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COMPARATIVE ANALYSIS OF PREVALENCE OF DENTAL CARIES WITH SALIVARY FLOWRATE AND SALIVARY pH BETWEEN CHILDREN WITH CONGENITAL HEART DISEASE AND NORMAL CHILDREN

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ABSTRACT

Dental caries is a widely observed chronic disease in humans, and anyone can be at risk of dental caries throughout their lifetime. Importantly, dental caries is the most common disease associated with oral health in school-aged children. Congenital heart disease (CHD) is the one of the most common congenital anomalies in children; approximately 8-10 of the 1000 children around the world are born with CHD. The salivary buffering capacity neutralizes acids in plague, dilute acids, transport the acid from the oral cavity, thus preventing a harmful pH change, and helps remineralization process by providing some minerals. This study is designed to evaluate the differences in frequency of dental caries, and association with salivary flow rate and salivary pH in children with CHD in comparison with that of normal children. The present study utilized dmft index (Henry T.Klein, Carrole E. Palmar and Knutson J.W in 1938) method for evaluation of dental caries and unstimulated method for salivary flow rate and quick chair side test for salivary pH. An oral examination was done for dental caries with patient seated on dental chair under bright light using a mouth mirror and WHO probe. Teeth should be examined by visual means and only the small lesions should be checked by using WHO probe. Saliva was collected in a plastic measuring tube by draining method (make the patient sit on a dental chair facing forward and downward and saliva was allowed to drip off the lower lip into a measuring tube fitted with funnel and the subject expectorates into the measuring tube at the end of collection period) for 3 minute and was assessed for flow rate per minute and values were collected. Salivary pH was measured by using portable pH meter and values were collected. Quick chair side test was used for salivary pH. The mean ± SD values of salivary pH in category of CHD patients was 6.504± 0.053 in children of CHD category, while the mean ± SD values of salivary pH in children of control category was 6.518 ± 0.040. The Mean ± SD values of salivary pH in children with CHD was lower than that of controls. The difference was significant statistically. ($p< 0.05$). The mean ± SD values of salivary flow rate in children of CHD category was 0.330 ± 0.014 ml/min, while the mean ± SD values of salivary flow rate in children of control category was 0.734 ± 0.015 ml/min. The mean ± SD values of salivary flow rate were lower in children in CHD category than control category. The findings were significant statistically. ($p< 0.05$). Salivary flow rate, pH were significantly diminished in children with congenital heart disease, and they had worse dental status compared to controls. Therefore, continuous monitoring of oral hygiene status is imperative in this group of patients.

KEYWORDS: Dental caries, salivary flow rate, salivary pH, CHD, children.

INTRODUCTION

Damage to the tooth enamel results in dental caries, sometimes referred to as tooth decay.[1] Everyone is susceptible to developing dental caries throughout the course of their lifetime because it is a chronic illness that is extensively documented in humans. Importantly, the most prevalent condition affecting oral health in school-aged children is dental caries. The World Health Organization (WHO) estimates that dental caries affects 60–90% of kids worldwide, mostly in developing nations. Dental caries are often under good control in industrialized nations, although their prevalence is rising in low- and middle-income nations. Children who have dental caries experience pain, which can make it difficult for them to eat, sleep, or communicate. It can also make it difficult for them to focus in class, which can have an impact on their scholastic development. Dental caries can cause excruciating pain and illness if it is not identified and treated right once, and if it is not treated, severe dental caries may necessitate expensive surgical intervention.[2]

Salivary flow is a crucial element because it favors the removal of bacterial substrates, safeguards the oral surfaces, and aids in regulating the growth of caries. A decrease in salivary flow has the potential to set off a chain of events that leads to the accumulation and maturation of the biofilm, the acidity of the microenvironment, and the selection of bacteria that produce acid. Due to its dependence on other salivary parameters (such as pH and buffer capacity), salivary flow rate may be the greatest clinical predictor of saliva's protective qualities.[3-5]

One of the most prevalent congenital defects in infants is congenital heart disease (CHD), which affects 8 to 10 out of every 1000 newborns worldwide. Children with serious heart disease are known to frequently experience oral health issues, particularly when they are young. As a result, a rising number of patients need meticulous dental care. Medication for heart failure was frequently necessary for this group of kids. It is generally known that these medications alter the biochemical characteristics of saliva, including the quantities of free radicals and antioxidants, but it is unclear whether there is a connection between these biochemical characteristics and oral health issues.[6-7]

Saliva production and quality are crucial factors in maintaining good oral health because they can help stop erosion and tooth caries. The salivary buffering capability prevents a hazardous pH change by neutralizing acids in food, diluting acids, transporting acids from the oral cavity, and giving certain minerals to aid in the remineralization process. Bicarbonate levels are crucial for maintaining the ability to neutralize acids, and when salivary secretion is inadequate, the ability of the saliva to act as a buffer also declines.[8-11]

The purpose of this study is to compare the frequency of dental caries in children with CHD to that of typically developing children, as well as their associations with salivary flow rate and pH.

METHODS AND MATERIALS

Source of data: A total number of 120 patients, 60 each in two groups were selected from the outpatient department.

This was a case control study employing convenient sampling method comprising of two groups, of 60 children with CHD in the study group and 60 healthy children in control group (The sample size estimation was done using G*POWER 3.1.9.2 Software and keeping the alpha error as 5% and power as 90%. The estimated total sample size is 120).

INFORMED CONCENT:- All potential participant's parents were explained about the study in a simple yet detailed manner. If the parents desired to be a part of the study then his/her consent (signature/thumb impression) was recorded in the informed consent form as in Annexure.

TYPE OF THE STUDY: In vivo study.

Financial details and conflict of interest
This study has not received any financial support from any organisation or individual therefore there is no conflict of interest in this regards.

MATERIALS TO BE USED

- Dental chair
- Gloves
- Face mask
- Mouth mirror
- W.H.O Probe
- Kidney tray
- Saliva measuring tube with funnel
- pH meter
- Index scoring sheet

METHOD

This was a case control study employing convenient sampling method comprising of two groups of 60 children with CHD in the study group and 60 healthy children in control group. The consent from the parents of both the control and study groups was obtained before the study. The present study utilized dmft index (Henry T.Klein, Carrole E. Palmar and Knutson J.W in 1938) method for evaluation of dental caries and unstimulated method for salivary flow rate and quick chair side test for salivary pH.

An oral examination was done for dental caries with patient seated on dental chair under bright light using a mouth mirror and WHO probe. Teeth should be examined by visual means and only the small lesions should be checked by using WHO probe.

Saliva was collected in a plastic measuring tube by draining method (make the patient sit on a dental chair facing forward and downward and saliva was allowed to drip off the lower lip into a measuring tube fitted with funnel and the subject expectorates into the measuring tube at the end of collection period) for 3 minute and was assessed for flow rate per minute and values were collected.

Salivary pH was measured by using portable pH meter and values were collected.

Thus, these collected values were sent for statistical analysis.

STATISTICAL ANALYSIS

Statistical analysis will be done by using ''Independent T-Test'' by 'SPSS' software system.

RESULTS

This was a case control study employing convenient sampling method comprising of two groups of 60 children with CHD in the study group and 60 healthy children in control group.

The numbers of male in this study were 72 (60%) while numbers of female were 48 (40%). (Table1, graph 1). In this study, the mean age ± SD was 9.00 ±1.905 years. 36 children were in the age group 6-7 years, 36 children were in the age group of 8-9 years, 36 children were in the age group of 10-11 years and 12 children were in the age group of 12 years and above. (table 1, graph 1).

Salivary pH was measured by using portable pH meter and values were collected. Quick chair side test was used for salivary pH The mean ± SD values of salivary pH in category of CHD patients was 6.504± 0.053 in children of CHD category, while the mean ± SD values of salivary pH in children of control category was 6.518 ± 0.040. The Mean ± SD values of salivary pH in children with CHD were lower than that of controls. The difference was significant statistically. ($p< 0.05$). (Table 2, Graph2)

For evaluating salivary flow rate in CHD patients and control group participant's un-stimulated method for salivary flow rate was used. Saliva was garnered in a plastic measuring tube by draining approach (make the patient sit on a dental chair facing forward and downward and saliva is allowed to drip off the lower lip into a measuring tube fitted with funnel and the subject expectorates into the measuring tube at the end of collection period) for 3 minute and was evaluated for flow rate per minute and values will be collected.

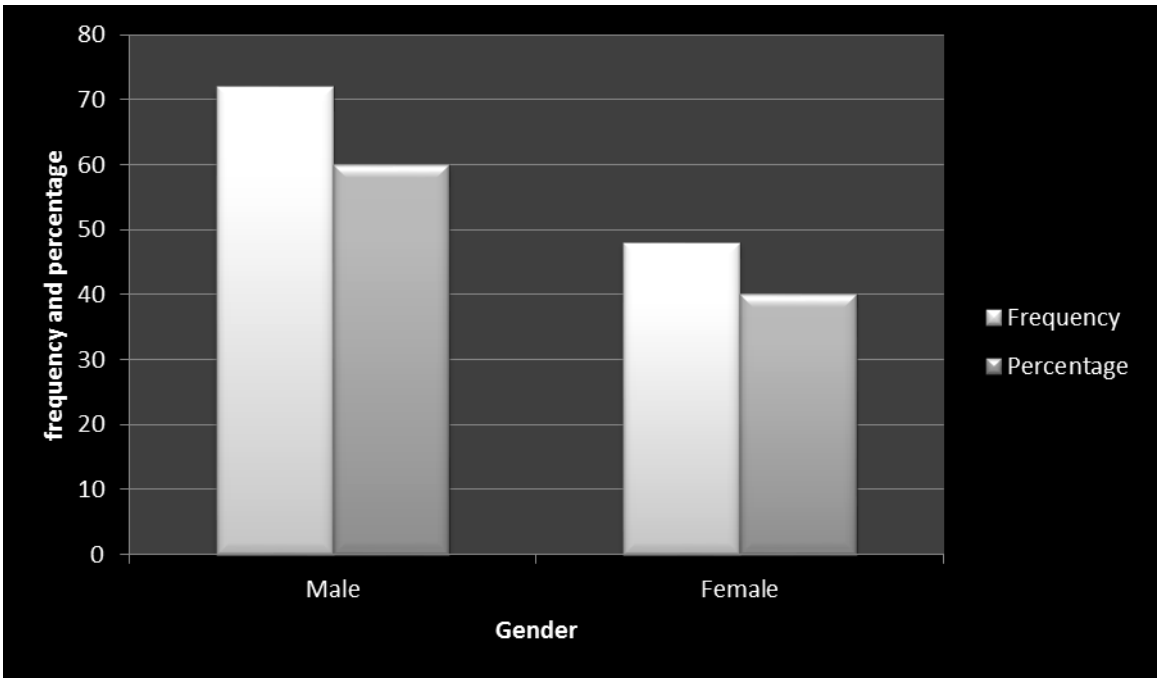
The mean ± SD values of salivary flow rate in children of CHD category was 0.330 ± 0.014 ml/min, while the mean ± SD values of salivary flow rate in children of control category was 0.734 ± 0.015 ml/min. The mean ± SD values of salivary flow rate were lower in children in CHD category than control category. The findings were significant statistically. ($p< 0.05$). (Table 4, graph 4).

The present study utilizes dmft index (Henry T.Klein, Carrole E. Palmar and Knutson J.W in 1938) method for evaluation of dental caries. An oral examination was done for dental caries with patient seated on dental chair under bright light using a mouth mirror and WHO probe. Teeth should be examined by visual means and only the small lesions should be checked by using WHO probe.

The mean ± SD DMFT score in children of CHD category was 2.52±0.0754 while the mean ± SD DMFT score in children of control category was 2.10 ± 0.110. The mean ± SD DMFT score in children of CHD category was greater in comparison to that of control group. The findings were significant statistically. ($p < 0.05$). (Table 5, graph5)

Table 1: Distribution of study participants according to gender.

Gender	Frequency (n=120)	Percentage
Male	72	60
Female	48	40

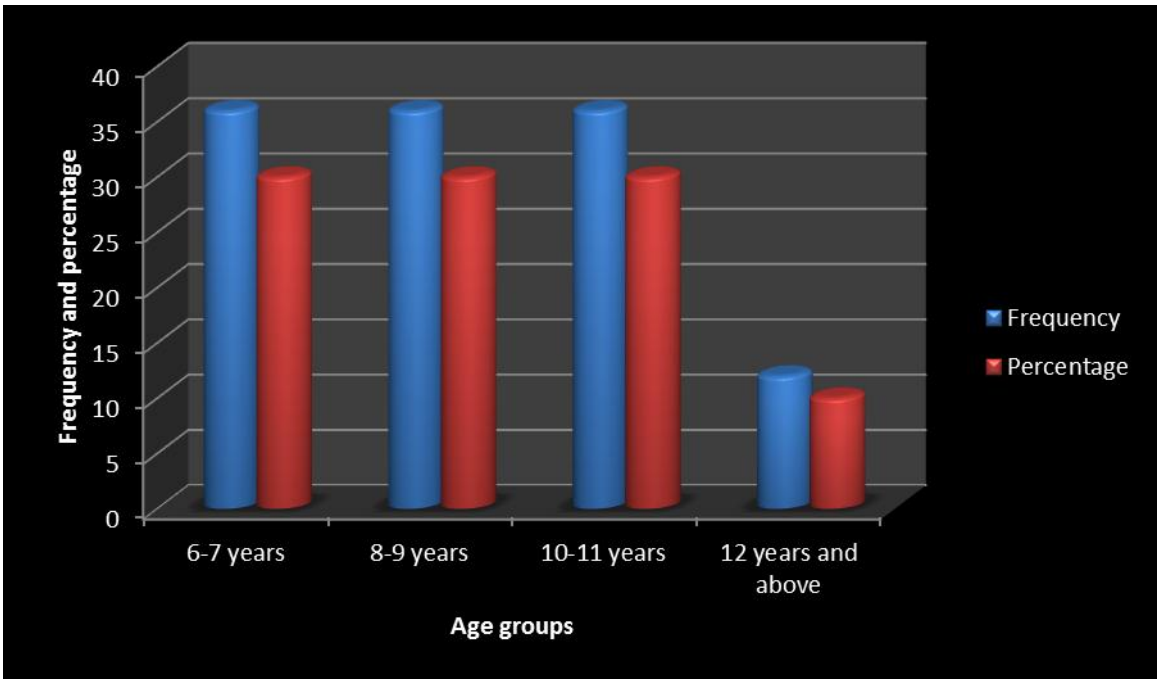


Graph 1: Distribution of study participants according to gender.

Table 2: Distribution of study participants according to age.

Age group	Frequency (n=120)	Percentage
6-7 years	36	30
8-9 years	36	30
10-11 years	36	30
12 years and above	12	10
Mean ± SD (years)	9.00 ±1.905	

SD: Standard Deviation

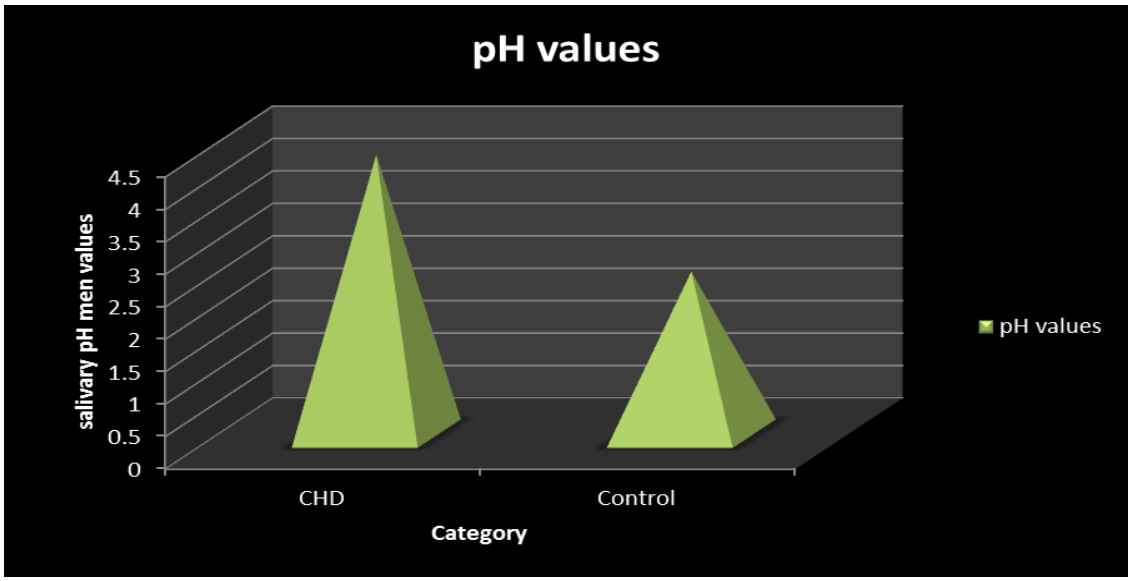


Graph 2: Distribution of study participants according to age.

Table 3: Salivary pH in studied groups.

Category	Mean ± SD	P value
CHD	6.504 ± 0.053	$p < 0.05$
Control	6.518 ± 0.040	

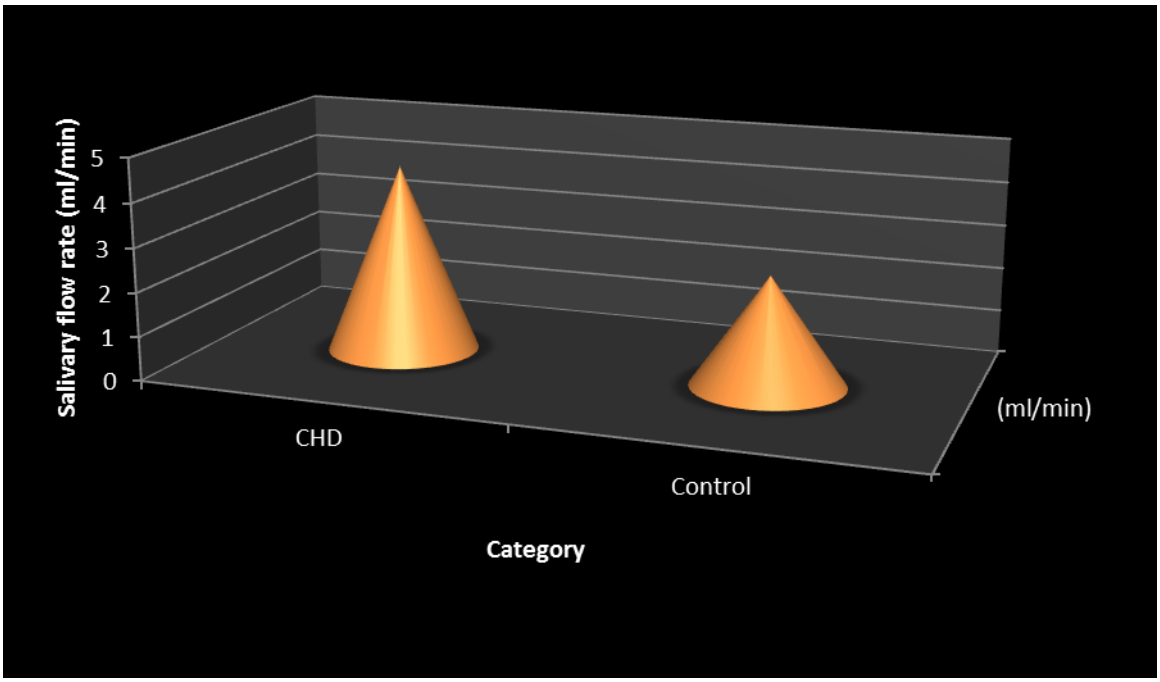
SD: Standard deviation



Graph 3: Salivary pH in studied groups.

Table 4: Salivary flow rate values in studied groups.

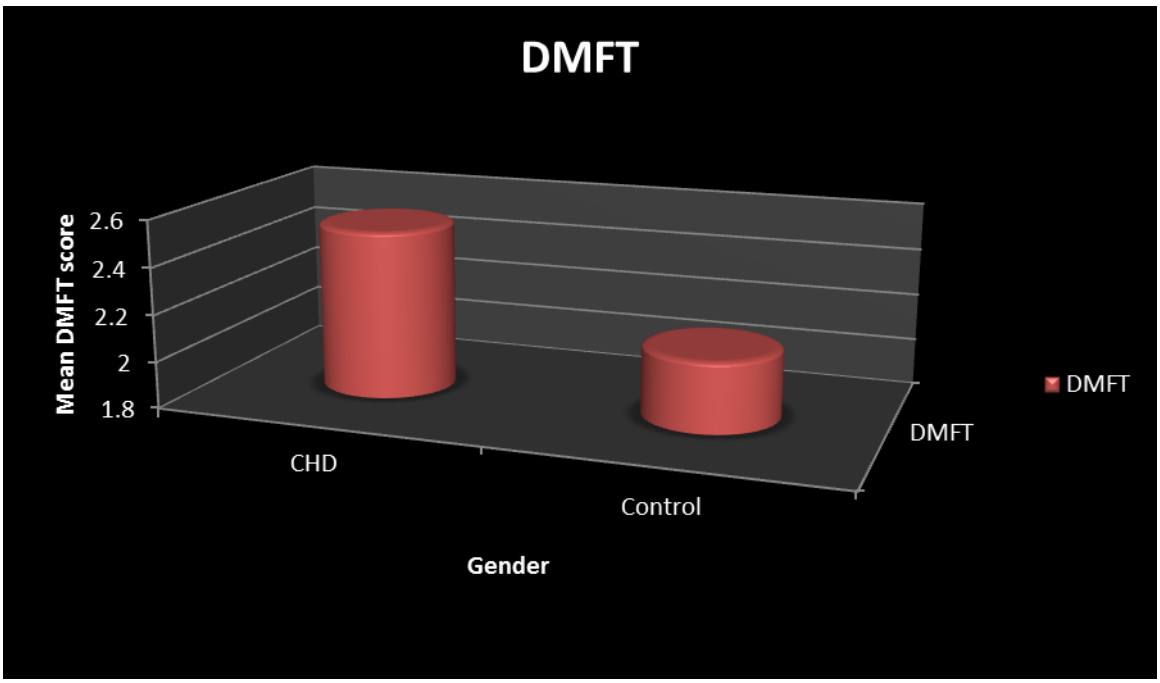
Category	Mean ± SD (ml/min)	P value
CHD	0.330 ± 0.014	p < 0.05
Control	0.734 ± 0.015	



Graph 4: Salivary flow rate values in studied groups.

Table 5: DMFT values in studied groups.

Category	DMFT (Mean ± SD)	P value
CHD	2.52±0.0754	p < 0.05
Control	2.10 ± 0.110	



Graph 5: DMFT values in studied groups.

DISCUSSION

Congenital heart disease in children necessitates long-term treatment with beta blockers, cardiac glycosides, anticoagulants, etc. The majority of these drugs have an acidic action. To promote long-term kid compliance, some fermentable carbohydrates are additionally added to therapeutic agents, which aid in lowering the pH of the oral cavity. Additionally, some medicines are xerogenic and cause dry mouth by two different mechanisms: a direct toxic effect on components of the salivary glands and an anticholinergic action, which reduces the flow rate of the saliva. Therefore, these patients are probably at increased risk for caries and potentially oral mucosal injury.[12-15] Saliva is essential to the oral environment.

Saliva balances the pH of the oral cavity to prevent dental cavities because the bicarbonate ion acts as a buffering system. While this is going on, the anti-bacterial properties of saliva serve to keep the balance of oral microbes. The most prevalent salivary immunoglobulin, secretory IgA, stops germs from sticking to the tooth surface and hinders their ability to colonize. This includes Streptococcus mutans in particular.

On the other hand, salivary supersaturated ions of calcium and phosphorus can encourage enamel remineralization over time. Salivary fluoride, calcium, and phosphate diffuse onto tooth surfaces, re-mineralizing the enamel and boosting its acid resistance.[16-17]

Due to the severity of the primary sickness, parents and even medical professionals frequently overlook their children's oral health, which causes several damages to the oral structures. Therefore, knowledge of patients' salivary changes in quantity and quality aspects would support preventive interventions like recommending food supplements or conducting routine dental exams.[18,19] This study sought to compare salivary flow rate and pH in children with congenital heart disease to healthy children due to the high frequency of congenital heart disease and the crucial role that oral health plays in sustaining general health status.

In the current investigation, we found that patients' salivary flow rate and pH were significantly lower than those of controls. To help children become more compliant and reduce their aversion, many paediatric drugs contain fermentable sugars, which in turn induces a drop in oral pH due to the impact of acid-producing bacteria on sugars.[20,21] Children with CHD typically have lower levels of salivary flow rate, which is probably caused by side effects from medication.

Digoxin, furosemide, and enalapril were among the 107 drugs that Chew assessed for their anticholinergic action. These drugs were regularly used by our patients.[13] In addition to directly competing with acetylcholine at the effector junction, medicines can also exert their anticholinergic effects indirectly by stimulating the sympathetic nervous system.[14]

According to our findings, Hegde et al.[7] observed a significant decrease in salivary pH and flow rate in cardiac patients, which was related to the level of salivary sialic acid; it was therefore suggested that sialic acid would be a good indicator for the severity of oral disease in these patients. In contrast, Rosén et al[3] concurred with our findings when they demonstrated that a low salivary flow rate may be a risk factor for children using cardiac medicines in a research on salivary changes in children with CHD.

The unstimulated method for salivary flow rate, rapid chair side test for salivary pH, and dmft index method for assessing dental caries were all used in the current study. A mouth mirror and WHO probe were used during an oral examination for dental caries while the patient was seated in a dental chair and in bright light. Teeth were visually inspected, and only minor lesions needed to be verified with a WHO probe. The patient was made to sit in a dental chair facing forward and downward, and saliva was allowed to drip off the lower lip into a measuring tube fitted with a funnel. At the conclusion of the 3-minute collection period, the subject expectorated into the measuring tube, which was then measured for flow rate per minute and values were taken. Salivary pH was be measured by using portable pH meter and values will be collected.

According to our results regarding DMFT of the first permanent molars, CHD children had worse dental status compared to controls.

In contrast, some studies found no change in the caries rate between children with CHD and healthy participants. Franco et al.'s study of children with CHD and healthy controls reported no differences in sIgA levels or caries rates. In a research, Hallett et al[16] discovered that patients had a higher rate of DMFT (peculiar to deciduous teeth), but that DMFT of permanent teeth was not statistically different. Tasioula et al[18] and Pollard et al[17] also came to the same conclusions. Streptococcus mutans, however, was substantially more prevalent in the saliva of children with CHD compared to those with acquired heart disease and healthy subjects, according to Ajami et al.[19]

Pimentel et al[20] found that CHD patients had a greater rate of dental caries at a young age. Children with CHD may have a higher risk of developing dental caries for a variety of reasons, including changed salivary quantity or quality and oral health conditions. Garg et al[21] connected the lower levels of salivary nitric oxide, which has an antibacterial action, to the increased incidence of dental caries in CHD patients. According to Saunders and Roberts[22], nearly 80% of CHD patients never or hardly ever washed their teeth on a regular basis, which was consistent with our findings. In contrast, the

healthier children routinely brushed their teeth twice daily.

In contrast, only 3% of youngsters in the healthy group never visited a dental clinic, whereas 18% of cardiac patients did.[22] Additionally, Hallett et al[16] discovered that roughly 60% of these patients were denied access to even parental assistance while brushing their teeth. Additionally, they noted that 21% of CHD patients had not had pulp treatments and that nearly two-thirds of patients did not receive proper dental care.

Because dental caries affects 10 to 12 children out of every 1000 births, it is particularly significant in children with congenital heart disease. The failure to practice proper oral hygiene, including brushing, flossing, and other dental procedures, is linked to CHD and caused bacteremia. The results of certain studies have demonstrated that these organisms are more common in the oral cavity of CHD patients.[12] Several studies suggested that the low calcium levels in this population's enamel may contribute to the onset of dental caries in children with CHD. Oral fluids have been investigated by a number of researchers to evaluate the features of systemic disorders, such as CHD. Controlling the oral bacteria that produces dental plaque and leads to dental caries is one of saliva's most crucial roles. Although it is generally established that CDH drugs alter the composition of saliva as well as biochemical aspects of saliva including pH and flow rate, it is unclear whether there is a connection between these biochemical aspects and oral health issues.

If such connections exist, they might be used to prevent caries and improve dental health. Through the examination of salivary composition and flow rate, various systemic and/or local diseases can be located and analysed with a better understanding of specific concentrations of salivary composition and its major immunological and biochemical components.[13]

Oral fluids have been investigated by a number of researchers to evaluate the features of systemic disorders, such as CHD. Different serum indicators found in oral fluids have been linked to myocardial injury, atherosclerosis, and inflammation. Although the long-term pharmaceutical requirements for CHD children are well known, there is less information about how this frequent drug use impacts the medically compromised children's dental health.

In addition to the issues posed by salivary secretion, long-term use of drugs with low ph, high acidity, and fermentable carbohydrates may directly affect dental caries and/or erosive lesions.[14] Saliva production and quality are crucial factors in maintaining good oral health because they can help stop erosion and tooth caries. The salivary buffering capability prevents a hazardous pH change by neutralizing acids in food, diluting acids, transporting acids from the oral cavity, and giving certain minerals to aid in the remineralization process. Bicarbonate levels are crucial for maintaining the ability to neutralize acids, and when salivary secretion is inadequate, the ability of the saliva to act as a buffer also declines.[15]

Generally speaking, CHD patients may be at a greater risk of developing caries due to malnutrition, developmental enamel abnormalities, poor oral hygiene practices, and the use of drugs that include sugar and have acidic or xerogenic effects.[20-27] Different results could be the consequence of different measurement techniques and study sample sizes.

CONCLUSION

In conclusion, salivary flow rate, pH was significantly diminished in children with congenital heart disease, and they had worse dental status compared to controls. Therefore, continuous monitoring of oral hygiene status is imperative in this group of patients.

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