2329	1387 (59.55%)	942 (40.45%)	
June 2020	1183	603 (50.97%)	580 (49.03%)	P＜0.001
June 2019	2213	1310 (59.20%)	903 (40.80%)	
July 2020	1916	1010 (52.71%)	906 (47.29%)	P＜0.001
July 2019	3064	1883 (61.46%)	1181 (38.54%)	

a*: A significant change was seen among the four months within 2020 with an obvious monthly increase (Pearson Chi-square test, □2=221.737, P<0.001).

b: There is no significant difference among the four months within 2019 (Pearson Chi-square test, $\chi 2=6.118$, P=0.106).

c*: There is a significant difference between the total amount (Apr 20 to July 31) of each group in 2019 and 2020 using Pearson Chi-square test ($\chi 2=289.960$, P<0.001).

Figure legend

Figure 1. The situation of COVID-19 pandemic in Wuhan, Hubei, and daily visits at the Department of Paediatric Dentistry in WHUSS from April 20 to July 31 in 2020 and 2019. The gray shading shows the number of hospitalized COVID-19 patients in Hubei Province. The red line shows the number of new confirmed COVID-19 cases in Wuhan City. The blue and orange lines represent the number of patients in 2020 and 2019, respectively.

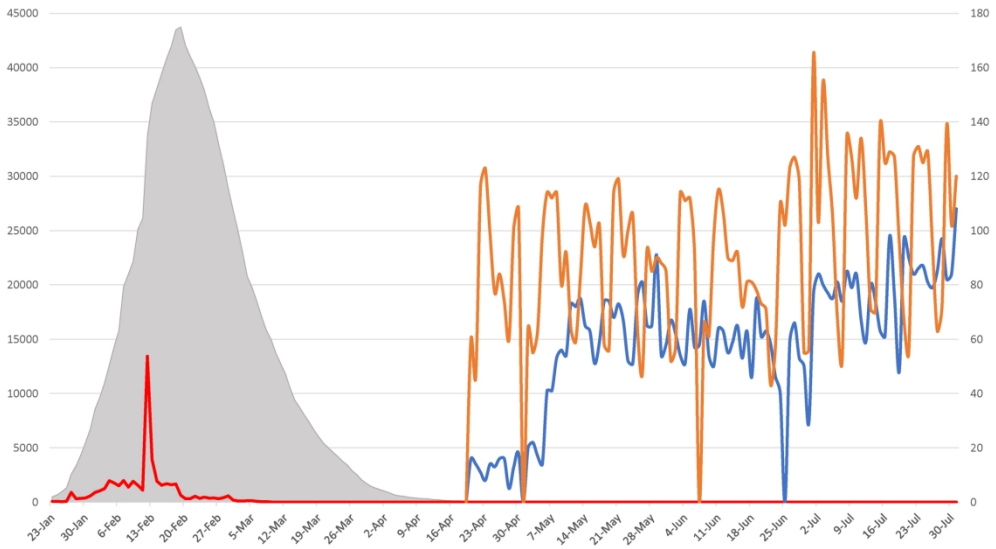

Figure 1. The situation of COVID-19 pandemic in Wuhan, Hubei, and daily visits at the Department of Pediatric Dentistry in WHUSS from April 20 to July 31 in 2020 and 2019. The gray shading shows the number of hospitalized COVID-19 patients in Hubei Province. The red line shows the number of new confirmed COVID-19 cases in Wuhan City. The blue and orange lines represent the number of patients in 2020 and 2019, respectively.

183x102mm (300 x 300 DPI)

Supplemental Materials and Methods

Workflow of the Dental Practice Personnel

Before the dental healthcare service reopened, all medical staff (Including dentists, nurses, logistics staff, management staff) were required to conduct nucleic acid tests for SARS-Cov-2 in April. Only those with negative infection were allowed to work. In addition, they were organized for on-line and on-site trainings to understand the knowledge related to COVID-19 and further enhance the awareness of prevention and control of nosocomial infection.

Since reopening in April 20, body temperature of each staff has been checked every morning at the hospital entrance. It was required that appearance of any symptoms related to COVID-19 infection such as fever should be reported. The person with COVID-19 symptom(s) would have been forbidden to work until they obtained a negative result about SARS-Cov-2 nucleic acid and recovered. Dentists and nurses in close contact with the patients were equipped with personal protective equipment including disposable N95 masks, gloves, caps, shoe covers, face shields, and work uniforms, all of which were used for no more than 4 hours.

Finally, for the management of clinical rooms, measures were taken to ensure all equipment in sight should be minimised to only what was necessary to avoid viral cross-contamination. And common contact areas, such as the chair lamp, handles, and dental comprehensive console, were covered with a barrier. All clinics (both in use and not used) needed to be disinfected with ultraviolet rays twice a day.

Patient Pathway for Paediatric Dental Services

All children except those who need emergent treatments were required to make an appointment through online registration system one week ahead of the interview. After filling out children's name, identification number, and parent's cell number, the parent would receive a text message with appointment information. And children together with their accompanying persons needed to go to the hospital as scheduled.

When entering the hospital, children and their accompanying persons should pass through the patient passage way in accordance with the bulletin boards posted by the hospital. Only those who provided the appointment messages, the children's identity information and the accompanying person's Health QR-code were allowed to enter the hospital. A child could only be accompanied by one family member, and anybody with fever was prohibited from entering the hospital.

The Health QR-Code was a technology which could reflect the person's current health status and also record all the people he/she closely contacts with. Once a person is confirmed to be infected with COVID-19, the government can locate all his/her close contacts and immediately take further measures to stop the disease from spreading.

After providing all the information in the entrance, children and their parents needed to go to the reception area of the hospital according to the specific route, and then went to the front desk to register and complete an information collection questionnaire (Appendix Table 1). Afterwards, they were allowed to enter the treatment area of the Department of Paediatric Dentistry to fill in another questionnaire (Appendix Table 2) before entering the treatment room. Based on the above information, infected/suspected patients will be

interviewed and treated at a specific isolation room.

The receiving dentist would inquire and examine the child according to the protocols, and X-ray examination might be needed during the process. According to the examination results, if the dentist believed that the child only needed non-AGP procedures, then the treatment would be completed directly during this visit. If the dentist thought that it was necessary to perform any AGP procedures, an appointment would be made with the parent for the next follow-up visit.

Before the follow-up visit, the child needed to go to another qualified hospital to complete the SARS-CoV-2 nucleic acid test and got a report. Please note that the nucleic acid test report was valid within 14 days. After the dentist verified the report during the follow-up visit, AGP could be performed on the child. With the completion of the treatment process, the children and their parent were required to leave the hospital according to the specific route instructed by the staff.

Appendix Table 1

Outpatient information registration form

Part 1: Patient information

Name: *Contact information:*

1. *Are you diagnosed or suspected of being a patient who has recovered from COVID-19?*
2. *Are you diagnosed or suspected of being an asymptomatic patient infected with COVID-19?*
3. *Have you ever experienced symptoms of COVID-19 including fever, dry cough, fatigue, difficulty breathing or other symptoms?*
4. *Have you recently been in contact with patients infected or suspected with COVID-19?*

Signature: *Date:* *Color of the Health QR Code:*

Time of the entrance: *Temperature:* *Recorder:*

Part 2: Accompanying person

Name: *Contact information:*

5. *Are you diagnosed or suspected of being a patient who has recovered from COVID-19?*
6. *Are you diagnosed or suspected of being an asymptomatic patient infected with COVID-19?*
7. *Have you ever experienced symptoms of COVID-19 including fever, dry cough, fatigue, difficulty breathing or other symptoms?*
8. *Have you recently been in contact with patients infected or suspected with COVID-19?*

Signature: *Date:* *Color of the Health QR Code:*

Time of the entrance: *Temperature:* *Recorder:*

Appendix Table 2

Informed Consent for Oral Clinic During the COVID-19 pandemic period

1. *The dentist has told me what kind of treatment I should take.*
2. *During the pandemic period of COVID-19, I understand that hospitals and dentists have taken strict precautions against the occurrence of nosocomial infections.*
3. *During the pandemic period of COVID-19, I understand that dentists can not identify asymptomatic patients, and there will be cross infection risk during oral diagnosis and treatment.*
4. *I understand that any treatment has risks, and drug may cause allergies or side effects.*
5. *I promise that the following facts are true (please tick the corresponding option)*
   - A. *I have been diagnosed with COVID-19 infection*
   - B. *I have been a suspected case of COVID-19 infection*
   - C. *I have recently had symptoms of COVID-19 infection*
   - D. *I have not had any symptoms of COVID-19 infection recently*
   - E. *I have not recently been in contact with patients who have been diagnosed or suspected of being infected with COVID-19.*
6. *If you choose A . B or C in the Question 5 , please answer this question (please tick the corresponding option)*
   - A. *I have been hospitalized and have not any symptom now.*
   - B. *I have been hospitalized and have some symptoms now.*
   - C. *I have not been hospitalized and have not any symptom now either.*
   - D. *I have not been hospitalized but have some symptoms now.*

I understand the above content and promise that the choices made are true and effective.

Patient signature: *Dentist signature:* *Date:*

Appendix Table 3. The changes in the patients' diagnoses from April 20 and July 31 in 2019. Nine common diagnoses were listed in the table. Other uncommon diagnoses were classified as "Other".

	Apr 2019	May 2019	Jun 2019	Jul 2019
Caries	329 (29.14%)	929 (28.99%)	918 (29.51%)	1212 (28.40%)
Pulpitis	128 (11.34%)	304 (9.49%)	295 (9.48%)	417 (9.77%)
Apical Periodontitis	255 (22.59%)	734 (22.90%)	688 (22.12%)	943 (22.09%)
Retained Primary Teeth	92 (8.15%)	281 (8.77%)	268 (8.62%)	369 (8.65%)
Malocclusion *	86 (7.62%)	253 (7.89%)	251 (8.07%)	538 (12.60%)
Tooth Trauma *	79 (7.00%)	244 (7.61%)	236 (7.59%)	152 (3.56%)
Early Loss of Primary teeth	32 (2.83%)	89 (2.78%)	86 (2.76%)	115 (2.69%)
Deep Pits and Fissures *	19 (1.68%)	56 (1.75%)	56 (1.80%)	124 (2.91%)
Supernumerary Teeth	30 (2.65%)	78 (2.43%)	85 (2.73%)	119 (2.79%)
Other	79 (7.00%)	237 (7.39%)	228 (7.32%)	279 (6.54%)
Total	1129	3205	3111	4268

The changes in the patients' diagnoses from April 20 and July 31 in 2019. The asterisks (*) represent significant difference using Pearson Chi-square test ($P<0.05$).

Appendix Figure 1

Appendix Figure 1. The proportion of representative treatment methods and the average number of teeth/ root canal treated per visit in 2020 and 2019.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	5
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	6
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	6
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7
		(*e*) Describe any sensitivity analyses	7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	8
		(b) Give reasons for non-participation at each stage	8
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	8
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	8-9

		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	9
Discussion			
Key results	18	Summarise key results with reference to study objectives	10-11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	12-13
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14
Generalisability	21	Discuss the generalisability (external validity) of the study results	14
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	15

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Changes in paediatric dental clinic after reopening during COVID-19 pandemic in Wuhan: a retrospective study

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Changes in paediatric dental clinic after reopening during COVID-19 pandemic in Wuhan: a retrospective study

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Keywords: COVID-19; Paediatric oral & maxillofacial surgery; Public Health

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Abstract

Objectives: Affected by COVID-19 pandemic, The Department of Paediatric Dentistry of School and Hospital of Stomatology, Wuhan University was closed in late January, 2020, and resumed on April 20. Our study aimed to explore the effects of COVID-19 pandemic on paediatric dental services which might assist global paediatric dentists to build confidence and make appropriate policies under the pandemic.

Design: A retrospective study was performed. Medical records of patients were retrieved but without any private information, including patient name, ID number and address.

Participants: All data of the patients from April 20 to July 31 in 2020 and 2019 was extracted and analyzed including demographics, dental diagnosis, and treatment methods. A total of 18,198 patients were included in the study.

Results: During this period, no medical staff or patient was infected with COVID-19 due to dental services. A total of 6,485 in 2020 but 11,713 during the same period in 2019 visited the department. Compared with 2019, gender distribution did not change, but age distribution changed with an increase under 6-year-old. The diagnoses including caries, retained primary teeth, malocclusion, deep pits and fissures changed significantly, while pulpitis, apical periodontitis, tooth trauma, early loss of primary teeth, supernumerary teeth showed little change. Aerosol Generating Procedures were adopted less frequently overall in this period.

Conclusions: The reopening of paediatric dental services is proceeding steadily with significant changes in the characteristics of the patients and treatment procedures.

Strengths and limitations of this study

1. Based on large sample size, the study explored the influence caused by COVID-19 pandemic on paediatric dentistry.

2. Our measures and experience to prevent and control the COVID-19 transmission at the paediatric dental clinic were shared.

3. The short-term impact of COVID-19 on paediatric dental care in Wuhan was explored.

4. The study only analyzed the situation in our hospital, which might not be applicable to some countries or areas.

5. Due to the limited time, further research is needed to discuss the medium-term and long-term impact of the COVID-19 on paediatric dental clinic.

Introduction

In December 2019, COVID-19 emerged in Wuhan and spread rapidly across the globe, becoming a major public health challenge for countries around the world.[1] The COVID-19 pandemic led to a high case fatality rate up to 2.12% in WHO region-wise till February 2021.[2,3] A novel highly infectious Corona RNA virus (named SARS-Cov-2) was responsible for the COVID-19, which could transmit via droplets or direct contact with infected people or contaminated surfaces.[4] Due to the transmission routes of COVID-19, many high-contact professions including dentistry were severely affected.[5] Dental healthcare professionals worked in close proximity to patients. And most dental procedures were AGPs (Aerosol Generating Procedures) which caused a large number of droplets and aerosols, such as use of a high-speed or low-speed handpieces, ultrasonic instruments,

and water-air syringes.[6-9] The standard protective measures were not sufficient to prevent the spread of COVID-19 because of the unique characteristics of dentistry, especially when patients were in the incubation period, or unaware they had been infected.[7] Therefore, among healthcare personnel, dentists were at an elevated risk of exposure to COVID-19. This risk was even more serious in paediatric dentistry, because affected children frequently presented asymptomatic, mild, or moderate clinical manifestations.[10-12] To prevent and control transmission of COVID-19, Wuhan city was locked down on January 23, 2020. On the second day, Hubei province activated level 1 response to public health emergencies. Then all elective treatments to dental patients in Wuhan city were postponed and only emergency dental care was reserved.[13,14]

The Department of Paediatric Dentistry in WHUSS (School and Hospital of Stomatology, Wuhan University) was the main center for the routine treatment and care for children's dental diseases in Wuhan. This department provided dental care to around 36,000 children in 2019. From January 24 to April 19, 2020, clinical procedures of this department were completely stopped. During this period, online consultations and oral health instructions were provided, and severe dental emergencies were recommended to the General and Emergency Department in WHUSS, which was the only available department in WHUSS special for emergency dental services.[14] Although it was important to provide treatment for children who presented with urgent or emergency dental complaints, dental non-emergencies that failed to receive immediate intervention were at an increased risk to exacerbate and even developed urgent or emergent complications. Therefore, the contradiction between the huge paediatric demands and the limited dental

service worsened after the closure of the Department of Paediatric Dentistry.[6,9,13] After being imposed a lockdown for as long as 76 days, Wuhan city successfully contained the spread of the virus. On April 8, 2020, all travel restrictions in and out of Wuhan was removed.[15] On April 20, the Paediatric Department of WHUSS was reopened and aimed to improve children's dental health care.

Similar to Wuhan in China, paediatric dental treatments were completely stopped or significantly influenced in several affected countries.[6,16-18] Paediatric Dentistry was essential children's health care. During this evolving and unprecedented COVID-19 pandemic period, it was an important issue to get a balance between prevention of potential exposure to SARS-CoV-2 infection and minimization of the harm to patients from postponed dental care.[16,18] New protocols and measures were needed as dental professionals returned to normal practice after weeks or months of confinement in many countries. Some articles have discussed the management of dental practice during the COVID-19 pandemic,[3,5,6] but few articles explored the situation and changes after the recovery of dental clinics based on large sample data.

In this study, we collected the data of the patients from April 20 to July 31 in 2020 and the corresponding period in 2019 to analyze the impact of the COVID-19 pandemic on the children's dental care. We also shared our experience on restructuring the patient pathway and workflow of healthcare personnel.

Materials and Methods

Inclusion and exclusion criteria

The information of the patients who visited the Department of Paediatric Dentistry, WHUSS from April 20 to July 31 in 2020 and the corresponding period in 2019 were retrieved, and compared (All private information was not been extracted, including patient name, ID number and address). Any medical record had one or even more information missing was excluded.

Patient and Public Involvement

Reporting of the study follows the STROBE guidelines. Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of our research

Workflow of the dental practice personnel

In order to ensure safety after reopening of the hospital, a series of measures had been applied among medical staff which mainly included: nucleic acid testing for all before reopening, personal protection training for employees, adequate provision of personal protective equipment, and a complete clinic management system. Please refer to the supplementary materials for details.

Patient pathway for paediatric dental services

During the pandemic, WHUSS and Paediatric Dentistry formulated protocols to prevent nosocomial infections of COVID-19. These measures included: online appointment system,

medical history collection of COVID-19, body temperature monitoring, provision of nucleic acid reports, et al. Patients needed to make an appointment online in advance, those who lacked an appointment would not be allowed to enter the hospital. The patient triage based on the COVID-19 exposure history was completed upon patient arrival. Children and their accompanying persons were required to provide the appointment messages, the children's identity information and the accompanying person's Health QR-code. All people needed to receive body temperature assessment. Please refer to the supplementary materials for details. The questionnaires for COVID-19 are shown on Appendix Table 1 and 2.

Data collection and management

Data collection included number and demographic information of visited children (age and gender), their diagnosis, and treatment options provided by dentists. Data associated with COVID-19 was obtained from the government.[19]

All data was classified according to specific standards. Age was divided into 4 groups: 0-3 years old, 4-6 years old, 7-12 years old, 13 years old and above. For the diagnosis of children, nine common diseases were listed while some uncommon diseases such as traumatic ulcer, central cusp, gingivitis were grouped into Other. Treatments were divided into Oral Health Consultation group (They received a comprehensive oral examination and oral health instruction without any dental procedures) and Oral Health Consultation & Treatment group. The latter group was further divided into AGPs Treatment Group and Non-AGPs Treatment Group according to whether any AGPs procedure was used.

Figure drawing and statistical analysis

The data was entered into Excel 2019 (Microsoft corporation, Redmon, Washington, USA) and imported into SPSS 25.0 (IBM Corporation, Armonk, New York, USA) for statistical analysis. Figures were drawn by Excel. Pearson chi-square test was used to verify the difference of categorical variables. Significance levels were set as $P<0.05$ using any test.

Results

The overall recovery process of the department of paediatric dentistry in WHUSS

From April 20 to July 31, a total of 2 medical staff experienced fever symptoms. Their test reports on nucleic acid of SARS-Cov-2 were both negative and were diagnosed as influenza instead of COVID-19. As of July 31, no medical staff or patient had contracted COVID-19 due to medical services.

After reopening on April 20, a series of measures had been taken to prevent COVID-19 infections and ensure the safety of medical staff and patients. These measures included: changes in the appointment system from a combination of on-site and online to online only; Strict verification of identification information before entering the hospital and clinic area; Collection of epidemiological information related to COVID-19 of each patient; and Perfect classified diagnosis and treatment system et al. All the above measures (Methods and Supplemental Materials and Methods) ensured the recovery process of the Department of Paediatric Dentistry of WHUSS to be promoted steadily.

The trend of COVID-19 pandemic in Wuhan (January 23 to July 31, 2020) is shown in Figure 1. The number of daily visits from the reopening day to July 31, 2020 (the blue line) and during the corresponding period in 2019 (the orange line) were retrieved. The daily visits in 2019 were at a comparably stable level, about 80 for average. In 2020, the number of visits remained very low in the early recovery stage (late April), and gradually increased. In the early first half of May, the average daily visits reached nearly 50, returning to 60% of the same period last year. Since late May, the number of the patients reached a relatively stable level, reaching 60, which was around 60%-80% of the same period in 2019.

Changes in the basic information of the children visiting WHUSS

To further understand the possible changes of the patients' characteristics, basic information of the children who visited the Department of Paediatric Dentistry in WHUSS was obtained. Table 1 shows their gender and age distribution. No significant difference was found in the gender distribution between 2019 and 2020. But a significant difference was seen in the age distribution with an increase of the children under 6 years old (0-3 and 4-6 years old groups) but a decrease of the elder children in 2020.

Changes in the diagnoses of the children visiting WHUSS

The disease diagnoses of the visited children in 2020 are shown in Table 2. Since the absolute number of children visiting varied greatly between 2020 and 2019, the percentages of the number of each diagnosis were further compared. Comparison among the four months within 2020, the diagnosis (%) of Retained Primary Teeth declined month by month. However, compared to the total patients in 2019, the COVID-19 pandemic has led to a significant increase of the percentage of Retained Primary Teeth. Meanwhile, significant impacts of COVID-19 on the percentage of Dental Caries, Malocclusion, and Deep Pits & Fissures were also seen, with an increase in the first diagnosis but decreases in the latter two. The detailed diagnoses for patients in 2019 are shown in Appendix Table 3.

Changes in the treatment operations

In order to analyze the impact of COVID-19 on the implement of dental treatment

operations, the data were further collected and shown in Table 3. On the whole, a higher proportion of children left the hospital after receiving oral health consultations only in 2020. But from April to July, the proportion of children undergoing treatment operations was increasing while in 2019, the ratio between these two groups was stable. By comparing the same month of 2019 and 2020, it was found that there were significant differences in April, May, and June, but there was no significant difference in July.

Considering the high risks of AGPs for COVID-19 transmission, the Oral Health Consultation & Treatment group was classified into two groups according to whether any AGPs was used (Table 4). Comparison between 2019 and 2020 showed that the proportion of AGPs operations dropped and non-AGPs treatment increased in 2020. Among April to July in 2020, the proportion of AGPs treatment showed an obvious increase month by month, but still at a lower level than the corresponding month of 2019. In April 2020, only 10 cases were operated with AGPs. Gradually, such attempts had been expanded, reaching nearly 30% in May, which increased month by month, finally reaching a level similar to 2019 in July.

Paediatric dental clinic provides all oral health care for children and adolescents which includes extensive procedures. Some representative treatment methods were selected and percentages of these treatment methods were calculated. The average number of teeth treated during a single visit was also displayed in Appendix Figure 1.

Discussions

After Wuhan City experienced the COVID-19 pandemic attack in 2020, the medical industry including dental care service had been seriously affected. To explore the changes of paediatric dental services during the pandemic, the information of children who visited the Department of Paediatric Dentistry of WHUSS including gender, age, diagnoses, and treatment options they received was extracted. By comparing with the same period in 2019, we found that the COVID-19 pandemic had an impact on the policies of dental hospitals and clinics, the distribution of children's age and oral diseases, as well as the treatment operations to the patients.

The strategy of pathway for patients and the performance of patient triage were reorganized and adopted till now. However, it still had some limitations. The collection of COVID-19 exposure history as well as the checking for body temperature were completed only upon patient arrival.[20-21] But if the patient or the accompany person was a potential COVID-19 infected person or had been contacted with an infected person, the spread of COVID-19 was hard to be avoided on the way to the hospital. Timothy et al. proposed self-triage and self-scheduling based on the phone, which was being rapidly adopted on health systems around the world.[22] So this kind of system for patient triage, both on the phone and upon patient arrival, which had the potential to greatly improve triage efficiency and prevent unnecessary visits during the COVID-19 pandemic, was a valuable measure for risk assessment of COVID-19 for patients.[22-23]

The regular dental health care in Wuhan was influenced by COVID-19 pandemic, including paediatric patients and dentists. The COVID-19 pandemic had affected children's dental health care in Wuhan, and the short-term changes in children caused by COVID-19

pandemic were mainly due to community closure and delayed treatment. A significant increase was observed in the children at younger ages (0-6 years old), which might be attributed to the closure of the community. During this period, children were required to stay at home all day, feeling upset by losing outdoor activities, and daily dental care was sometimes ignored. [24] Coupled with poor self-control and poor oral cleaning, young children were more prone to dental diseases. At the same time, due to the closure, children were unable to visit the hospital to receive regular oral examination and the fluoride anti-caries treatment, which made the incidence of dental caries further increased. [25,]

At present, the impact of delayed treatment on children mainly lead to the change of the reasons for these children's visit, which was mainly reflected in the change of disease distribution in our study. A significant decrease for dental trauma was found in 2020 (April to June), which may be attributed to reduced outdoor activities. Although community closure was canceled at the end of March, educational institutions especially kindergartens and elementary schools did not return to work at that time. To avoid the possibility of infection, most children were required to go out less frequently by their caregivers.[26] In Wuhan, China, summer vacation usually started from early July. It was found that for 2019, the percentage of dental trauma in July also reduced greatly either.

Hopcraft and Farmer investigated the impact of COVID-19 on dental services in Australia from February 2020 to September, finding that the pandemic had a significant impact on the provision of dental services to children from lower socioeconomic backgrounds, and the delayed dental care was likely to contribute to poorer oral health and long-term problems for many Australians.[27] Different from this study, we found that the

impact of the COVID-19 pandemic on Wuhan mainly concentrated in the first three months after reopening. In the fourth month (July 2020), the characteristics of children gradually returned to normal. It was speculated that the restriction measures in Wuhan lasted only three months. If the restrict time was prolonged, the impact might be more serious. Therefore, our study found that the impact of COVID-19 pandemic and the deferral of dental treatment in Wuhan mainly focused on the short-term impact, while the medium-term and long-term impact might be limited, needing more research to explore.

Another obvious change occurred in the dentists' treatment concepts, breaking the original routines.[5-7] Especially in late April when the outpatient service just recovered, more than half of the children did not receive any operation in the initial appointment. In addition, some parents or caregivers were also worried about the risk of COVID-19 infection by AGPs, so they refused to receive any treatment for their children but dental health consultation. With the resumption process proceeding in an orderly manner, the concerns of both dentists and parents decreased, so more dentists and parents were willing to receive AGPs till the end of July.

Many current guidelines recommend minimizing the use of AGPs,[7,9,28,29] but non-AGPs operations cannot solve some common dental diseases, such as endodontic treatments for pulpitis. Taking into account the complexity of children's oral diseases and their limited ability of oral hygiene control, failing to intervene in time will worsen the diseases and eventually make more complicated treatments necessary. Nevertheless, since the global pandemic has not yet been eliminated, the possibility of a recurrence of COVID-19 in Wuhan cannot be ruled out. Some medical staff hold the view that preventive

measures must also be paid attention to such as fluoride anti-caries treatment.[30] The application of fluoride can effectively prevent dental caries, which will reduce the probability of these children suffering from dental caries in the future and reduce their visits to the hospital.

As a retrospective report, we extracted and classified the data of the 4 months since the reopening of dental healthcare work in the Paediatric Dentistry of WHUSS. In-depth comparisons were conducted from three aspects, namely: comparison within 2019, comparison within 2020, and comparison between 2019 and 2020. In 2019, the data was mostly stable, and the dentists' treatment choice was directly determined by the patient's disease diagnosis, with no extra factors to worry about. The only fluctuation came from the summer vacation in July as discussed above. However, in 2020, a large amount of changes happened. When dentists just returned to work on April, most of them tried to avoid AGPs operations while parents also refused to take their children to hospital when it was not urgent enough regarding the danger of hospital environment. In this exploratory period, the attitudes of dentists and patients were relatively conservative. At the end of May, Wuhan City carried out nucleic acid tests on all citizens, which gave both dentists and patients incentives. The numbers of dentists at work, visited patients, patients treated and patients receiving AGPs also increased. This phenomenon was more significant from May to June. When entering July, after the first three months of exploration, the concepts of both dentists and patients have become stable. This month-to-month change has begun to shrink, approaching the degree compared with the same month in 2019. The overall reopening process has achieved phased success.

Conclusion

The COVID-19 pandemic has indeed brought an impact on children's dental care. Under this attack, lower visit number as well as younger age distribution can be found. And AGPs operations were used less frequently. Our department resumed medical service at the end of April, without any example to follow. Through the efforts of various departments of the hospital, plans and medical procedures have been formulated. Looking back at our reopening process, it cannot be perfect enough, but it is still satisfactory. Our experience may help global paediatric dental healthcare workers build confidence and make appropriate policies for resuming high-quality dental services during COVID-19 pandemic.

Research Ethics Approval: Human Participants

This study involves human participants and was approved by the Ethics Committee of School and Hospital of Stomatology, Wuhan University with the reference ID No. 2020-B70. Consent for participation in the study was not obtained because this retrospective study did not interfere with patients, nor did it involve any patient privacy. And due to the large sample size, not all patients could be found so consent for participation was not obtained.

Research Ethics Approval: Animals

This study does not involve animal subjects.

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Competing interests

The authors declare no potential conflicts of interest with respect to the authorship and/or publication of this article.

Author contributions

J. Yang, contributed to design, data acquisition and analysis, drafted manuscript and critically revised manuscript.

G. Yang, contributed to design, interpretation, drafted manuscript and critically revised manuscript.

R. Jin contributed to design, drafted manuscript and critically revised manuscript.

G. Song contributed to conception, data acquisition and critically revised manuscript.

G. Yuan contributed to conception and design, analysis and interpretation, drafted manuscript and critically revised manuscript.

All authors gave their final approval and agreement to be accountable for all aspects of the work.

Data sharing statement

Data including detailed medical record without any private information is available upon reasonable request through email by corresponding author: yuanguohua@whu.edu.cn.

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Table 1. Gender and age distribution of the children who visited the Department of Paediatric Dentistry in WHUSS from April 20 and July 31 in 2019 and 2020.

	2020 (n=6485)	2019 (n=11713)
Gender [a]		
Male	3429 (52.88%)	6280 (53.62%)
Female	3056 (47.12%)	5433 (46.38%)
Age [b*]		
0-3 years old	718 (11.07%)	593 (5.06%)
4-6 years old	2745 (42.33%)	4152 (35.45%)
7-12 years old	2839 (43.78%)	6229 (53.18%)
13 years old and above	183 (2.82%)	739 (6.31%)

a: There is no significant difference of the gender of the children between 2019 and 2020 using Pearson Chi-square test ($\chi 2=0.918$, $P=0.338>0.05$).

b*: The age distribution between 2019 and 2020 was significantly different with an obvious increase of the children under 6 years old (0-3 and 4-6 years old group) and a decrease of the children above 7 years old in 2020 using Pearson Chi-square test ($\chi 2=435.590$, $P<0.001$).

Table 2. The changes in the patients' diagnoses from April 20 and July 31 in 2020. Nine common diagnoses were listed in the table. Other uncommon diagnoses were classified as "Other".

	Apr 2020	May 2020	Jun 2020	Jul 2020	Total in 2020	Total in 2019
Caries	49	586	577	836	2048	3388
a b*	(30.82%)	(31.19%)	(31.97%)	(31.64%)	(31.58%)	(28.93%)
Pulpitis	8	151	171	257	587	1144
a b	(5.03%)	(8.04%)	(9.47%)	(9.73%)	(9.05%)	(9.77%)
Apical Periodontitis	36	412	407	596	1451	2620
a b	(22.64%)	(21.93%)	(22.55%)	(22.56%)	(22.37%)	(22.37%)
Retained Primary Teeth	30	286	184	236	736	1010
a* b*	(18.87%)	(15.22%)	(10.19%)	(8.93%)	(11.35%)	(8.62%)
Malocclusion	13	159	145	229	546	1128
a b*	(8.18%)	(8.46%)	(8.03%)	(8.66%)	(8.42%)	(9.63%)
Tooth Trauma	5	68	68	104	245	711
a b	(3.14%)	(3.62%)	(3.77%)	(3.94%)	(3.78%)	(6.07%)
Early Loss of Primary teeth	5	52	49	74	180	322
a b	(3.14%)	(2.77%)	(2.72%)	(2.80%)	(2.78%)	(2.75%)
Deep Pits and Fissures	3	26	28	45	102	255
a b*	(1.89%)	(1.38%)	(1.55%)	(1.70%)	(1.57%)	(2.18%)
Supernumerary Teeth	4	57	47	72	180	312
a b	(2.52%)	(3.03%)	(2.60%)	(2.73%)	(2.78%)	(2.66%)
Other	6	82	129	193	410	823
a* b	(3.77%)	(4.36%)	(7.15%)	(7.31%)	(6.32%)	(7.03%)
Total	159	1879	1805	2642	6485	11713

a: Comparison among the four months within 2020.

b: Comparison of the patients' diagnoses between the total period in 2020 and 2019.

The asterisks (*) represent significant difference using Pearson Chi-square test ($P<0.05$). The monthly diagnoses in 2019 were shown in supplemental material.

Table 3. All visits were grouped into Oral health consultation group and Oral health consultation & Treatment group according to whether treatment operation(s) was adopted.

Time a* b c*	Total visits	Oral health consultation only (Percentage)	Oral health consultation & Treatment (Percentage)	P value
April 2020	159	81 (50.94%)	78 (49.06%)	P<0.001*
April 2019	1129	332 (30.92%)	797 (69.08%)	
May 2020	1879	581 (34.46%)	1298 (65.54%)	P=0.006*
May 2019	3205	876 (27.48%)	2329 (72.52%)	
June 2020	1805	622 (29.41%)	1183 (70.59%)	P<0.001*
June 2019	3111	898 (27.33%)	2213 (72.67%)	
July 2020	2642	726 (28.87%)	1916 (71.13%)	P=0.511
July 2019	4268	1204 (28.21%)	3064 (71.79%)	

a*: A significant difference was seen among the four months within 2020 (Pearson Chi-square test, $\chi 2=54.989$, P<0.001).

b: There is no significant difference among the four months within 2019 (Pearson Chi-square test, $\chi 2=2.660$, P=0.447>0.05).

c*: There is a significant difference between the total amount (Apr 20 to July 31) of each group in 2019 and 2020 using Pearson Chi-square test ($\chi 2=15.097$, P<0.001).

Table 4. The patients treated by dental procedures were classified into two groups according to whether any AGPs was used.

Time a* b c*	Treated patients	AGPs treatment (Percentage)	Non-AGPs treatment (Percentage)	P value
Apr 2020	78	10 (12.82%)	68 (87.18%)	P＜0.001
Apr 2019	797	504 (63.23%)	293 (36.76%)	
May 2020	1298	383 (29.51%)	915 (70.49%)	P＜0.001
May 2019	2329	1387 (59.55%)	942 (40.45%)	
June 2020	1183	603 (50.97%)	580 (49.03%)	P＜0.001
June 2019	2213	1310 (59.20%)	903 (40.80%)	
July 2020	1916	1010 (52.71%)	906 (47.29%)	P＜0.001
July 2019	3064	1883 (61.46%)	1181 (38.54%)	

a*: A significant change was seen among the four months within 2020 with an obvious monthly increase (Pearson Chi-square test, □2=221.737, P<0.001).

b: There is no significant difference among the four months within 2019 (Pearson Chi-square test, $\chi 2=6.118$, P=0.106).

c*: There is a significant difference between the total amount (Apr 20 to July 31) of each group in 2019 and 2020 using Pearson Chi-square test ($\chi 2=289.960$, P<0.001).

Figure legend

Figure 1. The situation of COVID-19 pandemic in Wuhan, Hubei, and daily visits at the Department of Paediatric Dentistry in WHUSS from April 20 to July 31 in 2020 and 2019. The gray shading shows the number of hospitalized COVID-19 patients in Hubei Province. The red line shows the number of new confirmed COVID-19 cases in Wuhan City. The blue and orange lines represent the number of patients in 2020 and 2019, respectively.

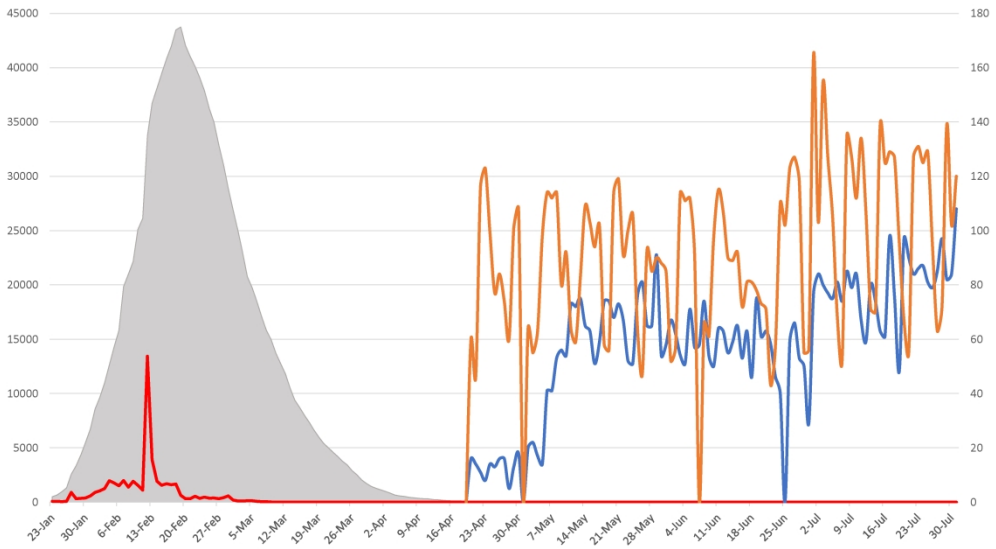

Figure 1. The situation of COVID-19 pandemic in Wuhan, Hubei, and daily visits at the Department of Pediatric Dentistry in WHUSS from April 20 to July 31 in 2020 and 2019. The gray shading shows the number of hospitalized COVID-19 patients in Hubei Province. The red line shows the number of new confirmed COVID-19 cases in Wuhan City. The blue and orange lines represent the number of patients in 2020 and 2019, respectively.

Supplemental Materials and Methods

Workflow of the Dental Practice Personnel

Before the dental healthcare service reopened, all medical staff (Including dentists, nurses, logistics staff, management staff) were required to conduct nucleic acid tests for SARS-Cov-2 in April. Only those with negative infection were allowed to work. In addition, they were organized for on-line and on-site trainings to understand the knowledge related to COVID-19 and further enhance the awareness of prevention and control of nosocomial infection.

Since reopening in April 20, body temperature of each staff has been checked every morning at the hospital entrance. It was required that appearance of any symptoms related to COVID-19 infection such as fever should be reported. The person with COVID-19 symptom(s) would have been forbidden to work until they obtained a negative result about SARS-Cov-2 nucleic acid and recovered. Dentists and nurses in close contact with the patients were equipped with personal protective equipment including disposable N95 masks, gloves, caps, shoe covers, face shields, and work uniforms, all of which were used for no more than 4 hours.

Finally, for the management of clinical rooms, measures were taken to ensure all equipment in sight should be minimised to only what was necessary to avoid viral cross-contamination. And common contact areas, such as the chair lamp, handles, and dental comprehensive console, were covered with a barrier. All clinics (both in use and not used) needed to be disinfected with ultraviolet rays twice a day.

Patient Pathway for Paediatric Dental Services

All children except those who need emergent treatments were required to make an appointment through online registration system one week ahead of the interview. After filling out children's name, identification number, and parent's cell number, the parent would receive a text message with appointment information. And children together with their accompanying persons needed to go to the hospital as scheduled.

When entering the hospital, children and their accompanying persons should pass through the patient passage way in accordance with the bulletin boards posted by the hospital. Only those who provided the appointment messages, the children's identity information and the accompanying person's Health QR-code were allowed to enter the hospital. A child could only be accompanied by one family member, and anybody with fever was prohibited from entering the hospital.

The Health QR-Code was a technology which could reflect the person's current health status and also record all the people he/she closely contacts with. Once a person is confirmed to be infected with COVID-19, the government can locate all his/her close contacts and immediately take further measures to stop the disease from spreading.

After providing all the information in the entrance, children and their parents needed to go to the reception area of the hospital according to the specific route, and then went to the front desk to register and complete an information collection questionnaire (Appendix Table 1). Afterwards, they were allowed to enter the treatment area of the Department of Paediatric Dentistry to fill in another questionnaire (Appendix Table 2) before entering the treatment room. Based on the above information, infected/suspected patients will be

interviewed and treated at a specific isolation room.

The receiving dentist would inquire and examine the child according to the protocols, and X-ray examination might be needed during the process. According to the examination results, if the dentist believed that the child only needed non-AGPs procedures, then the treatment would be completed directly during this visit. If the dentist thought that it was necessary to perform any AGPs procedures, an appointment would be made with the parent for the next follow-up visit.

Before the follow-up visit, the child needed to go to another qualified hospital to complete the SARS-CoV-2 nucleic acid test and got a report. Please note that the nucleic acid test report was valid within 14 days. After the dentist verified the report during the follow-up visit, AGPs could be performed on the child. With the completion of the treatment process, the children and their parent were required to leave the hospital according to the specific route instructed by the staff.

Appendix Table 1

Outpatient information registration form

Part 1: Patient information

Name: *Contact information:*

1. *Are you diagnosed or suspected of being a patient who has recovered from COVID-19?*
2. *Are you diagnosed or suspected of being an asymptomatic patient infected with COVID-19?*
3. *Have you ever experienced symptoms of COVID-19 including fever, dry cough, fatigue, difficulty breathing or other symptoms?*
4. *Have you recently been in contact with patients infected or suspected with COVID-19?*

Signature: *Date:* *Color of the Health QR Code:*

Time of the entrance: *Temperature:* *Recorder:*

Part 2: Accompanying person

Name: *Contact information:*

5. *Are you diagnosed or suspected of being a patient who has recovered from COVID-19?*
6. *Are you diagnosed or suspected of being an asymptomatic patient infected with COVID-19?*
7. *Have you ever experienced symptoms of COVID-19 including fever, dry cough, fatigue, difficulty breathing or other symptoms?*
8. *Have you recently been in contact with patients infected or suspected with COVID-19?*

Signature: *Date:* *Color of the Health QR Code:*

Time of the entrance: *Temperature:* *Recorder:*

Appendix Table 2

Informed Consent for Oral Clinic During the COVID-19 pandemic period

1. *The dentist has told me what kind of treatment I should take.*
2. *During the pandemic period of COVID-19, I understand that hospitals and dentists have taken strict precautions against the occurrence of nosocomial infections.*
3. *During the pandemic period of COVID-19, I understand that dentists can not identify asymptomatic patients, and there will be cross infection risk during oral diagnosis and treatment.*
4. *I understand that any treatment has risks, and drug may cause allergies or side effects.*
5. *I promise that the following facts are true (please tick the corresponding option)*
   - A. *I have been diagnosed with COVID-19 infection*
   - B. *I have been a suspected case of COVID-19 infection*
   - C. *I have recently had symptoms of COVID-19 infection*
   - D. *I have not had any symptoms of COVID-19 infection recently*
   - E. *I have not recently been in contact with patients who have been diagnosed or suspected of being infected with COVID-19.*
6. *If you choose A . B or C in the Question 5 , please answer this question (please tick the corresponding option)*
   - A. *I have been hospitalized and have not any symptom now.*
   - B. *I have been hospitalized and have some symptoms now.*
   - C. *I have not been hospitalized and have not any symptom now either.*
   - D. *I have not been hospitalized but have some symptoms now.*

I understand the above content and promise that the choices made are true and effective.

Patient signature: *Dentist signature:* *Date:*

Appendix Table 3. The changes in the patients' diagnoses from April 20 and July 31 in 2019. Nine common diagnoses were listed in the table. Other uncommon diagnoses were classified as "Other".

	Apr 2019	May 2019	Jun 2019	Jul 2019
Caries	329 (29.14%)	929 (28.99%)	918 (29.51%)	1212 (28.40%)
Pulpitis	128 (11.34%)	304 (9.49%)	295 (9.48%)	417 (9.77%)
Apical Periodontitis	255 (22.59%)	734 (22.90%)	688 (22.12%)	943 (22.09%)
Retained Primary Teeth	92 (8.15%)	281 (8.77%)	268 (8.62%)	369 (8.65%)
Malocclusion *	86 (7.62%)	253 (7.89%)	251 (8.07%)	538 (12.60%)
Tooth Trauma *	79 (7.00%)	244 (7.61%)	236 (7.59%)	152 (3.56%)
Early Loss of Primary teeth	32 (2.83%)	89 (2.78%)	86 (2.76%)	115 (2.69%)
Deep Pits and Fissures *	19 (1.68%)	56 (1.75%)	56 (1.80%)	124 (2.91%)
Supernumerary Teeth	30 (2.65%)	78 (2.43%)	85 (2.73%)	119 (2.79%)
Other	79 (7.00%)	237 (7.39%)	228 (7.32%)	279 (6.54%)
Total	1129	3205	3111	4268

The changes in the patients' diagnoses from April 20 and July 31 in 2019. The asterisks (*) represent significant difference using Pearson Chi-square test ($P<0.05$).

Appendix Figure 1

Appendix Figure 1. The proportion of representative treatment methods and the average number of teeth/ root canal treated per visit in 2020 and 2019.

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page No
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	2
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	4
Objectives	3	State specific objectives, including any prespecified hypotheses	5
Methods			
Study design	4	Present key elements of study design early in the paper	5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	6
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	6
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	7
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	7
Bias	9	Describe any efforts to address potential sources of bias	6
Study size	10	Explain how the study size was arrived at	6
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	7
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	7
		(*b*) Describe any methods used to examine subgroups and interactions	7
		(*c*) Explain how missing data were addressed	6
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	7
		(*e*) Describe any sensitivity analyses	7
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	9
		(b) Give reasons for non-participation at each stage	9
		(c) Consider use of a flow diagram	-
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	9
		(b) Indicate number of participants with missing data for each variable of interest	-
Outcome data	15*	Report numbers of outcome events or summary measures	10-11

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	10-11
		(*b*) Report category boundaries when continuous variables were categorized	-
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	-
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	11
Discussion			
Key results	18	Summarise key results with reference to study objectives	12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	13-14
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	14-15
Generalisability	21	Discuss the generalisability (external validity) of the study results	15
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	16

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.