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Prevalence of Dental Caries in Cystic Fibrosis (CF) Patients in a Tertiary Care Center in Saudi Arabia

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Abstract

Introduction: More than 90% of individuals with Cystic Fibrosis (CF) have at least one enamel defect, and are at an increased risk of candidiasis, due to the use of inhaled steroids, long-term antibiotic regimens, and from the effects of CF-related diabetes.

Objectives: This is the first report on the prevalence of dental caries in CF patients (pediatric and Adult group) in Saudi Arabia.

Methodology: A retrospective chart review of dental examination that were carried out in all confirmed CF patients during their follow up period in CF clinic from the period January 2015-December 2018. Scoring was done according to WHO criteria.

Results: A total of 131 patients divided into two groups: group I less than 12 years and group II above 12 years of age. The Male/ female ratio was equal. Males were 64/131 (48.8%), females 67 (51.2%). Total teeth dmft/ DMFT score is 4.85 (4.6) in group I compared to 5.94 (4.27) in group II (P=0.005), which are lower compared to the healthy Saudi population of (5, and 7.4 respectively). Decayed primary/ Permanent for group I were 41 (62.1%)/ 13 (19.7) compared to 6 (9.2%)/ 55 (84.6) for group II. Filling primary/ permanent for group I were 6 (9.1%)/ 4 (6.1 %) compared to 0.0 / 17 (26.2%) for group II. Open bite in 5 (7.6%)/ 3 (4.6%) for both groups respectively. Positive dental staining in 10 (15.2%)/19 (29.2%) for the both groups.

Conclusion: Dental caries is common in Saudi CF patients. Prevalence of dental caries score in our CF population is lower compared to the healthy Saudi Population but still unmet the WHO year 2000 goals. Patients with CF should be screened routinely for caries, and periodontal diseases.

Keywords: Cystic fibrosis, dental caries, Open bite, Dental manifestations.

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1.1 Introduction :

The prevalence of dental caries is increasing across different nations around the globe. A review of the literature showed that dental caries is adversely affecting the oral health of children, adolescents, adults and elderly populations in Saudi Arabia (1). A systematic review on the prevalence, severity, and progression of dental caries in different age groups of Saudi communities was carried out (from 1982 to 2012) and showed that dental decay, missing and filled teeth (dmft= pediatrics less than 12 years old and DMFT= for patients who are more than 12 years old and adults) showed that: In children with primary dentition ages 3-7 years, the highest caries prevalence was almost 95% and maximum estimate of dmft was 7.34. Approximately, 91% was the highest caries prevalence and greatest DMFT value was 7.35 among the children/adolescents ages 12-19 years. The adults with a mean age between 30 and 45 years had maximum caries prevalence of 98% and DMFT of 14.53 while older individuals had greatest DMFT score of 24.3 (1). To our knowledge this is the first report on dental manifestation of cystic fibrosis patients in Saudi Arabia.

Cystic fibrosis (CF) is an autosomal recessive condition which typically

causes Sino pulmonary disease, and in most cases, pancreatic insufficiency with a resultant failure to thrive (2). Management includes treatment of bronchial inflammation and infection with antibiotics and physiotherapy, pancreatic enzyme replacement therapy, and fat-soluble vitamin supplementation. A high calorie, high fat diet is recommended for these patients, and high sugar foods are often eaten to maintain the increased caloric intake needed. CF patients have been reported to have abnormal dentitions, with dental effects related either to the disease itself or as a consequence of treatment (2).

More than 90% of individuals with CF have at least one enamel defect, including demarcated opacities, diffuse opacities, and enamel hypoplasia (1-3). Although early studies reported that individuals with CF had less plaque than those without CF, more recent studies have shown that the plaque levels tend to be the same among both groups (1-3). Studies have also shown that those with CF experience fewer gingival bleeding sites than people without CF. Patients with CF are at an increased risk of candidiasis, due to the use of inhaled steroids and long-term antibiotic regimens, and from the effects of CF-related diabetes (3-6).

A systematic review and Meta-Analyses for Dental caries prevalence in children and adolescents with cystic fibrosis between 1960 and 2013 (7), resulted in 696 studies. Fifteen publications were included in the qualitative systematic review. Ten studies concluded that children with CF had significantly lower caries prevalence than control children, three studies reported that children with CF had higher caries prevalence, and two studies found no difference by CF status. Of the seven studies including age-based subgroup analyses, only one study supported the current paradigm. All studies had limitations that may bias study results (7).

Malocclusions or (Open bite) and mouth breathing have been associated with chronic nasal and sinus obstruction often seen in patients with CF (2).

Dental staining (8) is the coronal staining of permanent teeth which has been reported in children with CF (8). These findings appear to be historical, linked to the intake of tetracycline antibiotics during dental development. Other antibiotics including doxycycline and linezolid have also been associated with tooth discoloration in CF. Nebulized antibiotics, particularly the off-label utilization of the carbapenem antibiotic meropenem, have been associated with marked black tooth discoloration (8).

The Objectives of our study is to identify the prevalence of dental manifestations of all confirmed Pediatric and adult CF patients that are followed in CF clinic. Comparison of the prevalence of dental manifestations between adult and Pediatric groups to find the correlation of dental manifestations and other factors such as: Education of the patients and of both parents, and Type of nutritional rehabilitation.

To our knowledge, Dental caries in cystic fibrosis patients have never been reported before in Saudi Arabia or the Middle East. This will be the first report of its kind from a tertiary care referral center for such patients.

2.1 Methodology:

2.1.1 Study Design: A retrospective chart review to examine the dental notes for all confirmed Pediatric and adult CF patients that are followed in CF clinic and evaluated routinely by the department of dentistry from the period January 1998 to December 2018.

2.1.2 Case Definition: A patient with CF disease is defined as: One who has a typical pulmonary manifestations and/or typical gastrointestinal manifestations (GI) and/or a history of CF in the immediate family in addition to sweat chloride concentration >60 mEq/ liter and or Pathologic CFTR mutations on both chromosomes, or one who has a typical pulmonary manifestations and/or typical gastrointestinal manifestations (GI) and/or a history of CF in the immediate family in addition to sweat chloride concentration >60 mEq/ liter and or Pathologic CFTR mutations on both chromosomes (2).

2.1.3 Dental Examination: was done by the dental department that includes the following findings: Decayed teeth, missing teeth, and filling composites of dental cavities for both the primary (dmft) and permanent denture (DMFT). Scoring was done according to WHO criteria (1,9-10). Dental charting was used to aid visual dental finding (7). Each child was examined either sitting on a portable dental chair, on the lap of the parent or knee to knee position depending on the behavior and age of the child. Natural light and disposable mirror heads were used for the examination. The probe was used sparingly on doubtful surfaces.

Teeth cleaning was evaluated by Plaque Index to evaluate its efficiency as good (which means cleaning frequency of 2 times per day), Fair (as once per day), and poor (as once weekly).

2.1.4 Ethical considerations: All data needed for research were obtained through routine clinical care. All data were stored in the research unit, accessed only by the principle investigator and the assigned Clinical Research Coordinator. The entire patient's information was kept strictly confidential. Each patient was given a study number, and all patients data were entered in to the designated data sheet (EXCEL) without any patient's identification. The Declaration of Helsinki and GCP guidelines were followed.

2.1.5 Statistical Statement: The data collected from this study were electronically entered into a database. The department of Biostatistics Epidemiology and Scientific Computing (BESC) carried out statistical analysis of the data utilizing the SPSS program. The prevalence of dental decay was computed based on the total score of dental caries for the 2 groups (<12 years and > 12 years, due to completion of the permanent teeth at 12 years of age), compared to the total decay score of the normal Saudi population that have been computed before in the literature for both groups (1).

Conventional parametric tests were used for comparisons (X^2 test, Student's t-test. variance analysis). Non-parametric tests were used for comparisons if the variable is not normally distributed and the Fisher's exact test were used for small samples.

3.1 Results:

A total of 131 patients divided into two groups: group I less than 12 years and group II above 12 years of age. The Male/ female ratio was equal, males were 64/131 (48.8%), females 67 (51.2%) (Table 1). : Total teeth dmft/ DMFT score is 4.85 (4.6) in group I compared to 5.94 (4.27) in group II (P=0.005), which are lower compared to the healthy Saudi population of (5, and 7.4 respectively) (Table 2). Decayed primary/ Permanent for group I were 41 (62.1%)/ 13 (19.7) compared to 6 (9.2%)/ 55

(84.6) for group II. Missing primary/ Permanent for for group I were 7 (10.5%)/ 2 (3%) compared to 0.0/ 8 (12.3%) for group II (Table 2). Filling primary/ permanent for group I were 6 (9.1%)/ 4 (6.1 %) compared to 0.0 / 17 (26.2%) for group II (Table 2). Open bite in 5 (7.6%)/ 3 (4.6%) for both groups respectively. Positive dental staining in 10 (15.2%)/19 (29.2%) for the both groups.

Four patients (6.1) were on home oxygen for less than 12 years old group compared to 5 (7.7) for more than 12 years old group and 5 (7.7) had lung transplant for the > 12 years old group (Table 1).

All patients were evaluated by the clinical nutritionist at diagnosis. Thirty-three patients (50%) were advised to take high calories, high protein, and high fat diet for less than 12 years old group compared to 5 (7.7%) for more than 12 years old group. Another Thirty-three patients (50%) were advised to take high calories, high protein supplemental formula for less than 12 years old group compared to 60 (92.3% for more than 12 years old group (Table 1).

Region	Group I	Group II
Total CF patients: # (%)	66 (50.3%)	65 (49.7%)
Male/ female: # (%)	26 (39.4)/ 40 (60.6)	38 (58.5)/ 27 (41.5)
Age at dental diagnosis Mean (SD) years	7.74 (2.9)	18.57 (4.75)
Total Number of CF patients for KSA regions (£)		
Eastern	28 (42.4%)	34 (52.3%)
Western	3 (4.5%)	4 (6.2%)
Central	11 (16.7%)	16 (24.6%)
Northern	8 (12.1%)	9 (13.8%)
Southern	16 (24.2%)	2 (3.1%)
Home oxygen # (%)	4 (6.1)	5 (7.7)
Lung Transplantation # (%)	0.0	5 (7.7)
Nutritional rehabilitation		
High calories high protein high fat diet	33 (50%)	5 (8%)
High calories high protein Supplemental feeding	33 (50%)	60 (92%)

Table (1). Comparisons of Demographic Data, Total= 131 patients

Legend Table 1:

SD= Standard deviation
#= Number of Patients
KSA= Kingdom of Saudi Arabia
(£) = Notice that the Eastern province has the highest referral

Region	Group I	Group II
Total CF patients: # (%)	66 (50.3%)	65 (49.7%)
dmft/ DMFT Total Scores Mean (SD)	4.85 (4.6)	5.94 (4.27)
Literature KSA dmft/ DMFT Scores (Healthy) Ref	3-7 years: 7.3 in 95%	**12-19 years:** 7.4 in 91%/ **30-45 years:** 15 in 98% **>45 years:** 24 in 98%
WHO in 2000 (Ref) dmft/ DMFT Total score	50% -free of dental caries	50% -free of dental caries
Decayed primary/ Permanent	**41 (62.1%)/ 13 (19.7)**	**6 (9.2%)/ 55 (84.6)**
# (%) of decayed teeth		
1-5 6-10 11-15 >16	28 (42.4 %)/ 10 (15.2%) 9 (13.5 %)/ 3 (4.5%) 0.0 / 4 (6.2 %)	6 (9.2 %)/ 31 (47.6%) 0.0 / 16 (24.6%) 0.0 / 7 (10.7 %) 0.0 / 1 (1.5 %)
Missing primary/ Permanent	**7 (10.5%)/ 2 (3%)**	**0.0/ 8 (12.3%)**
# (%) of Missing teeth	16 (24.2%)	2 (3.1%)
1-5 6-8	6 (9 %)/ 2 (3%) 1 (1.5 %)/ 0.0	0.0 / 8 (12.3%) 0.0
Filled primary/ Permanent	**6 (9.1%)/ 4 (6.1 %)**	**0.0 / 17 (26.2%)**
# (%) of Filled teeth		
1-3 4-8	6 (9.1 %)/ 3 (4.5%) 2 (3%)/ 1 (1.5%)	0.0 / 14 (21.5%) 0.0/ 3 (4.5%)
Literature KSA dmft/ DMFT Scores (Healthy) Ref	**3-7 years: 7.3** in 95%	**12-19 years:** 7.4 in 91%/ **30-45 years: 15** in 98% **>45 years: 24** in 98%
WHO in 2000 (Ref) dmft/ DMFT Total score	50% -free of dental caries	50% -free of dental caries
Positive Staining	10 (15.2%)	19 (29.2%)
Open bite	5 (7.6%)	3 (4.6%)

Table (2): Comparisons of Dental Manifestations Data of both groups, Total= 131 patients

Legend Table 2:
dmft= dental decay, missing and filled teeth for pediatric patients less than 12 years old.
DMFT= dental decay, missing and filled teeth for pediatric patients more than 12 years old and adults
SD= Standard deviation
CF= Cystic Fibrosis
#= Number of Patients
KSA= Kingdom of Saudi Arabia
WHO= World health organization
Ref= references

3.1.1 Teeth cleaning (Table 3):

For Group 1: There were 38 (57.6) patients who admitted to do regular teeth cleaning with 9 (13.6%) as of a good degree compared to 52 (78.8%) of mothers with 33 (50%) as of a good degree, and fathers of 49 (74.2%) with 19 (28.8%) as of a good degree (Table 3).

For the more than 12 years old group: There were 46 (70.8) patients who admitted to do regular teeth cleaning with 21 (32.3%) as of a good degree, compared to 53 (81.5) of mothers with 34 (52.3%) as of a good degree, and fathers of 54 (83.1) with 33 (50.8%) as of a good degree (Table 3).

	(Group 1) Total= 66 patients											
	Patients' cleaning Number (%)				Mothers' cleaning Number (%)				Fathers' cleaning Number (%)			
	Yes 38 (57.6)	No 23 (34.8)	Miss 5 (7.6)	Total 66 (100)	Yes 52 (78.8)	No 9 (13.6)	Miss 5 (7.6)	Total 66 (100)	Yes 49 (74.2)	No 12 (18.2)	Miss 5 (7.6)	Total 66 (100)
Degree of Dental cleaning	Number		Percent		Number		Percent		Number		Percent	
Good	9		13.6%		33		50%		19		28.8%	
Fair	18		27.3%		13		19.7%		24		36.4%	
Poor	10		15.2%		5		7.6%		5		7.6%	
Missing	29		43.9%		15		22.7%		18		27.3%	
Total	66		100%		66		100%		66		100%	
	(Group II) Total= 65 patients											
	Patients' cleaning Number (%)				Mothers' cleaning Number (%)				Fathers' cleaning Number (%)			
	Yes 46 (70.8)	No 17 (26.2)	Miss 2 (3.1)	Total 65 (100)	Yes 53 (81.5)	No 10 (15.4)	Miss 2 (3.1)	Total 65 (100)	Yes 54 (83.1)	No 12 (18.2)	Miss 2 (3.1)	Total 65 (100)
Degree of Dental cleaning	Number		Percent		Number		Percent		Number		Percent	
Good	21		32.3%		34		52.3%		33		50.8%	
Fair	19		29.2%		15		23.1%		13		20%	
Poor	6		9.2%		4		6.2%		7		10.8%	
Missing	19		29.2%		12		18.5%		12		18.5%	
Total	65		100%		65		100%		65		100%	

Table (3): Comparisons of 2 Groups (Group I) and (Group II) in relation to the Degree of dental Cleaning in patients and both parents,Total= 133 patients

Legend Table 3:
Miss= Missing data

4.1 Discussion:

Al-Mohammadi et al (11) study in boys aged 2,4 and 6 years showed that the dmft score and caries prevalence of Al-Ahassa area was considerably lower as compared with that of Riyadh city and other parts of the Middle East (11). The fact that approximately three quarters of the study children had clinical caries and that on average each child had 3 carious teeth, indicates an immediate need for enhanced preventive efforts. A major decay component indicated a high percentage of untreated caries.

Our data also showed that 50% of our population were from the Eastern province (Table 1) and the dmft/DMFT of our CF population is less than the general population.

There are several theories as to why individuals with CF may be at reduced risk of dental caries and periodontal diseases. One hypothesis suggested that the natural pH buffering effects created by consuming a diet high in dairy products protects the dentition from decay. Another theory proposed that: because patients with CF undergo long-term antibiotic regimens (in addition to pancreatic enzymes), they may be less likely to develop caries and gingival bleeding, as these agents can

change the microbial flora of the mouth. Azithromycin is frequently prescribed for individuals with CF, and it is particularly effective against Gram-negative bacteria, and may penetrate dental biofilm, has good periodontal tissue penetration, and is retained in the periodontal pocket for up to 14 days. Additionally, individuals with CF have altered salivary content with higher calcium and phosphate concentrations, which may increase the saliva's buffer capacity (5).

Our study has shown that the dmft/ DMFT score of both groups (<12 years old and > 12 years old) are lower compared to that of the normal Saudi Population 4.85 (4.6) for (<12 years old and 5.94 (4.27) for > 12 years old group. This could be explained due to the early use of antibiotics prophylaxis as Azithromycin, which may have helped in reducing the bacterial colonization.

In *Pseudomonas aeruginosa* (*P. aeruginosa*) CF colonization, inhaled tobramycin does not affect *S. mutans*, therefore adolescents with CF may lose protection against caries. In fact, inhalation forces this anti-Gram-negative antibiotic into the mouth, which may exert ecologic pressure in favor of Gram-positive flora such as *S. mutans*, thereby increasing caries risk in adolescents with CF (6).

Our data showed that total DMFT score for the > 12 years old group of 5.94 (4.27) is higher than the pediatric group despite better dental hygiene which could be explained due to the shift of bacteria to *P. aeruginosa.*

The World Health Organization and World Dental Federation (FDI) established goals to achieve 50% of children aged 5-6 years to be caries free and global average of DMFT not to be >3 for 12-year-old children [12 -14]. However, even after 19 years, the proportion of caries free CF children is far less and DMFT score in 12-year-old CF children is much greater than WHO and FDI stated goals, which were to be achieved by 2000. Similarly, according to WHO's basic global indicator of oral health 2000, DMFT >6.6 for the children aged 12 years is considered very high, between 4.5-6.5 is high and 2.7-4.4 is moderate [13]. This could be explained by poor hygiene (13% had good teeth cleaning with the patient and both parents (50% for mothers, and 36.4% for fathers) in <12 years old Cf group and (32.3% for CF patients > 12 years old group to have good teeth cleaning and 52.3% in mothers and 50.8% in fathers) compared to the international studies of 80% (1) probably due to prolonged Azithromycin prophylaxis.

Keeping WHO guidelines in mind, it can be clearly seen from the present study that CF children in Saudi Arabia have a high DMFT estimate. The situation is particularly alarming because high burden of caries can negatively affect growth, development and learning in the children.

Another reason for high dmf/DMFT in our CF patients could be explained due to high sugar contents in their nutritional supplements as all patients were advised to take high calories, high protein diet regimens either as regular oral intake or as nutritional supplements to maintain their growth. Further studies need to be done to evaluate such relationship in our CF communities.

Inadequate access to oral health care particularly in remote areas, non-availability of fluoridated water and paucity of clinical and population-based research on the detrimental effect of caries can account for increased prevalence of caries in the Saudi CF communities (15).

Regular professional care and good home oral hygiene habits are extremely important in CF patient management (4).

5.1 Conclusion:

Dental caries is common in Saudi CF patients. Prevalence of dental caries score in our CF population is lower compared to the healthy Saudi Population but still unmet the WHO year 2000 goals. Patients with CF should be screened routinely for caries, and periodontal diseases.

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References:

1) Al-Ansari Asim. Prevalence, severity, and secular trends of dental caries among various Saudi populations: A literature review. Saudi J Med Med Sci 2014;2 (3):142-50.

2) Fernald, G. W., Roberts, M. W., & Boat, T. F. (1990). Cystic fibrosis: A current review. The American Academy of Pediatric Dentistry, 12(2), 72-78

3) Narang A, Maguire A, Nunn J H, Bush A. Oral health and related factors in cystic fibrosis and other chronic respiratory disorders. Arch Dis Child 2003;88:702–707.

4) Chi, D. L. (2013). Dental caries prevalence in children and adolescents with cystic fibrosis: A qualitative systematic review and recommendations for future research. International Journal of Paediatric Dentistry Int J Paediatr Dent, 23(5), 376-386. doi:10.1111/ipd.12042.

5) Aps JK, Martens LC. [Oral health risks in patients with cystic fibrosis]. Rev Belge Med Dent (1984). 2004;59(2):114-20. French. PubMed PMID: 15693167

6) Teeters, A., Gurenlian, J. R., & Pickett, F. A. (n.d.). Treating Patients with Cystic Fibrosis. The Journal of Professional Excellence Dimensions of Dental Hygiene. September 2013; 11(9): 63–67.

7) Abhishek Mehta1. Literature Review Article, Comprehensive review of caries assessment systems developed over the last decade. RSBO. 2012 Jul-Sep;9(3):316-21

8) Harrington N. Barry P. J. Barry S. M. Dental treatment for peo-

ple with cystic fibrosis; Eur Arch Paediatr Dent 2016; 17:195–203. DOI 10.1007/s40368-016-0229-9

9) Amjad H. Wyne, BDS, MDS, Nadya A. Al-Ghannam, BDS, MDS, Abdullah R. Al-Shammery, BDS, MDS, Nazeer B. Khan, MSc, PhD. Caries prevalence, severity and pattern in pre-school children. Saudi Med J 2002; Vol. 23 (5): 580-584

10) Donald L. Chi, DDS, PhD. Dental caries prevalence in children and adolescents with cystic fibrosis: a qualitative systematic review and recommendations for future research; Int J Paediatr Dent. 2013 September; 23(5): 376–386. doi:10.1111/ipd.12042.

11) Saeed M. Al-Mohammadi, Andrew J. Rugg-Gunn and Timothy J. Butler Caries prevalence in boys aged 2,4 and 6 years according to socio-economic status in Riyadh, Saudi Arabia Community Dent Oral Epidemiol 1997: 25: 184 6.

12) World Health Organization. Oral health information systems. Available from: http://www.who.int/oral_health/action/ information/surveillance/en/. [Last accessed on 2014 Jul 11].

13) World Health Organization. DMFT levels at 12 years 1996. Available from: http://apps.who.int/iris/bitstream/10665/61182/1/WHO_ ORH_ DMFT12_96.1.pdf?ua=1. [Last accessed on 2014 Jul 11].

14) National Institute of Dental and Craniofacial Research. Dental Caries (Tooth Decay) in Children (Age 2-11). Available from: http://www.nidcr.nih.gov. [Last accessed on 2014 Jul 11].

15)Saudi Arabian Central Department of Statistics & Information. Demographic Research Bulletin 2007. Available from: http://www.cdsi.gov.sa/english/index.php?option=com_docman&task=cat_view&gid=43&Itemid=113. [Last accessed on 2014 Jul 11].