



PREVALENCE OF DENTAL CARIES AMONG SCHOOL-AGED CHILDREN WITH CARDIAC DISEASES: ICDAS AND MICROBIOLOGICAL PARAMETERS

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ABSTRACT

Objective: Prevalence of tooth decay among school-aged children especially with the medically compromised one makes it one of the major public health. Therefore, this study was directed to detect the prevalence of carious lesions among children and young adults with cardiac diseases with newly developed International Caries Detection and Assessment System (ICDAS). **Subjects and methods:** Egyptian children and young adults aged between 5-16 years were chosen for this study. A total of four hundred participants were selected according to previously designed criteria's and then divided into the control healthy group and cardiac disease group. **Results:** The results of the ICDAS assessment exhibited a statistically higher caries prevalence among participants with cardiac diseases with statistically higher dentine defects. However, the results of the microbiological analysis showed a statistically significant increase in the *Streptococcus mutans* and *Lactobacilli* bacterial count in subjects with cardiac diseases. **Conclusion:** school-aged children with cardiac diseases showed a higher prevalence in tooth decay and *Streptococcus mutans* and *Lactobacilli* count when compared to the control group.

KEYWORDS: Cardiac disease, Children, Dental caries, Microbiology, ICDAS

INTRODUCTION

Cardiovascular diseases (CVDs) one of the most common general health diseases that occur in children and young adults especially in developing countries ^(1,2). There is a common association between cardiac diseases and poor oral hygiene, where increased risk of coronary heart diseases was reported to be associated with bad oral health status ^(3,4). Furthermore, the increased carious lesions and poor oral hygiene were reported in subjects with cardiac diseases ^(5,6).

In children, CVDs were manifested orally with several soft tissue manifestations such as cyanotic gingivitis, tongue cleft, dark reddish color of the filiform papillae of the tongue, wrinkled tongue, and cleft lip ^(2,5). Furthermore, CVDs can cause several adverse intraoral reflections including xerostomia, burning mouth sensation, gingival bleeding, and gingival hyperplasia ⁽⁷⁾. Additionally, in children with CVDs, several dental manifestations were reported including enamel hypoplasia with a high prevalence of tooth decay, periodontal diseases, and delay of teeth shedding ⁽⁸⁾.

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Studies revealed that the oral cavity and its associated structures can be adversely affected by several chemicals and drugs such as cardiovascular drugs, anticoagulant drugs, as well as antiseptic drugs⁽⁹⁾. Moreover, intrinsic discoloration of teeth was reported especially in permanent teeth where the medical drugs go in blood streaming and cause this phenomenon⁽⁵⁾.

Generally, the initiation and progression of the caries process are essentially related to the colonization and action of *Streptococcus mutans* and *Lactobacillus* species^(10,11). Findings show that the initiation of the caries process related to the colonization and action of *Streptococcus mutans*, while *Lactobacilli* was responsible for the progression of dental caries^(12,13). Additionally, *Streptococcus mutans* were claimed to be the causative bacteria in the infective endocarditis in subjects medically compromised with CVDs^(14,15).

There was a huge distraction in the literature related to the terminology used for caries diagnosis as well as caries detection⁽¹⁶⁾. However, in the last decade, a new triad-terminology is known as “cariou lesion detection, cariou lesion assessment, and caries diagnosis” was evolved to detect, assess, and diagnose cariou lesions⁽¹⁶⁻¹⁸⁾. Generally, “cariou lesion detection” was used to determine whether the caries disease is present or not⁽¹⁷⁾. While “cariou lesion assessment” was used to characterize the cariou lesion once it has been clinically detected⁽¹⁶⁾. However, “caries diagnosis” was collect all available data and imply it as a professional one⁽¹⁸⁾.

However, the clinical criteria systems remained focused on assessing the cariou disease at only the end-stage or ‘decayed’ status⁽¹⁹⁾. A new caries detection system was generated to detect the cariou lesion in its early state with criteria used to measure the caries status from its beginning until its decayed stage⁽²⁰⁾. However, there were no enough studies that explored the association between tooth caries in its initial or end-stage and CVDs⁽²¹⁾.

Therefore, this study aimed to assess the prevalence of cariou lesions among school-aged

children and young adults based on the ICDAS caries detection system and microbiological assessment.

SUBJECTS AND METHODS

A total of four hundred school-aged Egyptian children aged between 5-16 years were examined over the period from December 2019 to October 2020 after their parents/caregiver’s approval and signing of informed consent. The enrolled participants were registered from outpatients’ clinics of pedodontics and oral health department, Faculty of Dentistry (Al-Azhar University, Assiut, Egypt), or outpatients’ clinics from the Al-Azhar University hospitals (Al-Zahraa hospital, and Al-Hussein hospital) in Cairo, Egypt. The enrolled subjects were grouped into two groups; medically free subjects “control group” and subjects with cardiac diseases “study groups”.

Eligibility criteria of population

All recruited participants were selected according to the following specially designed inclusion and exclusion criteria:

Inclusion Criteria

The enrolled participants with cardiac diseases should be under medical treatment for at least 6 months and have no history of another systemic disease. While for medically free subjects; no history of regular medication or antibiotic medication for at least two weeks before investigation.

Exclusion Criteria

Participants those medically complicated with any systemic disease other than cardiac disease or have a duration of medical treatment from cardiac diseases less than 6 months were excluded. While for the medically free group; a participant with a history of regular medication or antibiotic medication for at least two weeks before investigation was excluded.

Ethical Consideration

The ethical approval of this study was by the Ethics Committee of Faculty of Dental medicine, Al-Azhar University, Cairo, Egypt (EC Ref No: 164/230/8/7/19).

Procedures

Dental Examination

After taking complete medical and medication history for all enrolled participants. In the beginning, all examined teeth surfaces should be cleaned before any dental examination. A complete dental examination was carried out under artificial light using a dental probe and a plain mouth mirror according to World Health Organization (WHO) criteria ^(22,23).

Dental Assessment using International Caries Detection and Assessment System (ICDAS II) scoring

The examination of cavities or enamel lesions was carried out with aid of a ball end probe under artificial light ⁽²⁴⁾. A dental assessment was carried out while taken into consideration all present deciduous and permanent teeth. Then, ICDAS II score for lesion detection, diagnosis, and assessment was used ⁽²⁵⁾ (Table 1):

TABLE (1) ICDAS II assessment system.

Code 0	Sound tooth surfaces No evidence of caries after 5-sec air drying.
Code 1	The first visual change in enamel: Opacity or discoloration (white or brown) is visible at the entrance to the pit or fissure seen after prolonged air drying.
Code 2	The distinct visual change in enamel visible when wet, the lesion must be visible when dry.
Code 3	Localized enamel breakdown (without clinical visual signs of dentinal involvement) seen when wet and after prolonged drying.
Code 4	Underlying dark shadow from dentin.
Code 5	Distinct cavity with visible dentin.
Code 6	Extensive (more than half the surface) distinct cavity with visible dentin.

Microbiological analysis

Unstimulated saliva samples were collected by asking each enrolled participant to spit at least 1 ml in a sterilized container for the microbiological examination of *Streptococcus mutans* and *Lactobacilli* colonization ⁽¹⁰⁾. Then, thioglycolate broth was added to each container as a transfer medium and persevered in an icebox. After that, all saliva samples were transported to the microbiology laboratory in the Microbiology Department, Faculty of Medicine, Al-Azhar university for Girls. All collected samples were then vortexed for 15 seconds and serially diluted to 1:1000 in an isotonic saline solution before inoculation ⁽²⁶⁾. Then, the diluted saliva samples were spread over *Mitis Salivarius* and Rogosa agar media to detect *Streptococcus mutans* and *Lactobacilli* colonization count respectively. Then, the colonies were counted in each diluted saliva samples and expressed numerically in colony-forming unit/ milliliter (CFU/ml) ⁽²⁶⁾

Statistical analysis

The statistical analysis was carried out using the software SPSS program, version 20 (Statistical Package for Social Sciences). A chi-square test and unpaired *t*-test were used to statistically compare the collected data in both groups at a level of significance of $p < 0.05$.

RESULTS

ICDAS assessment

The pattern of caries distribution as per ICDAS codes

The ICDAS results (code 0) showed a higher caries prevalence among participants with cardiac diseases in comparison with control participants, as participants those never having experienced dental caries of the total number of examined teeth were with the percentage of (48.79%) and (55.78%) respectively (Figure 1).

While ICDAS results for enamel defects (code 1, code 2, and code 3) represent a percentage of (13.14%), (4.35%), and (2.29%) for subjects with cardiac diseases respectively. While for control participants, ICDAS results for enamel defects revealed a percentage of (5.64%), (7.14%), and (6.14%) respectively (Figure 1).

However, the ICDAS results for dentine defects (code 4, code 5, and code 6) represent a percentage of (1.71%), (8.22%), and (21.50%) respectively for participants with cardiac diseases. While for control participants, ICDAS results for dentine defects represent (6.93%), (7.5%), and (10.86%) respectively (Figure 1).

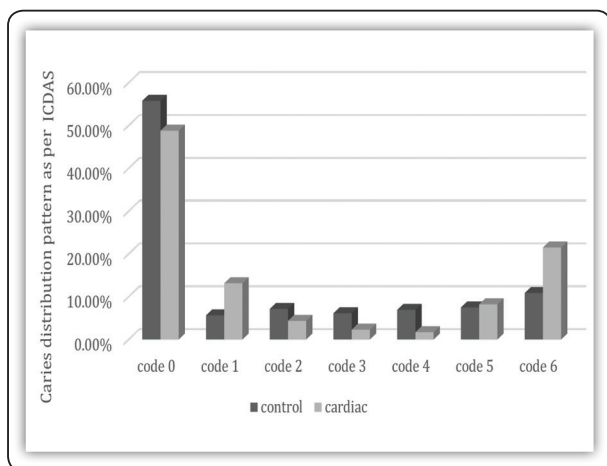


FIG (1) Caries distribution pattern as per ICDAS codes.

Caries prevalence as pre-ICDAS

The results of caries prevalence as pre-ICDAS of as indicated by the Chi-Square test along the study showed a statistically significant difference with the value of ($p < 0.00001$) between subjects with cardiac diseases and control participants. The prevalence of dental caries among subjects with cardiac disease and the control group was (51.21%) and (44.21%) of the total examined teeth respectively. However, the caries-free teeth were (48.79%) and (55.78%) of the total examined teeth for subjects with cardiac diseases and control group respectively (Figure 2).

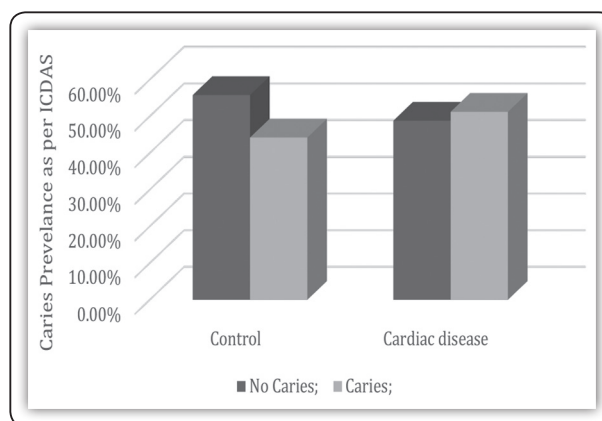


FIG (2) Caries prevalence as per ICDAS.

Enamel and dentine caries prevalence as pre-ICDAS

Enamel and dentine caries prevalence as pre-ICDAS showed a statistically significant difference as indicated by the Chi-Square test with a level of significance of ($p < 0.00001$) between participants with cardiac diseases and control participants. Participants with cardiac diseases showed enamel and dentine caries prevalence of (38.63%) and (61.37%) respectively. While control participants exhibited enamel and dentine caries prevalence of (42.81%) and (57.19%) respectively (Figure 3).

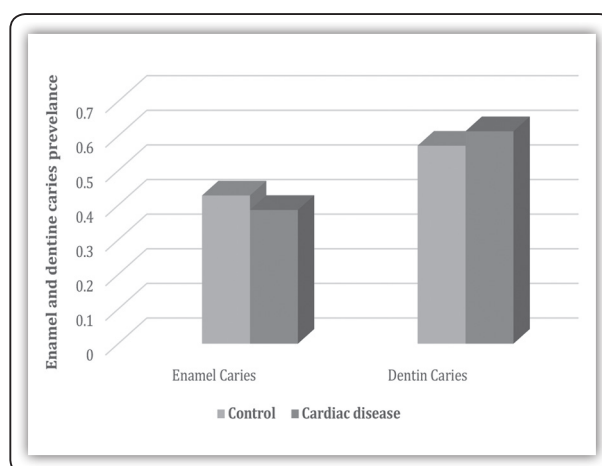


FIG (3) Enamel and dentine caries prevalence as per ICDAS.

Microbiological analysis results

Microbiological analysis results as indicated by unpaired *t*-test; revealed a statistically significant higher *Streptococcus mutans* and *Lactobacilli* count (CFU/ml) among participants with cardiac diseases in comparison with control participants with a statistical significance level of ($P=0.0001$) (Figure 4). The results showed *Streptococcus mutans* and *Lactobacilli* count of (6858 ± 174.98) and (5671 ± 256.58) respectively for participants with cardiac diseases. While the *Streptococcus mutans* and *Lactobacilli* colony count for the control group were (4599 ± 127.32) and (5127 ± 232.29) respectively.

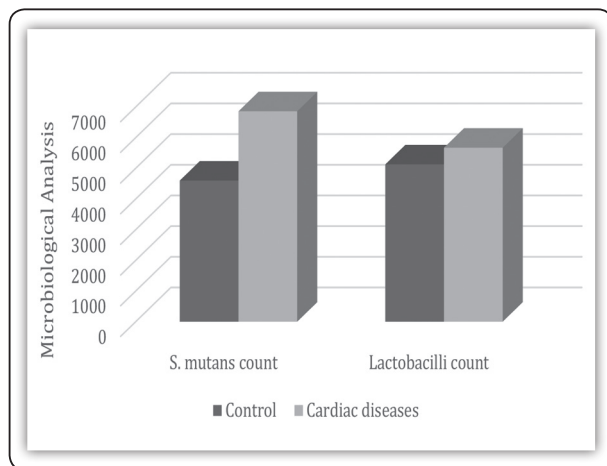


FIG (4) Microbiological analysis results.

DISCUSSION

Tooth decay is the most prevalent public health problem (27). Daily oral hygiene measures such as tooth brushing and flossing help in the removal of the accumulated plaque from tooth surfaces, especially the proximal contacts and retentive occlusal surfaces, which are most prone to decay (28,28). Tooth brushing before bedtime is considered the most important time for oral hygiene measure, as salivation flow decreases during sleep (29). The high salivary flow usually helps to buffers the acidic pH, prevents the process of demineralization, and helps the remineralization process, as well as helps in the removal of the fermented bacterial products (30).

Also, the results of the present study showed a significant increase in dental caries in children with heart diseases due to poor oral hygiene. These results agreed with the results of Stecksén-Blicks et al., (31) who stated that children with congenital heart disease have poorer oral hygiene than healthy controls despite intensive preventive efforts. Additionally, in agreement with the results of the present study, it was stated that; children with cardiac diseases several dental manifestations were reported including enamel hypoplasia with a high prevalence of tooth decay, periodontal diseases, and delay of teeth shedding (32).

Despite the high caries prevalence among medically compromised school-aged Egyptian children, there is only a few epidemiological studies of the prevalence of dental caries among the Egyptian population have been published. Schulz-Weidner et al., (33) concluded that medically-free children have more care about brushing their teeth than medically compromised children. On the other hand, Balmar et al., (34) reported no more carious lesions and poor oral hygiene among children with CVDs. This may be because of that the children with CVDs have proper oral hygiene, as well as their caregivers, have higher knowledge about proper dental care and the infective endocarditis that could influence cardiac children with poor oral hygiene (34,35).

However, some researchers suggested that caries initiation in children with CVDs maybe because of the lower calcium level in their dental enamel (36). Furthermore, another study concluded that hypoxia in children with CVDs was suggested as another causative factor associated with the initiation of dental caries (37). This in agreement with the results of the present study where the enamel hypoplasia in cardiac children was more than the control group.

Moreover, Al Alousi et al., (38) stated that the higher rate of developmental enamel defects that present in populations with CVDs was observed because of malnutrition. Various researchers reported that some nutrient elements may affect

the function of the epithelial cell and hence the mineralization process via preparing the ground for enamel hypoplasia defect formation in populations with CVDs^(5,38). This could explain the results of enamel hypoplasia in the present study which is similar to the control group even with more oral hygiene measures.

The results of the present study concluded a significant increase in *S. mutants* and *Lactobacilli* count in saliva in children with cardiovascular diseases. This may be due to the poorer oral hygiene in children with cardiac disease in comparison to the healthy control group^(31,33). However, the results of Pourmoghaddas et al.,⁽¹⁰⁾ stated that there is no statistically significant increase in the colonization count of *Streptococcus mutants* and *Lactobacilli* in children with cardiac diseases. Moreover, the results of the study of Hallett et al.,⁽³²⁾ found that there is no significant correlation between the pathogenic microorganisms in saliva and the incidence of dental caries and they suggested other mechanisms which could be involved in tooth decay.

CONCLUSION

ICDAS system had the clinical ability to differentiate between early/non-cavitated and cavitated carious lesions. Moreover, school-aged children with cardiac diseases had a higher caries prevalence as well as a statistically higher *Streptococcus mutants* and *lactobacilli* count compared to control participants.

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