EGYPTIAN DENTAL JOURNAL
www.eda-egypt.org
VOL. 68, 3055:3063, OCTOBER, 2022
PRINT ISSN 0070-9484 • ONLINE ISSN 2090-2360
ORTHODONTICS, PEDIATRIC AND PREVENTIVE DENTISTRY
Submit Date : 16-06-2022 • Accept Date : 09-08-2022 • Available online: 1-10-2022 • DOI : 10.21608/edj.2022.145229.2155

CLINICAL AND MICROBIOLOGICAL ASSESSMENT OF DENTAL CARIES AMONG CHILDREN/ADOLESCENTS WITH CHRONIC RENAL FAILURE

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ABSTRACT

Background: Renal failure is a common public health disease among the young age (Children/ Adolescents) population. Most of those population doesn't have any dental care in combination with the increasing attention of their parents/caregivers toward their systemic disease.

Objective: The present study was directed to assess the correlation between Chronic Renal Failure (CRF) and the prevalence of dental caries among children and adolescents.

Subject and Methods: This study was conducted on four hundred Egyptian children and adolescents aged 6-18 years. The enrolled subjects were selected according to designed criteria and divided into two equal groups; subjects with renal failure and control healthy subjects. Each subject was clinically assessed using the International Caries Detection and Assessment System (ICDAS). A saliva sample from each subject was taken for microbial investigation and assessment.

Results: The results revealed a significantly lower caries prevalence among the subjects with chronic renal failure with significantly higher enamel defects. Moreover, the microbiological analysis showed a significant reduction in the count of Streptococcus mutans and Lactobacilli in (CRF) individuals.

Conclusion: Subjects with chronic renal failure showed a significant reduction in dental caries and bacterial counts with a significant increase in enamel defects.

KEYWORDS: Dental caries - Renal Failure – ICDAS - Streptococcus mutans - Lactobacilli

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INTRODUCTION

Dental caries is a complex, and multifactorial disease that can affect any age. Dental caries is usually influenced by many factors- such as dietary habits, sociodemographic backgrounds, and the presence of systemic disease as renal disease. However, dental caries could be prevented by the application of preventive oral hygiene measures [1-5].

Inappropriate dietary habits in association with improper oral hygiene measures together with time, usually promote the residence of microbial microorganisms in the accumulated dental plaque to initiate the carious lesion [3]. Generally, tooth decay is considered a microbial disease in which dietary habits play a crucial role in its incidence [6]. *Streptococcus mutans* (*S. mutans*) were reported to be the main microorganism that initiates tooth decay [7]. Moreover, *Lactobacilli* play an important complementary role in the progression of dental caries [6,8].

However, various factors could modify this microbial effect such as the oral manifestation of some systemic diseases [5]. Generally, oral health reflects the health of the entire body, especially in patients with systemic diseases such as chronic renal failure (CRF) [9,10]. The oral health of patients undergoing renal therapy is insufficient. Poor oral health and its components can affect the oral health-related quality of life of these patients [2]. Usually, patients with CRF suffer from oral problems related to this disease which include; dry mouth "xerostomia" due to lower fluid intake and lower salivary flow, as well as bad odor and metallic taste resulting from higher urea concentration in form of ammonia in saliva [9,11].

Also, patients with CRF could be suffering from enamel hypoplasia, enamel erosion, or pulp obliteration [12]. Moreover, some searchers reported a direct relationship between the number of dental caries in primary teeth and elevated pH levels and the total amount of antioxidants in the saliva of children with CRF [13,14]. On the other hand, other researchers reported a lower level of tooth decay in children with CRF due to the inhibitory effect of ammonia against the growth of *S. mutans* and *Lactobacilli* [15]. Furthermore, a study concluded that children (6-18y) undergoing renal dialysis showed significantly worse oral health conditions than healthy controls except for dental caries status [16].

Recently, ICDAS was designed essentially to understand the process of caries initiation and propagation in the field of epidemiological and clinical studies [17]. In general, the ICDAS system identifies the stages of carious lesions in enamel and dentin based on their visual appearance clinically [18]. However, it integrates various systems with new criteria for caries detection such as radiographic assessment and the type of restoration used for the treatment of carious lesions [19,20].

Therefore, the present study was directed to assess the correlation between *S. mutans* and *Lactobacilli* count and the ICDAS system for dental caries detection in children and adolescents (6-18y) with (CRF) in comparison to apparently healthy children and adolescents [16].

SUBJECTS AND METHODS

This study was conducted on four hundred Egyptian children and adolescents aged between 6-18 years based on power test analysis and a previous study sample [3]. The enrolled subjects in this study were divided into 2 mains matched [each group was formed of 100 children (6-12y) and 100 teenagers (13-18y)] groups; the healthy "medically free" group_and the subjects having (CRF) group. All enrolled children were examined over the period from 17th of December 2019 to 18th October 2020.

The enrolled subjects in this study were recruited from different outpatients' clinics of university hospitals as follows; Al-Hussein university hospital (Cairo, Egypt), Al-Zahraaa university hospital

(Cairo, Egypt), and Outpatients of pedodontics department, Faculty of Dentistry, Al-Azhar University. For the control (medically free) group, the enrolled subjects were selected from attending siblings of the clinic patients or from our relatives, neighbors, and acquaintances.

The subjects were divided into two groups according to their general health status subjects with CRF group "study groups" and the medically free group "control group".

Eligibility criteria of the population [16]

The selection of all enrolled subjects was based according to the following inclusion and exclusion criteria:

Inclusion Criteria

For subjects with CRF

1. Age ranged from 6 to 18 years old.
2. Parent/caregiver acceptance.
3. Patient and Parent/caregiver cooperation.
4. Medically compromised children (CRF) with a medical treatment duration of at least 6 months before investigation.
5. No history of another systemic disease than that investigated in their group.

For the control group

• *The enrolled children were having the following criteria*

1. No history of antibiotic medication for at least 2 weeks before investigation.
2. No history of acute infectious disease of the oral cavity or salivary glands within the 3 months preceding the dental examination.
3. No history of medication regularly.
4. No history of systemic diseases.

Exclusion criteria

For subjects with CRF

1. Patients or Parents/caregivers' refusal.
2. Uncooperative patients or Parents/caregivers.
3. No history of antibiotic medication for at least 2 weeks before investigation.
4. Medical treatment duration less than 6 months for the tested groups.
5. Medically compromised children that had more than the investigated systemic disease.

For the control group

• *The excluded children were having the following criteria:*

1. A history of antibiotic administration within 2 weeks before investigation.
2. A history of acute infectious disease of the oral cavity or salivary glands within the 3 months preceding the dental examination.
3. A history of medication regularly.
4. A history of any systemic diseases.

Ethical Consideration

Written informed consent was signed by the children's parents, guardians, or caregivers. The study was approved by the Institutional Ethics Committee (EC Ref No: 164/230/8/7/19) in the Faculty of Dentistry AL-Azhar University (boys branch). The followed procedures were following the ethical standards of the responsible committee on human experimentation (institutional or regional) and with the Helsinki Declaration of 1975, as revised in 2000.

Patient Consent

Permission was obtained from parent's/caregivers for including their children in the present

study. Each parent's/care giver signed an informed consent having details about the whole examination procedure before starting the study.

Subjects history taking

Complete medical and dental history, as well as drug history, were collected before the selection of the enrolled subjects in the present study.

Oral Examination

Oral clinical examination was carried out according to WHO criteria on a dental chair in artificial light by using a plain mouth mirror and a dental probe with the application of infection control condition [21,22]. All present teeth were taken into consideration during the clinical examination [23]. A standardized dental examination starts from the upper right molars to the upper left molars, then to the lower left molars, ending with the lower right molars.

Dental Assessment using ICADS II scoring

The dental caries was assessed by International Caries Detection and Assessment System II (ICDAS II) and the score was registered as in (Tab. 1) [24,25]:

Microbiological analysis

Fresh unstimulated samples of saliva were collected from each enrolled subject along with the study for microbiological examination for detection and count determination of *S. mutans* and *Lactobacilli* [26]. The sample was collected by asking them to spit at least 1 ml in a sterilized container, first thing after getting up in the morning. The collected saliva sample was added to a tube containing 9 ml thioglycolate broth medium as a transfer medium. The saliva sample was transported to the laboratory (Microbiological department, faculty of Medicine, Al-Azhar university for girls) after collection using the thioglycollate broth and processed on the same day. The sample was vortexed (15 s) and diluted at 1:1000 in an isotonic saline solution before inoculation [27].

For detection of *S. mutans* and *Lactobacilli* count, saliva samples were spread on *Mitis Salivarius* agar and Rogosa agar respectively. Serial dilution and plate spread techniques were used for viable cell count. Then, the number of the colonies was counted using a digital counter and its concentration in saliva was expressed in colony-forming unit/ milliliter (CFU/ml) [27].

TABLE (1): ICDAS system for dental caries assessment.

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 is visible when wet, the lesion must be visible when dry.
Code 3;	Localized enamel breakdown (without clinical visual signs of dentinal involvement) is seen when wet and after prolonged drying.
Code 4;	Underlying dark shadow from dentin.
Code 5;	Distinct cavity with visible dentin.
Code 6;	Extensive distinct cavity (more than half the surface) with visible dentin.

Statistical analysis

All results were collected, tabulated, and statistically analyzed using the Statistical Package for Social Sciences SPSS program version 21. A chi-square test and unpaired *t*-test were used to compare the two groups at a $p < 0.05$ level of significance.

RESULTS

The distribution of caries pattern as per ICDAS codes throughout the study was represented in Table (2). The caries prevalence generally was relatively low in subjects with CRF in comparison to healthy subjects. The percentages of caries-free teeth were (66.92%) and (55.78%) respectively of the total number of examined teeth in both groups. The results of screening for enamel defects showed that the first visual change in enamel (code 1) represents 11.57% and 5.64% of the examined teeth in CRF and healthy subjects respectively. While the distinct visual change in enamel without cavitation (code 2) was presented in 7.93% and (7.14%) of the enrolled subjects with renal failure and healthy subjects respectively. The localized enamel breakdown without clinical visual signs of dentinal involvement (Code 3) represented 6.36% and 6.14% of the enrolled subjects with renal failure and healthy subjects respectively. The results of screening for dentin defects showed that the underlying dark shadow from dentin (code 4) represents 1.93% and 6.93% of the enrolled subjects with renal failure and healthy subjects respectively. While the distinct cavity with visible dentin (code 5) represents 2.36% and 7.50% of the enrolled subjects with renal failure and healthy subjects respectively. The percentage of the extensive distinct cavity with visible dentin "more than 1⁄2 tooth surface" (code 6) represent 2.93% and 10.86% in both subjects' groups.

The degree of caries pre-ICDAS for the enrolled subjects among the control and renal failure groups in the study was summarized in (Figure 1).

However, the caries prevalence generally was higher in the control group in comparison to the CRF group with a statistically high significance ($P < 0.00001$) as indicated by the Chi-Square test. The total number of examined teeth of the enrolled subjects in the control group and renal failure groups (55.78%) and (66.92%) respectively had never experienced dental decay. While (44.21%) of the total number of examined teeth of the enrolled subjects in the control group experienced dental decay. Moreover, (33.07%) of the total number of examined teeth of the enrolled subjects in the renal failure group experienced dental decay.

TABLE (2): Caries Pattern distribution as per ICDAS codes among the studied groups' subjects:

Codes	CRF group		Control group	
	No. of Teeth present	Percentage (%)	No. of Teeth present	Percentage (%)
Code 0	937	66.92%	781	55.79%
Code 1	162	11.57%	79	5.64%
Code 2	111	7.93%	100	7.14%
Code 3	89	6.36%	86	6.14%
Code 4	27	1.93%	97	6.93%
Code 5	33	2.36%	105	7.50%
Code 6	41	2.93%	152	10.86%

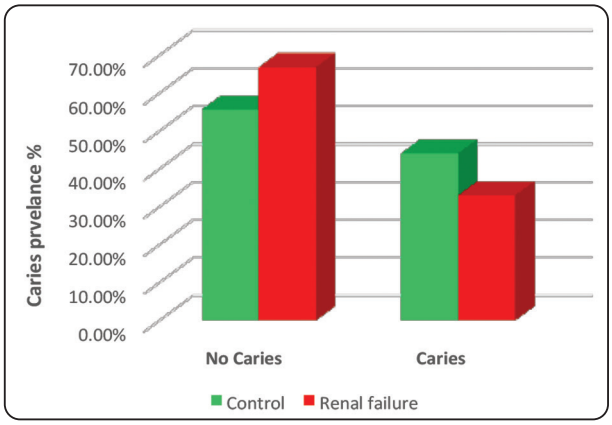

Fig. (1): Caries prevalence in the control group and renal failure group.

The caries distribution pre-ICDAS for the enrolled children among the control and renal failure group throughout the study was summarized in (Figure 2). The caries prevalence generally was relatively high in the control group when compared with the renal failure group and the difference was statistically significant ($P < 0.00001$) as indicated by the Chi-Square test. The enamel caries distribution among the control group (42.81%), and for the renal failure-group was (78.19%) of total caries that occur in the studied groups respectively. While the dentin caries distribution among the control group was (7.19%), and for the renal failure group was (21.8%) of total caries occurs in both studied groups respectively.

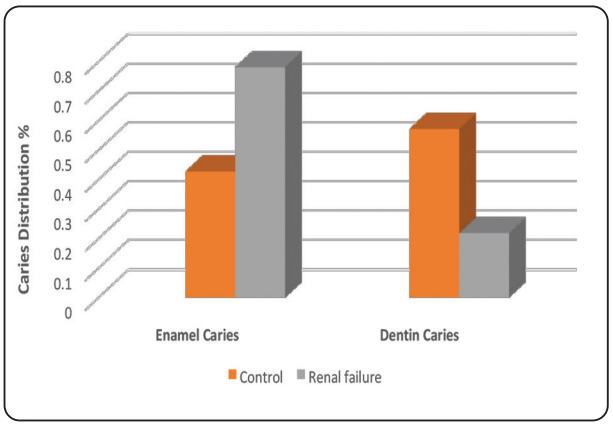

Fig. (2): Caries distribution in the control group and renal failure group.

Microbiological analysis results:

The statistical analysis results of the *S. mutans* and *Lactobacilli* count (CFU/ml) showed a statistically significant difference in *S. mutans* and *Lactobacilli* counts (CFU/ml) between the enrolled subjects in the control group and CRF group with a P-value of (P=0.0001) as indicated by unpaired *t*-test (Figure 3). The enrolled healthy subjects showed a significantly higher *S. mutans* (CFU/ml) count of (4599±127.32) and (5127±232.29) for *S. mutans* and *Lactobacilli* respectively. While the enrolled children with CRF showed significantly lower *S. mutans* and *Lactobacilli* (CFU/ml) counts [(1805±167.15) (2245±97.44) respectively] than the control healthy group.

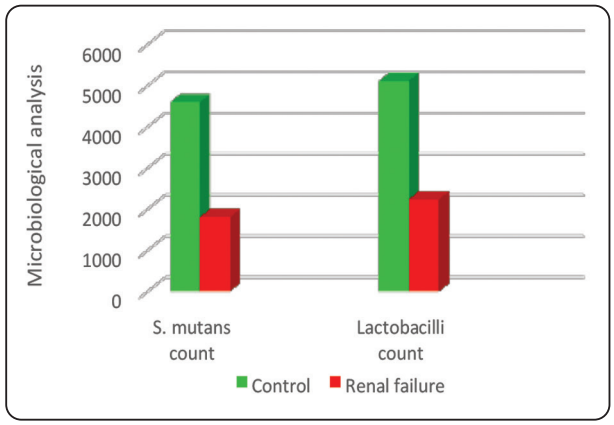

Fig. (3): Microbiological counts difference in both groups.

DISCUSSION

Chronic renal diseases represent a global public health problem. Recent studies demonstrate a mutual cause-effect relationship between it and oral diseases, in which the presence of one induces the onset and faster progression of the other [28]. ICDAS system is an accepted universal system to assess and monitor the prevalence of early carious lesions for enamel and dentin as well as it helps in proper planning for treatment of early carious enamel lesions[25]. The ICDAS was designed especially for the population with a reduced prevalence of cavitated carious lesions, with the purpose to introduce a criterion of non-cavitated caries among those populations[22]. Moreover, the ICDAS-II method for caries assessment was focusing on the available and ordinary visual methods for diagnoses of dental caries [29]. Therefore, it is suitable for designed epidemiologic studies [22,30].

Various medical conditions such as CRF can affect the oral health of patients with variable oral manifestations such as enamel hypoplasia, dental caries, and dry mouth caused by drug therapy or poor oral hygiene [9,31]. Therefore, this study correlated the incidence of dental caries and general

health status among children and adolescents with renal failure. However, this study did not distinguish between primary and permanent teeth because this differentiation was irrelevant to the analysis. The exact localization of the caries was not taken into consideration in the analysis for the same reason.

In agreement with the results of the present study, a study found that subjects with chronic renal failure have a lower caries prevalence due to inhibition of bacterial growth as well as due to buffer capacity of bacterial plaque acids [15]. In the present study, there was a significant decrease in the bacterial count of *S. mutans* and *lactobacilli* species in subjects with CRF when compared with healthy children. These results were in agreement with the study of Cláudia et al., 2019 [32] who stated that there was a positive correlation between the duration of hemodialysis and the amount of IgA anti-Streptococcus mutans, urea in saliva, and the number of CFU of Streptococcus mutans. Also, these results were in the same line as Alexa et al., 2022 [33] study who demonstrated that renal disease patients have highly prevalent Xerostomia & hyposalivation, more deepened pockets, but an equal number of carious teeth compared to healthy controls. These results may be referred to as the increase of antibacterial IgA and the inhibitory effect of ammonia that resulted from the splitting of salivary urea as well as the buffer capacity of the alkaline pH in subjects with CRF [32,34]. Also, our results came compatible with many studies that showed the collected saliva from subjects with CRF may also have a significant role in caries reduction since the hemodialysis patients have a high amount of ammonia in their saliva as a common complication of this disease [34,35].

In this context, this study showed that the incidence of dental caries was significantly lower in children with renal failure when compared with the healthy group. This is in agreement with the results of many studies, which reported that subject with CRF is associated with a lower prevalence of dental caries [31,35]. Furthermore, caries reduction among subjects with CRF can be explained in light of the inhibitory effect of salivary ammonia associated with this systemic disease [14,15].

However, although the higher concentration of salivary phosphate in subjects with uremia may facilitate the remineralization of early carious lesions [34], it was explored that the developmental defects of enamel such as hypoplasia were common in subjects with chronic renal failure [35.36]. This is exactly what showed in this study where the enamel carious lesions were significantly higher in subjects with CRF when compared to those of healthy subjects. This may be referred to several reasons as; the growing of carious lesions over enamel defects occurred due to disturbed metabolism of calcium and phosphate with calcium reduction in subjects with CRF. Also, malnutrition may play a role since the diet in developing countries especially those of low socioeconomic standards is usually cariogenic in nature. Thus, it is possible that developing carious lesions become rapidly inactivated by the effect of the high salivary pH in CRF due to the high salivary ammonia content. That's why enamel caries was higher and dentin caries was lower in CRF children and the opposite was true for healthy children. Another possible explanation is that enamel lesions in CRF may have been developed before the onset of CRF and became inactivated thereafter due to the previously mentioned reasons [35-37]. [36].

Limitation of the study

1. Restored teeth were not counted in both groups which also accounts for the total caries experience in both individuals.
2. The difficulty of entering schools and obtaining a permit to examine students, due to corona disease precautions.
3. Lack of resources and poor funds since there were no sponsors nor financial support for this study, only self-financing.
4. Neither the onset of CRF nor a correlation between caries experience and CRF duration were assessed.

CONCLUSION

In the light of this study's results and limitations it could be concluded that;

1. The subject with CRF has significantly higher enamel defects so they need to build up special oral health care programs for them.
2. Also, the CRF patients have significantly lower carious lesions and significantly lower bacterial count of *S. mutans* and *lactobacilli*

A diet history analysis neednеeds to be assessed in future studies and correlated with caries experience.

Conflict of interest

The author declares that he has no conflict of interest.

Funding

This study did not receive any funding.

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