ORIGINAL RESEARCH

A Comparative Assessment of Dental Caries Experience in Relation to Nutritional Status among 6–12-year-old School-going Children and Those with Congenital Heart Disease in Bhubaneswar City

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Abstract

Aim: To assess the dental caries experience in relation to nutritional status among 6–12- year-old school-going children and those with congenital heart disease in Bhubaneswar city.

Materials and methods: A cross-sectional study was conducted among 6–12-year-old healthy school-going children and those with congenital heart disease for a period of 6 months (October 2019–March 2020) in Bhubaneswar, India. Type III clinical examination was carried out as per American Dental Association (ADA) specifications using plane mouth mirrors and community periodontal index (CPI) probes. Clinical oral examination and measurement of the weight and height of the child were performed by a single examiner. Data was analyzed using Statistical Package for the Social Sciences (SPSS) version 21.0.

Results: The overall mean decayed missing filled primary teeth surfaces (dmfs) in primary dentition was higher (5.93 ± 10.224) in subjects with congenital heart disease (CHD) (group I) than in healthy controls (3.41 ± 6.192). The overall mean decayed missing filled permanent teeth surfaces (DMFS) in permanent dentition was 0.33 ± 1.105 in subjects with CHD (group I) and 0.24 ± 0.714 in group II. In group I, the majority of them (58.9%) were underweight, followed by 41.1% who were a healthy weight. However, in group II, 47.9% of the study subjects were healthy weight, 26.1% were underweight, 14.4% were obese, and 11.7% were overweight.

Conclusion: This study concluded that children with CHD have a higher dental caries experience and poor nutritional status as compared to healthy school-going children.

Keywords: Congenital heart disease, Dental caries, Nutritional Status, Oral health.

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Introduction

One of the most prevalent birth defects in the world is congenital heart disease. The defects can range in severity from modest (small opening in the heart) to severe (parts of the heart missing or poorly formed).[1] Common anomalies include the ventricular septal defect (VSD) and atrial septal defect, but significant CHDs include the coarctation of the aorta, tetralogy of fallot, and hypoplastic left heart syndrome.

In developing nations, the prevalence of CHD is significant due to the high birth rate.[2] A total of >2,00,000 infants are thought to be born in India each year with CHD, out of a total of 1.35 million worldwide.[3] According to research, CHD causes about 27.5% of stillbirths and 10% of infant deaths in India,[4] making it a significant health burden.

Depending on the kind and degree of the specific problem, there may be signs and symptoms of CHDs. Most newborns with CHDs have unknown etiology. It is hypothesized that it results from a complex interaction between genes and environmental, dietary, and maternal factors.[1]

The treatment protocol for CHDs depends on the type and severity of the defect present. Some children might need surgical intervention to repair the defect, while some can be treated without surgery.

Studies have shown that children with CHD have poor oral health and a high prevalence of dental caries as compared to healthy controls.[5] In addition to dentoalveolar infections, children diagnosed with CHD and requiring surgical interventions also possess the risk of acquiring infective endocarditis.[6]

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Developmental enamel defects and inadequate oral hygiene practices make their teeth prone to dental caries. It has been noted that the medicines prescribed to patients with CHD contain 30–50% of sugar.[7] Hypoxia in children suffering from cyanotic CHD was found to be another factor for dental caries.[8]

High incidence of gastroesophageal reflux, frequent ingestion of sweetened nutritional supplements, and xerostomia are other

potential factors toward an increase in untreated decayed teeth in children with CHD.[9] As the oral cavity might be a source of bacteremia, dental caries left untreated in such patients are also believed to delay cardiac treatment.[10]

Children with CHD are generally found to have decreased height and weight. In a study by Panggabean et al., it was discovered that children with CHD[11,12] had malnutrition that was more severe and pervasive. Similar findings were made by Al-Etbi, who found that 60% of the kids with VSD were underweight. Similar results were found in research by Hassan et al.[13] that showed a high incidence of 84% malnourished individuals with CHD compared to controls.

The adverse impact of CHD on the nutritional status can be attributed to the increase in total energy expenditure amongst these patients.[7] Feeding children with CHD is difficult, which results in insufficient intake of calories thereby resulting in impaired growth.[14]

There is evidence linking obesity and dental caries brought on by consuming sugary foods and drinks, as well as social, behavioral, and physical inactivity factors.[15] Earlier studies investigating the connection between dental caries and body mass index (BMI) in students discovered that 87.1% of them were underweight.[16] According to a study by Clarke et al., severe early childhood caries may be a sign of undernutrition because it interferes with eating and sleeping patterns.[17]

It has also been stated that there is a high prevalence of dental caries in children who are underweight. This might be due to the fact that caries in primary dentition is associated with undernutrition in early childhood.[18]

Poor dietary practices, morphology, and the sequence of tooth eruption all affect how susceptible a tooth is to dental caries.[16] Studies on the enamel problems that lead to dental caries in kids with congenital heart abnormalities are scarce. Oral hygiene practices have also yielded disappointing findings in other research that evaluated the attitudes and knowledge of caregivers of children with CHD.[19,20] The majority of them had not taken their child to the dentist despite being aware of their child's dental health.

In India, a significant majority of children with CHD go undetected and untreated as a result of the rise in cases and the lack of adequate healthcare resources. Lack of initiative prevents the provision of thorough medical care and raises knowledge of birth abnormalities. The systemic and oral health of children with CHD must be improved by collaboration between doctors and dentists. It is crucial to promote basic dental care practices in children with CHD after doing an early oral examination.

Limited research has been carried out regarding oral health and nutritional assessment of children with congenital heart disease in India. Despite advances in cardiac management, there is a lack of information regarding the dental aspect of these patients. Keeping this in mind, the present study has been conducted with the aim to assess the dental caries experience and nutritional status among 6–12-year-old children with congenital heart disease as well as healthy controls. Further, this study also intended to correlate the relationship between dental caries and nutritional status in the two groups.

Methodology

A cross-sectional study was conducted among 6–12-year-old healthy school-going children and those with congenital heart disease for a period of 6 months (October 2019–March 2020) in Bhubaneswar, India. A minimum total sample size of 386, 129 in group I (children with congenital heart disease) and 257 in group II (healthy children) was found to be sufficient for an alpha of 0.05, power of 95%, 0.4 as effect size (assessed for the difference in the mean number of decayed primary and permanent teeth).

The stratified cluster random sampling technique was followed. Children with no antibiotic prophylaxis and under cardiac medications for at least three months from the start of the examination date were included in the study. Children who were uncooperative for clinical examination during the study or with any type of severe systemic disease other than congenital heart disease were excluded.

Type III clinical examination was carried out using plane mouth mirrors and CPI probes. Clinical oral examination and measurement of the weight and height of the child were performed by a single examiner. Written informed consent was obtained from the parent/guardian of the child prior to the start of the study. Training and calibration of the examiner and recording assistant were carried out in the Department of Public Health Dentistry, Kalinga Institute of Dental Sciences, KIIT Deemed to be University, Bhubaneswar, under the supervision of the guide. The study was approved by the Institute Ethics Committee (IEC) of Kalinga Institute of Medical Sciences, Bhubaneswar, Odisha, with the reference number KIMS/KIIT/IEC/183/2018. The procedures adhered to the ethical guidelines of the Declaration of Helsinki. Data was analyzed using SPSS version 21. The normality of the continuous data was checked by the Shapiro–Wilk test. Bivariate analysis was performed using the Chi-squared test, independent *t*-test and one-way analysis of variance along with the *post hoc* Bonferroni test. The Chi-squared test is used to compare categorical data. A one-way analysis of variance test was used to compare more than two independent means. *Post hoc* pairwise comparison was done using the *post hoc* Bonferroni test. Multivariate analysis was done using the binomial logistic regression model to explore the association between BMI and dental caries. The level of statistical significance was set at 0.05.

Results

The study population consisted of 129 children with congenital heart disease (group I) and 257 healthy controls (group II). Gender-wise distribution is as follows—in group I, 67 (51.9%) were males, and 62 (48.1%) were females. In group II, 158 (61.5%) were males, and 99 (38.5%) were females. The mean age of the subjects was 7.13 and 8.41 in groups I and II, respectively (Table 1).

Among the study subjects, in group I, all of them used toothbrushes for cleaning their teeth, whereas in group II, 256 (99.6%) used toothbrushes, and I (0.4%) used fingers. No statistical significance was observed. All the participants in group I brushed their teeth in a horizontal manner, whereas in group II, 224 (87.2%) brushed horizontally, and 33 (12.8%) followed the circular method of toothbrushing. This difference was found to be statistically significant (Fig. 1).

The overall mean decayed missing filled primary teeth surfaces (dmfs) in primary dentition was higher (5.93 ± 10.224) in subjects with CHD (group I) than in healthy controls (3.41 ± 6.192), and this difference was statistically significant ($p < 0.05$) (Table 2).

The overall mean decayed missing filled permanent teeth surfaces (DMFS) in permanent dentition was 0.33 ± 1.105 in subjects with CHD (group I) and 0.24 ± 0.714 in group II, and no statistically significant difference was observed (Table 3).

The distribution of study participants according to BMI categories are as follows—in group I, the majority of them (58.9%)

Table 1: Sociodemographic variables

	Age			*Gender*		*Total*
	N	*Mean*	*Standard deviation (SD)*	*Males N (%)*	*Females N (%)*	*N (%)*
Group I	129	7.13	0.666	67 (51.9%)	62 (48.1%)	129 (100.0%)
Group II	257	8.41	0.923	158 (61.5%)	99 (38.5%)	257 (100.0%)

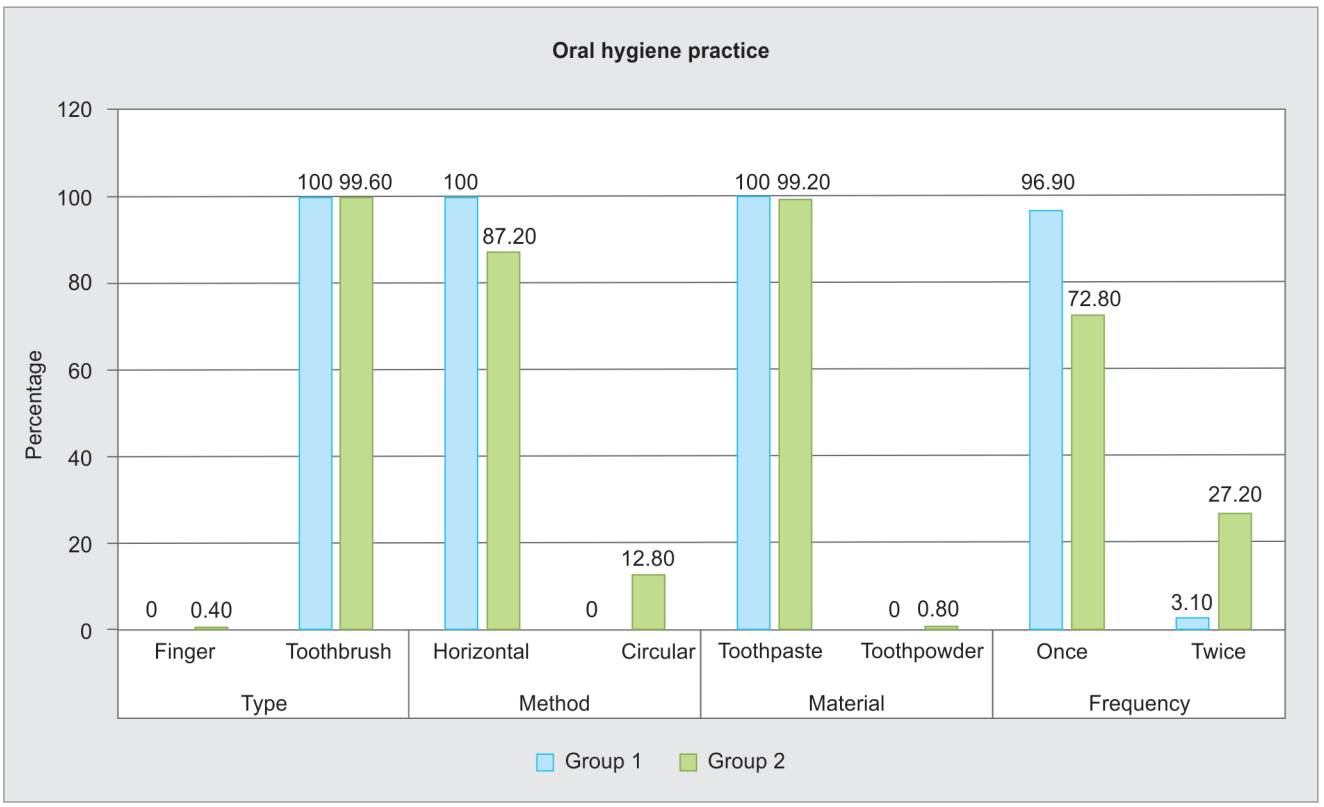

Fig. 1: Oral hygiene practices

were underweight, followed by 41.1% who were of healthy weight. However, in group II, 47.9% of the study subjects were healthy weight, 26.1% were underweight, 14.4% were obese, and 11.7% were overweight (Fig. 2).

It was observed that the odds of the occurrence of dental caries in group II is 0.8376 times less than that of group I. For gender, the odds of occurrence of dental caries were 1.467 times more in females than males, and no statistically significant difference was found. For frequency of cleaning, the odds of occurrence were 0.166 times less in those who brushed twice daily than the ones who brushed once, and this difference was found to be statistically significant ($p < 0.05$) (Table 4).

For BMI, it shows that the occurrence of dental caries in category 2 is 0.571 times less than that of category 1, which was found to be statistically significant.

Discussion

Congenital heart disease is one of the major disease burdens in the world. Apart from various systemic conditions, children with CHD are at risk of poor oral health. Integration of oral and general health services is essential in improving their oral health status. Thus, the present study aimed to assess the dental caries experience in relation to nutritional status among children with CHD and healthy controls in Bhubaneswar city.

In the current study, 257 healthy controls and 129 patients with congenital heart disease participated. The study's participants were between 7.13 and 8.41 years old on average. In research by Zahra et al., similar findings were seen, with children's mean ages with and without CHD being 7.8 and 7.4 years, respectively.[8] In another study, it was discovered that the average age of children with CHD was 8.78 and 8.43 in the control group.[21] In group I, there was 67 (51.9%) males and 62 (48.1%) females, while in group II, there were 62 (48.1%) males and 99 (38.5%) females. In a study conducted by Sivertsen et al., the case group had 58.7% females, while the control group had 52.2%.[5]

Results of this study show that all the children with CHD cleaned their teeth using a toothbrush, whereas only one (0.4%) among the healthy controls used fingers for cleaning. All the participants with CHD and the majority of them, 224 (87.2%) without CHD, followed the horizontal method of tooth brushing. It was seen that all children with CHD used toothpaste, but in those without CHD, 255 (99.2%) used toothpaste, and two (0.8%) of them used toothpowder. Among the study subjects with CHD, 125 (96.9%) brushed their teeth once daily, four (3.1%) brushed twice, and the majority of the healthy controls, 187 (72.8%),

Table 2: Mean comparison of dmfs between the groups in primary dentition

	Group I (N = 129)		*Group II (N = 257)*		
	Mean	*SD*	*Mean*	*SD*	*p-value*
Decayed surfaces	5.93	10.224	3.39	6.158	0.033, significant (S)
Filled with decay surfaces in primary dentition	0.00	0.000	0.02	0.152	0.219, nonsignificant (NS)
Filled without decay surfaces in primary dentition	0.00	0.000	0.02	0.197	0.316, NS
Missing due to decay surfaces	0.00	0.000	0.00	0.062	0.479, NS
Missing surfaces due to other reasons	0.00	0.000	0.00	0.000	
DMFS in primary dentition	5.93	10.224	3.41	6.192	0.031, S

dmfs, decayed missing filled primary teeth surfaces; DMFS, decayed missing filled permanent teeth surfaces

Table 3: Mean comparison of DMFS between the groups in permanent dentition

	Group I (N = 129)		*Group II (N = 257)*		
	Mean	*SD*	*Mean*	*SD*	*p-value*
Decayed surfaces	0.33	1.105	0.23	0.713	0.673, NS
Filled with decay surfaces in permanent dentition	0.00	0.000	0.00	0.000	1.000, NS
Filled without decay surfaces in Permanent dentition	0.00	0.000	0.00	0.000	1.000, NS
Missing surfaces due to caries in permanent dentition	0.00	0.000	0.00	0.000	1.000, NS
Missing surfaces due to other reasons in Permanent dentition	0.00	0.000	0.00	0.000	1.000, NS
DMFS in permanent dentition	0.33	1.105	0.24	0.714	0.604, NS

Significant at *$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$

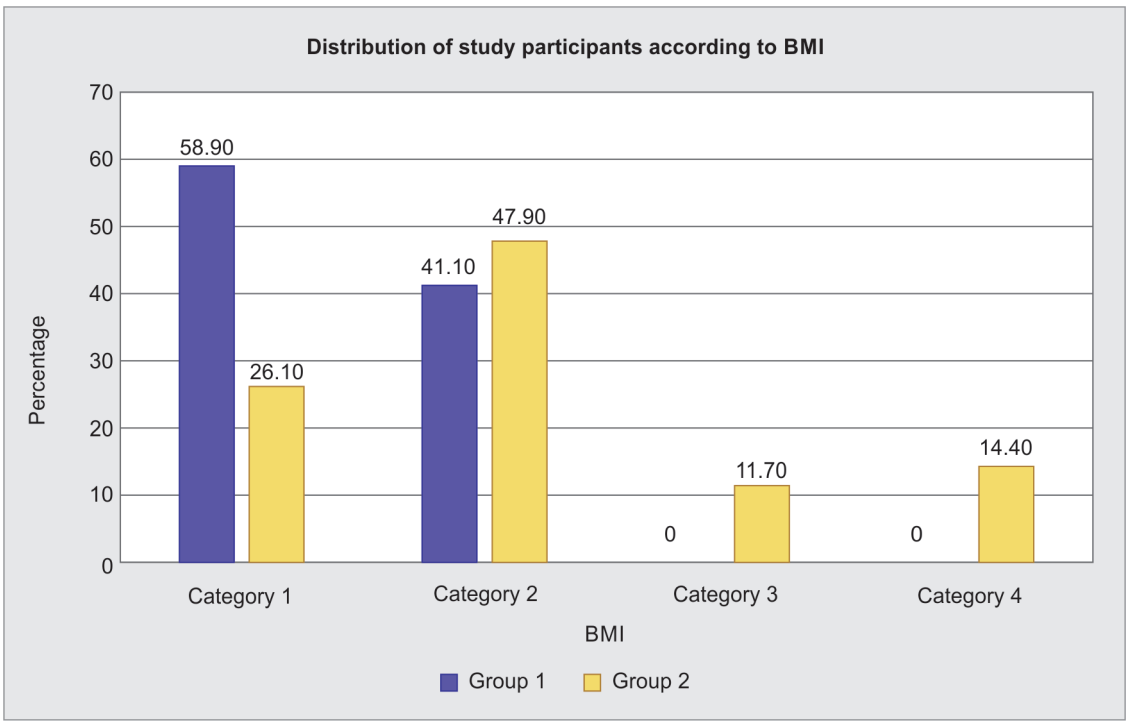

Fig. 2: Distribution of study participants according to BMI categories

brushed their teeth once a day. Similarly, in a study done by Reshma Suvarna et al., it was seen that 87.4% of the study participants used toothbrushes and toothpaste for cleaning their teeth.[22] However, 56.3% of the subjects brushed their teeth twice daily, and 42.5% of them brushed once.[22]

Schulz-Weidner et al. conducted a study where it was found that children without CHD brushed twice a day (65.4%) when compared to 45.1% of them with CHD.[23] This might be due to hospital stays for a prolonged period, thereby neglecting oral health and delaying dental appointments.[23]

The mean decayed missing filled primary teeth (dmft) and dmfs in primary dentition were 2.33 and 5.93, respectively, among subjects with CHD, whereas 1.62 and 3.41 were among healthy controls, which was observed to be statistically significant ($p < 0.05$). The mean decayed missing filled permanent teeth (DMFT) and DMFS in permanent dentition were 0.29 and 0.33 among subjects with CHD. However, for healthy controls, it was 0.20 and 0.24, respectively. No statistical significance was observed.

Similarly, in a study carried out by Chowdhury et al., the mean dmft in primary dentition was 2.42 among children with CHD, which

Table 4: Correlation between the variables between the two groups

		B	*Standard error*	*Wald*	*Degree of freedom*	*p-value*	*Odds ratio (OR)*		*95% confidence interval (CI) for OR*
							Lower		*Upper*
Step 1a	Group I (CHD children)	Reference category							
	Group II (healthy children)	–0.178	0.311	0.326	1	0.568	0.837	0.455	1.541
	Age	0.101	0.133	0.578	1	0.447	1.107	0.852	1.437
	Gender (males)	Reference category							
	Gender (females)	0.383	0.235	2.668	1	0.102	1.467	0.926	2.324
	Frequency of cleaning as once	Reference category							
	Frequency of cleaning as twice	–1.798	0.313	32.952	1	<0.001	0.166	0.090	0.306
	BMI category 1	Reference category							
	BMI category 2	–0.560	0.258	4.698	1	0.030	0.571	0.344	0.948
	BMI category 3	0.110	0.469	0.055	1	0.815	1.116	0.445	2.799
	BMI category 4	0.032	0.428	0.006	1	0.939	1.033	0.447	2.389

was higher when compared to the control group (0.009), and the mean DMFT in permanent dentition was 2.15 and 0.13, respectively.[20] This could be due to decreased dental intervention in children with CHD as a result of the complexity of cardiac diseases.[20] Ajami et al.,[24] in their study, found that the mean DMFT was higher in the control group (2.87) than in subjects with CHD (2.81). It was stated that this might be because of an increase in patients' awareness regarding nutrition and oral healthcare.[24]

On the assessment of nutritional status, it was found that the majority of the children were underweight (58.9%), and 41.1% were a healthy weight. Amongst the healthy controls, 47.9% were healthy weight, 26.1% were underweight, 14.4% obese, and 11.7% were overweight. The mean BMI of those with and without CHD was 13.455 and 16.366, respectively.

Similar findings were seen in a study conducted by Balogun and Omokhodion in which children with CHD had lower mean scores for weight for height, height for age and weight for age as compared to healthy controls.[25] It has been suggested that this could possibly be for a wide range of reasons like the poor socioeconomic status of parents leading to poor nutrition of the child, parental malnutrition resulting in birth defects and the metabolic pathway determining energy production.[25]

Hassan et al., in their study, found the prevalence of malnutrition to be 84% in subjects with CHD and 20% in the control group.[13] Batte et al. in their study observed that 42.5% of children with CHD were underweight.[26] The results were similar in studies done by Vaidyanathan et al.[27] and Okoromah et al.,[28] where the prevalence of malnourished children was 59.0 and 90.4%, respectively. This was explained due to factors such as the distribution pattern and severe complications of congenital heart diseases.[13] In contrast, Vaidyanathan et al., in their study, mentioned that socioeconomic status and diet had no impact on the nutritional status.[27,28]

The present study points out that the occurrence of dental caries was 0.8376 times less in healthy controls than in children with CHD. This was in accordance with the study conducted by Ali et al., where the occurrence of caries was twice more in CHD cases than in controls.[19]

It was observed that females were 1.467 times more at risk than males for the occurrence of dental caries. Whereas a study done by Idrees et al. showed that males had two times more risk of developing dental caries compared to females.[29] The possible reasons for females having a higher dental caries experience than males could be due to hormonal differences, early tooth eruption and a difference in the dietary lifestyle.[30]

With regards to the frequency of cleaning, the occurrence of dental caries was found to be 0.166 times less in those who brushed twice daily than those who brushed once. It is believed that tooth brushing removes the biofilm effectively, and fluoride present in dentifrices helps in caries prevention.[31]

A similar finding was observed in another study where children who did not brush their teeth frequently had 5.02 times more chances of occurrence of caries than those who brushed frequently.[19] Suvarna et al. in their study have also reported how low brushing frequencies resulted in unsatisfactory oral hygiene among children with CHD.[22]

For nutritional status, it was seen that the chances of occurrence of dental caries in children who were healthy weight were 0.571 times less than that of underweight children. Al-Ansari and Nazir[32] in their study, found that the participants with high caries experience were 2.21 times more likely to have obesity than those with low caries experience.

This study emphasizes the importance of dental care for kids with CHD in order to stop the advancement of tooth problems. Such children's parents or caregivers should be educated on the value of good oral hygiene practices and the necessity of receiving dental care. Additionally, this at-risk group's metabolism and functioning are significantly influenced by nutrition. Children who are malnourished or underweight have a higher risk of getting dental caries; hence required preventive measures should be implemented.

In order to reduce the possibility of selection bias, the study's participants with CHD were drawn from a variety of cardiac care facilities in the city of Bhubaneswar. Additionally, multicentric investigations produce a wider variety in the instances selected. To the best of our knowledge, no research has been done in India that examined the relationship between nutritional status and dental caries in kids with CHD.

Conclusion

This study concluded that children with CHD have a higher dental caries experience and poor nutritional status as compared to healthy school-going children. Along with the regular visits to the pediatrician, these children should also be taken for dental

checkups for early diagnosis and prompt provision of services. There is a need to educate parents, caregivers, nurses and healthcare workers regarding the importance of good oral health in children with cardiac diseases. The relationship between oral and systemic health should be stressed, and public health programs targeting this group should be initiated at the grassroots level.

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