

Oral Health Condition and Dental Care in Children with Congenital Heart Disease during the COVID-19 Pandemic: A Systematic Review

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Abstract

Congenital heart disease (CHD) is one of the most common congenital defects, present at birth, it can affect the walls, valves or the great vessels of the heart. CHD considered to be among the most common malformations in newborn infants with an incidence of 8 out of 1000 live births worldwide. Children with congenital disease certainly need special health care. Healthy teeth and gums are important for everyone, especially for children with heart conditions. Providing children with dental care during the COVID-19 pandemic, and in particular during the increased social restrictions, can be a challenging task. The purpose of writing this systematic review is to examine about oral health condition and dental care in children with congenital heart disease during the COVID-19 pandemic. Data source of Pubmed, published from 2011-2021. After eliminating duplicated articles, the titles and abstracts of each article were analyzed across 119 articles resulting in 86 articles being excluded. The full-text articles in the remaining 33 articles were re-analyzed and excluded 23 articles and produced 10 articles which were then entered into the analysis. Based on this systematic review shows that children with congenital heart disease (CHD) have poor oral health. Education and disease awareness about and prevention of dental illnesses have to be guided and steered by the parents. The role of dentists and pediatricians is very important in this case. Providing children with dental care during the COVID-19 pandemic, and in particular during the increased social restrictions, can be a challenging task.

Keywords: CHD, Children, Oral Health, Dental care, COVID-19

Introduction

Congenital heart disease (CHD) is one of the most common congenital defects, present at birth, it can affect the walls, valves or the great vessels of the heart.¹ Cardiac defects are commonly diagnosed at the 18–20 week antenatal anomalies ultrasound scan. CHD has a range of aetiologies including; chromosomal abnormalities, maternal illness, and maternal drug use, in addition to multifactorial and isolated causes.^{2,3} Children with CHD have a decreased quality of life compared to healthy children. They present with reduced physical, motor, cognitive, and emotional functioning. Children with congenital disease certainly need special health care. The American Academy of Pediatric Dentistry (AAPD) recognizes that providing both primary and comprehensive preventive and therapeutic oral health care to

individuals with special health care needs (SHCN) is an integral part of the specialty of pediatric dentistry. The AAPD values the unique qualities of each person and the need to ensure maximal health attainment for all, regardless of developmental disability or other special health care needs.^{4,5}

Healthy teeth and gums are important for everyone, especially for children with heart conditions. Young children with CHD are at greater risk for tooth decay because their baby teeth may have weak enamel. Children with congenital heart disease may have weaker teeth due to poor oxygenation. Positional anomalies and crowding in the permanent dentition have also shown to be more prevalent in the cardiac group. Cardiac medications that may cause dry mouth can also increase risk for cavities. There are complicated background factors often associated with nutrition, medication, and the demanding situation of these children's families that all play a part in their dental health.⁶ Worryingly, a number of studies have shown that children with CHD have higher levels of untreated oral disease compared to healthy children. There are concerns that reduced access to dental care is due to a combination of limited parental knowledge, medical treatment taking priority and general dental practitioners (GDPs) not feeling confident in managing medically compromised patients.²

On March 11th 2020, The World Health Organization (WHO) characterized the Coronavirus Disease 2019 (COVID-19) as a pandemic. The disease was first reported in December 2019 to WHO China Office as pneumonia of unknown cause. Prevention of oral health in children represents the gold standard towards which health professionals specialized in paediatric dentistry should always be oriented. It is precise during the COVID-19 pandemic period that adequate management of the oral health of children becomes of crucial importance.^{7,8} The present study concluded that the COVID-19 pandemic has negatively impacted the eating habits and dental care of children. Furthermore, it has triggered moderate and high levels of fear among parents/caregivers.⁹ So the purpose of writing this systematic review is to examine about oral health condition, dental care and education in children with congenital heart disease during the COVID-19 pandemic.

Methods

Data source

A search was performed on Pubmed. Studies published from 2011-2021. Pubmed terms and keywords used for the search included various combinations of the following: "Congenital heart disease", "children", "oral health", "dental care", "COVID-19", or each of the searches, the titles and abstracts were screened and the full text versions of articles that met criteria were downloaded. The flowchart in Figure 1 identifies the included and excluded articles at each stage.

Inclusion criteria

1. Articles published from 2011-2021
2. Articles in English
3. Scientific articles that have been published and are available online
4. Articles that examine about oral health condition and dental care in children with congenital heart disease

Exclusion criteria

1. Articles in Indonesian
2. Articles that cannot be accessed for free
3. Articles that do not discuss about oral health condition, dental care and education in children with congenital heart disease

Data collection

The data that will be used in this research is secondary data. The data is obtained from articles that are searched for in the article database which will then be reviewed according to the research criteria set by the researcher.

Procedure Systematic Review

1. Literature search was conducted on the online database PubMed. In addition, a search for the list of references to articles that fall into the inclusion criteria was also carried out to find out whether there were other related studies that were relevant to this research.
2. Keywords were determined in the literature search
3. Eliminate duplicated literature
4. Articles are filtered on the basis of title, abstract, and keywords
5. Read complete or partial articles that have not been eliminated to determine whether the articles meet the eligibility criteria.
6. Data collection was done manually by creating a research matrix containing: author's name, year, title, result and conclusion.
7. Processing the data that has been obtained

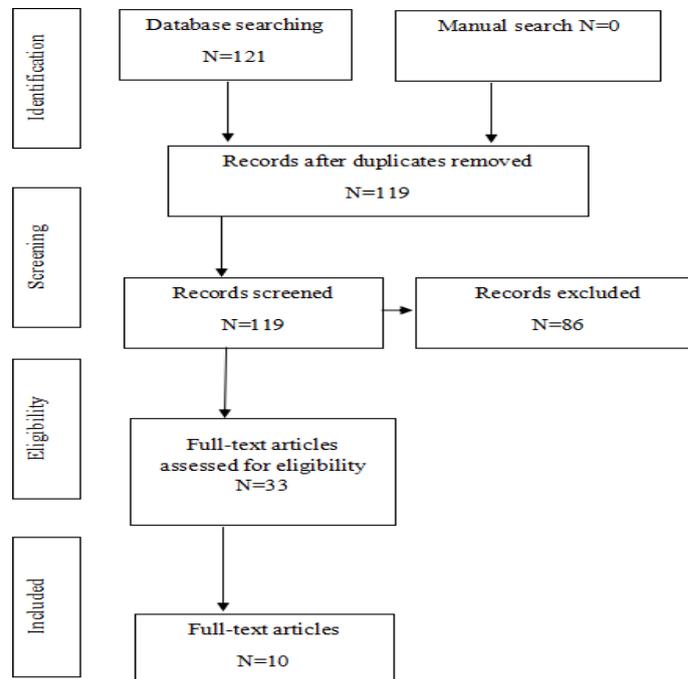


Figure 1. A flow chart describing the search methodology and numbers of articles included/excluded at each stage

Result

After eliminating duplicated articles, the titles and abstracts of each article were analyzed across 119 articles resulting in 86 articles being excluded. The full-text articles in

the remaining 33 articles were re-analyzed and excluded 23 articles and produced 10 articles which were then entered into the analysis.

Table 1. The characteristics of each article entered into a systematic review

No	Author, Year	Title	Sample (n)	Conclusion
1	Ali HM, et al.,2017 ¹⁰	Dental plaque microbial profiles of children from Khartoum, Sudan, with congenital heart defects	160	CHD cases harbored higher counts of cariogenic and periodontopathogenic bacterial species in both primary and permanent dentitions. These increases correlated positively with caries and gingivitis. Thus, the data point to the critical need to inform caregivers of the increased susceptibility of CHD patients to oral disease and the need

				for increased attention to oral care in this vulnerable population
2	Carrillo C, et al.,2018 ¹¹	Oral Health of Children with Congenital Heart Disease at a Pediatric Health Science Centre	156	Almost half of children with CHD who presented for dental consultation had severe early childhood caries.
3	Sivertsen TB, et al.,2018 ¹²	Effectiveness of an oral health intervention program for children with congenital heart defects	119	The oral health promotive program did not influence the prevalence of caries nor dental erosion. However, the findings indicated better oral hygiene, reduced gingival bleeding and less untreated dentine caries in the intervention compared with the control group.
4	Sun LC, et al.,2017 ¹³	Risk factors for infective endocarditis in children with congenital heart diseases - A nationwide population - based case control study	24.729	Invasive heart procedures were more significantly associated with: Infective endocarditis (IE) in children with CHDs while dental procedures were not an important risk factors for IE in children with CHD, regardless of whether antibiotic prophylaxis was given
5	Sivertsen TB, et al.,2016 ¹⁴	Oral health among children with congenital heart defects in Western Norway	100	More than a third of the children with CHD were found to have an oral health status that may imply risk for systemic hazardous effects
6	Cantekin K, Gumus H, Torun YA, Sahin H, 2015 ¹⁵	The evaluation of developmental enamel defects and dental treatment conditions in a group of Turkish children with congenital heart disease	128	Although there was no significant difference in the development of dental caries or the prevalence of enamel defects between children with congenital heart disease and healthy children, the care score was low in children with congenital heart disease. In addition, children with congenital heart disease had a higher rate of pulled primary teeth and delayed treatment of decayed teeth.

7	Pimentel ELC, et al., 2013 ¹⁶	Caries experience in young children with congenital heart disease in a developing country	114	Children with congenital heart disease have poor oral health at a very young age. The educational level of fathers, cyanosis, negative behavior, use of daily medicine and a one-parent family seem to influence the caries experience in children with congenital cardiac disease. Education on the importance of dental care is essential to improve oral health in the patients suffering from cardiac
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				disease.
8	Ali HM, et al.,2016 ¹⁷	Oral health related background factors and dental service utilisation among Sudanese children with and without a congenital heart defects	293	Lower frequencies of brushing and use of fluoride tooth paste were reported among CHD cases, and brushing had the predominant significant impact on caries prevalence. The child's age and the mother's level of education were the main factors affecting the child's (CHD cases) dental services utilisation.
9	Liu Z, et al.,2014 ¹⁸	Counseling Role of Primary Care Physician in Preventing Early Childhood Caries in Children with CHD	100	In conclusion, this study provided rigorous epidemiologic evidence of the important roles of PCPs in preventing ECC among children with congenital heart disease in Guangzhou, China. Mother's education level, parental awareness of IE and the impact of oral health on IE were associated with the development of ECC in children with CHD. In addition, education on improving the PCPs' knowledge and perception of oral health is also imperative now, which may provide an important basis for enhancing their role in preventing dental caries in children with CHD.
10	Ali HM, et al.,2017 ¹⁹	Presence of plaque, gingivitis and caries in Sudanese children with congenital heart defects	293	The findings clearly showed that this group of Sudanese children with CHDs was more severely affected with gingivitis and caries than the control group without CHDs. These results are cause for concern in children at risk of developing systemic infections and serious complications related to poor oral health.

Discussion

Congenital heart diseases (CHD) and structural changes of the heart are considered to be among the most common malformations in newborn infants with an incidence of 8 out of

1000 live births worldwide. Therefore, the practice of antibiotic endocarditis prophylaxis, which has been revised and published in 2007 and 2015 by the American Heart Association (AHA), and the importance of excellent oral health in all patients with CHD have to be established and reinforced.²⁰⁻²³ Poor oral health in children with cardiac conditions can have negative effects on quality of life. The impact of poor oral health may exacerbate other health problems for children with cardiac conditions including low weight gain, and difficulty with eating.²⁴⁻²⁶ Oral health is important to the systemic health of all children but is of greater importance for children with congenital heart disease (CHD), who are at increased risk for infective endocarditis.^{22,27} The risk for developing IE varies markedly among the types of CHD lesions.¹³

One of the most important health problems in normal child population worldwide is dental caries and periodontal diseases. These two global health problems are more considered in children with congenital heart disease (CHD).^{28,29} Study by Pimentel ELC, et al., showed that children with congenital heart disease have poor oral health at a very young age.¹⁶ Children with CHD have high percentages of untreated carious lesions, gingival inflammation, and plaque accumulation in both the primary and permanent dentition.¹⁹ Almost half of children with CHD who presented for dental consultation had severe early childhood caries.¹¹ Ali HM, et al., found that caries and gingivitis were both significantly more prevalent in the CHD cases.¹⁰ Sivertsen TB, et al., more than a third of the children with CHD were found to have an oral health status that may imply risk for systemic hazardous effects, caries prevalence at dentine level was found to be significantly higher than the reported prevalence in the general population of same age.¹⁴ On the other hands, study by Cantekin K, et al., showed that there was no significant difference in the development of dental caries or the prevalence of enamel defects between children with congenital heart disease and healthy children, but the care score was low in children with congenital heart disease. In addition, children with congenital heart disease had a higher rate of pulled primary teeth and delayed treatment of decayed teeth.¹⁵

The bacterial composition of plaque samples from CHD cases showed higher counts of several bacterial species, including some with high carcinogenicity and periopathogenicity, with significant positive correlations with the level of gingivitis in both CHD cases and controls.¹⁰ The same bacteria (e.g. *S. mutans* and *P. gingivalis*) are also known to cause bacterial infective endocarditis and other systemic complications among children with CHD.³⁰ Children with CHD had a higher caries experience compared with the general pediatric population, with most lesions untreated. The delayed presentation was associated with greater caries experience. The high prevalence of untreated carious lesions, minimal dental treatment received prior to presentation, and late age of referral suggest that better access for timely, appropriate preventive and operative care is needed.²⁴ Children with CHD must be treated in a precise, diagnosis-specific manner in caries risk assessment. Caries

experience in the primary dentition was the only significant predictor of permanent dentition caries incidence.³¹

This seems especially important as children with complex CHD reach adulthood nowadays and remain in need of life-long medical follow-ups. Education and disease awareness about and prevention of dental illnesses have to be guided and steered by the parents. Ali HM, et al.,¹⁷ the effects of brushing" and „mother"s level of education" were significantly influencing caries prevalence among CHD cases. Study by Liu Z, et al.,¹⁸ also showed that mother"s education level, parental awareness of IE and the impact of oral health on IE were associated with the development of ECC in children with CHD. The earlier and the more clearly that this information is passed on to the children, the better will be their dental and general quality of life and the lower their individual risk for Infective endocarditis (IE). However, this is a process that has to be guided by dentists and pediatricians alike.²⁰ Sivertsen TB, et al.,¹² that the intensive oral health promotion program did not influence the caries or the dental erosion, but indicated better oral hygiene, reduced gingival bleeding and less untreated dentine caries in the intervention compared to the control group, all beneficial for avoiding future risk of infective endocarditis.

Study by Carrillo, et al.,¹¹ showed that most children with a cardiac lesion referred for dental consultation who presented with caries required treatment under general anesthesia. Although a general anesthetic for dental intervention is frequently needed, it imparts additional risks of morbidity or mortality when required in advance of corrective cardiac surgery or for children with unstable cardiac conditions. Because dental caries is a preventable disease, health care providers who treat children with CHD should consider a more collaborative approach to ensure oral health is optimized in this at risk population. This can be achieved by a combination of awareness of health care providers of the importance of oral health and its role in systemic health and "front-line providers" emphasizing to parents the importance of a non-cariogenic diet, initial dental assessment by 1 year of age and preventive dental care to mitigate caries risk for this medically compromised patient population.^{11,18}

Children with congenital heart disease (CHD) are often at increased risk of developing infective endocarditis (IE). Maintaining good oral health is an essential aspect of reducing this risk. Good oral and dental health is thought to be important to prevent IE. Since IE risk is increased in the 6 months following cardiac surgery it is recommended that a child should have a dental assessment and any necessary treatment carried out before they have cardiac surgery. However, children with CHD should be dentally healthy all the time in order to reduce their risk of IE.³² Guidelines published in 2018 by the Scottish Dental Clinical Effectiveness Programme (SDCEP) provide advice for dentists for the implementation of the National Institute for Health and Care Excellence (NICE) guidelines for antibiotic prophylaxis for invasive dental procedures.^{21,33,34} Prophylactic antibiotics must be given according to the guidelines. A survey conducted by Sivertsen TB, et al.,³⁵ shows that over-prescription of endocarditis antibiotics among children with CHD should be taken seriously. Perhaps posters with the key contents of the ESC guidelines should be distributed at the local dental clinics, with a request for feedback about whether or not the antibiotic prophylaxis guidelines are felt to be consistent and easy to follow. The current restricted prophylaxis

guidelines mean that optimal oral hygiene is even more important than ever. Education about children with CHD is also needed in dentistry and in dental education.

During late 2019 and early 2020, a new fatal disease called coronavirus disease 2019 (COVID-19) broke out in China and Southeast Asia. The World Health Organization (WHO) announced that the COVID-19 outbreak had become a public health emergency of international concern on January 31, 2020, and then categorized it as a pandemic on March 11, 2020.^{36,37} COVID-19 is difficult to control in the dental environment. Due to the nature of dental treatment, procedures typically produce aerosols and splatters, which can contain large amounts of saliva or blood from patients and thus carry the risk of large-scale transmission of the virus.^{38,39} Providing children with dental care during the COVID-19 pandemic, and in particular during the increased social restrictions, can be a challenging task. Dental health in children with CHD must have more attention paid to it. Primary care physicians (PCPs), as community-based primary care medical providers, play an important role in providing access to preventive dental services, particularly for preschool children. According to the previous research, screening, referral and counseling were the traditionally recommended interventions for the PCP to prevent dental caries in preschool children in some developed countries. But in the era of pandemics, counseling can be done through teledentistry.^{18,40}

It is precisely during the COVID-19 pandemic period that a specific classification of dental emergencies and dental non-emergencies becomes of crucial importance. Some potentially life-threatening real dental emergencies such as uncontrolled bleeding, diffuse soft-tissue bacterial infection and maxillofacial fractures occur by accident. However, the most common reason for dental-related emergency department visits was not a matter of life-and-death such as dental caries and trauma. Dental non-emergencies that do not require immediate intervention can take palliative measures to reduce the occupation of emergency visit and minimize infection risk of COVID-19. Attention has been aroused by various dental organizations due to the complexity of pediatric emergency during COVID-19 lockdown.⁴¹⁻⁴⁵

Paediatric dentistry is an age-defined speciality that provides both primary and comprehensive, preventive and therapeutic oral health care for infants and children through adolescence, including those with special health care needs, like congenital heart disease (CHD). The paediatric dentist needs to keep abreast with the day-today developments in this pandemic and also the behaviour of the virus. They should follow the guidelines prescribed by their respective local associations and do not follow unverified sources. Always try to evaluate the need for precautions and preventive measure to put in place when treating an emergency, including the proper preventive attire, both for patient and parents.^{46,47}

Protocols to be followed by paediatric dentists:^{47,48,49}

1. Proper screening of all patients, even if asymptomatic.
2. Consider all paediatric patients (mostly asymptomatic) and parents as carriers of the virus
3. Consider the patients who have recovered recently as potential carriers of the virus for 30 days
4. Identifying the urgency of the treatment needed, especially for child patient as they are more vulnerable to the virus and consider preventive and minimally invasive treatment

5. Categorically classify all procedures according to the urgency of treatment and weighing the risk-benefit ratio
6. Urgent cases like severe unbearable pain due to pulpal involvement that needs pulp therapy and extraction should be performed with proper care of the child and parent including airborne precautions with PPEs for every case.
7. The paediatric dentist should try to reduce stress in parents and children and create a relaxed and anxiety-free environment
8. Always follow local, national and global guidelines when treating patients.

Tele-screening of patients is required, collecting information about symptoms of COVID-19 and recent travel history to and from epicentres of COVID-19. Only emergency management of life threatening/severe pain conditions not subsiding with medications. In case paediatric dental professionals must offer treatment on a face-to-face basis, they should follow all precautions that have been put in place to reduce the risk of crossinfection during treatment and evidence comprehensive risk assessment completion.^{50,51,52,53,54,55}

Conclusion

Children with congenital heart disease (CHD) have poor oral health. This seems especially important as children with complex CHD reach adulthood nowadays and remain in need of life-long medical follow-ups. Education and disease awareness about and prevention of dental illnesses have to be guided and steered by the parents. However, this is a process that has to be guided by dentists and pediatricians alike. Providing children with dental care during the COVID-19 pandemic, and in particular during the increased social restrictions, can be a challenging task.

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