

## Caries Risk Assessment in Children using Salivary Parameters

Nazish Munir Mohamed Hussein, Sajith Bhaskar and Ahmed Al-Radaideh

Ajman University of Science & Technology, Ajman, United Arab Emirates

Correspondence should be addressed to Sajith Bhaskar, [fjac.sajith.b@ajman.ac.ae](mailto:fjac.sajith.b@ajman.ac.ae)

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**Abstract** The aim of the study was to assess the caries risk in children aged 5-8 years using salivary parameters such as salivary flow rate, pH, buffering capacity and bacterial count (*Streptococcus Mutans*). 30 children, aged 5-8 years visiting the dental clinic at Ajman University of Science & Technology, Fujairah were randomly selected. Salivary parameters were assessed and caries index recorded for each. Children were found to have a very high caries rate; the mean deft was 10.67. No correlation was found between salivary flow rate and caries index. Negative correlation was found between pH and caries index but this was not statistically significant. Significant positive correlation was found between buffering capacity, levels of salivary *S. Mutans* and caries index. Association between caries prevalence and various salivary parameters is weak and inadequate to accurately identify caries risk at an individual level. However the predictive value improves and becomes more significant at population level. Various salivary tests must be used in combination or clusters for enhanced caries risk assessment.

**Keywords** *Buffering Capacity; Caries; Flow Rate; pH; Saliva; Streptococcus Mutans*

### 1. Introduction

A significant increase in the burden of oral-health related diseases in the Middle East has been observed recently [1]. Various studies have been carried out in the UAE to ascertain the prevalence of dental caries. The data obtained clearly shows that there is an increasing trend of dental caries in the primary dentition of children in the UAE [2]. This trend can be attributed to numerous factors such as an increase in refined carbohydrates and sugar consumption, lack of oral health awareness and inadequate knowledge about proper oral hygiene practises. Hence this disease is considered to be a major public health problem in the region [3].

Dental caries is a chronic complex disease with a multifactorial etiology. Caries result from an imbalance between multiple risk factors and protective factors in addition to interplay of three principles factors: host, microflora and substrate over the time. Although not directly involved, but past caries experience, social and behavioral factors can also aid in caries risk identification. The flow of saliva, its buffer capacity and presence of fluoride play an important role in caries prevention [4].

Saliva is a biologic fluid in the oral cavity, composed of a mixture of secretory products from the major and minor salivary glands. It is generally accepted that saliva is of paramount importance for the maintenance of oral health [5]. The buffering capacity helps to control the oral pH, and other compounds work together to avert dental caries by mechanical washing, antimicrobial action and salivary capacity to remineralize [6].

As saliva plays an important role in caries prevention, significant reduction or deterioration of salivary functions can contribute to the development of dental caries [7].

The evaluation of caries risk is of paramount importance. It provides an opportunity to make improvements in the oral hygiene, diet, and also to implement customized preventive measures in an exposed population [8]. This study was undertaken to assess the effect of various salivary parameters on caries incidence, in order to identify high risk groups and thus improve the approach in prevention and therapy.

## **2. Materials and Methods**

### **2.1. Ethical Considerations**

The study was initiated after approval of research plan by the Ethics Committee of Ajman University of Science & Technology.

### **2.2. Subject Selection**

45 children aged between 5-8 years visited the dental clinic at the College of Dentistry at Ajman University of Science & Technology, Fujairah Campus between March-April 2013. Out of these, 30 children who fulfilled the inclusion and exclusion criteria were randomly selected.

The following inclusion & exclusion criteria were set and implemented.

#### Inclusion criteria

- Children who were permanent residents of Fujairah
- Children with informed consent from the parent/guardian
- Children in the age group of 5-8 years

#### Exclusion criteria

- Children who were severely ill
- Children who had taken antibiotics in the last month
- Children using orthodontic appliances

### **2.3. Data Collection and Calibration**

The subjects underwent a clinical examination, sialometry, and salivary analysis. No radiographs were taken. The same examiner examined all children to reduce variability in data collection and recording.

### **2.4. Clinical Examination**

Dental caries for the entire dentition was recorded clinically by one examiner according to the WHO criteria. Visual examination & probing with an explorer were used to detect caries. The number of carious (d), primary teeth indicated for extraction due to caries (e) and filled (f) teeth were recorded for each patient and the deft score was calculated. Permanent teeth if present were registered

separately. Presence of decayed (D), missing (M) and filled (F) teeth was recorded separately by DMFT index.

## 2.5. Salivary Analysis

### 2.5.1. Flow Rate

Subjects were asked not to eat, drink or use mouth rinses for 2 hours before saliva sample collection. Samples from each subject were collected between 10.00 a.m. - 11.00 a.m. to minimize variability due to circadian rhythms effects. The subjects were asked to sit and relax in order to create a stress free environment, prior to saliva collection. Children were made to swallow the pre-existing saliva, in order to clear the mouth of any residual unstimulated saliva. Next, each subject was asked to chew on a standard piece of paraffin wax pellet for 5 minutes and expectorate all saliva. The stimulated saliva was collected in a graduated sampling container. Saliva was collected in the collection cup at regular intervals of time. After disappearance of the froth, the total volume of saliva collected was noted and the secretion rate, in milliliters per minute, was calculated. The saliva samples of all the participants were identified by a code number during the period of sample collection and processing.

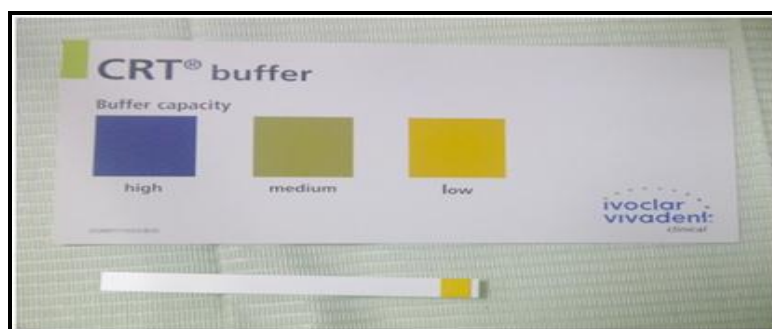
### 2.5.2. pH

The pH of the stimulated saliva was measured immediately after collection, using a digital pH meter. The electrode was immersed into the collection cup containing the saliva sample. The reading was allowed to stabilize for a few seconds before it was recorded.

The electrodes were washed with distilled water between each use to ensure removal of any salivary residues which could affect the pH of the next sample. The accuracy of the pH meter was checked at regular intervals and calibration repeated if necessary.

### 2.5.3. Buffering Capacity

Salivary buffering capacity was estimated soon after collection using a commercially available CRT buffer strip test (Ivoclar, vivadent). The buffer strip was removed from the package and placed onto an absorbent tissue with the test side up. Using the micropipette provided, sufficient saliva was drawn from the cup and a drop was used to wet the test field on the strip. Immediately the strip was turned around to 90 degrees to soak up the excess saliva on absorbent tissue. (This was done to prevent the excess saliva from swelling on the test field and possibly affecting the result of the test) 5 minutes of reaction time was ensured as per the manufacturers' instructions. The buffering capacity was determined by comparing visually the colour changes in the CRT buffer strip with the manufacturer's colour chart provided in the kit. The buffering capacity was categorized as high, medium or low. (Figures A.1, A.2, A.3)



**Figure A.1:** Yellow Coloured Test Field Indicating Low Buffering Capacity



**Figure A.2:** Green Coloured Test Field Indicating Medium Buffering Capacity

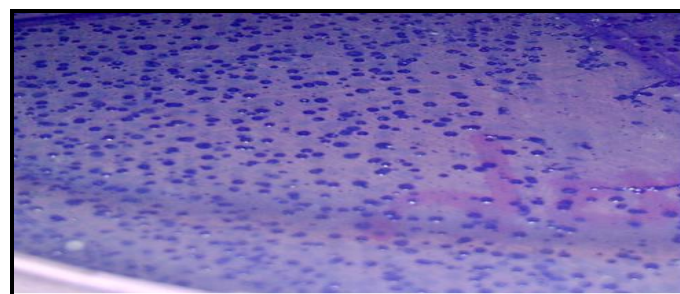


**Figure A.3:** Blue Coloured Test Field Indicating High Buffering Capacity

#### 2.5.4. Microbial Composition

A sterile swab was used to spread 0.2 ml of saliva on Mitis Salivarius agar. Plate was incubated at 37°C for 24 hrs. The number of colony forming units (CFU) was determined using a colony counter.

Growth was classified as heavy, moderate or mild based on the number of CFUs. (Table 1, Figure A.4)



**Figure A.4:** A Petri Dish Showing 'Moderate' Growth of *Streptococcus Mutans*

**Table 1:** Salivary *Streptococcus Mutans* Growth Categorized as Mild, Moderate and Heavy Depending on the Number of CFU

CFU	$\leq 10^3$	$10^4$	$\geq 10^5$
Category	Mild	Moderate	Heavy

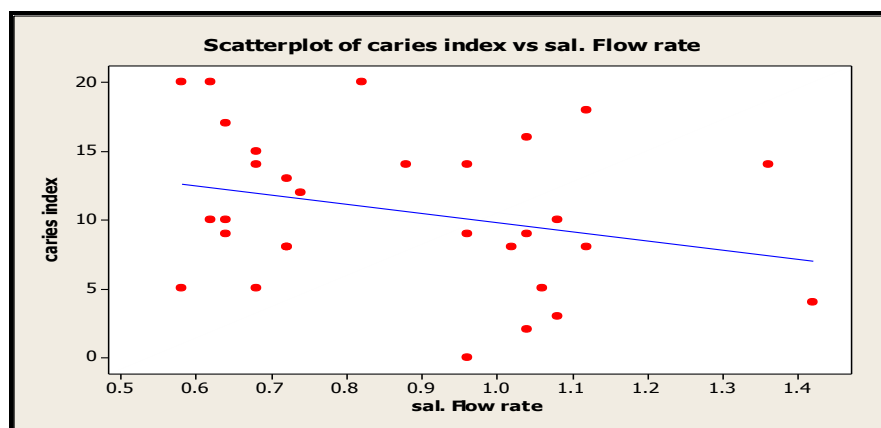
### 3. Results

Results were compiled and analysed using SPSS software. Pearson's correlation coefficient was used to analyse the correlation between individual salivary parameters, i.e. salivary flow rate, pH, buffering capacity, Streptococcus Mutans levels and the deft index.

The caries index in the present sample was found to be very high; the mean deft score for the entire group was 10.67. The mean deft score was 11.43, 11.1, 10.1, and 11.8 for 5, 6, 7, and 8 year olds respectively. The decayed tooth 'dt' component was very high in all the subjects and made the most significant contribution to the overall deft score.

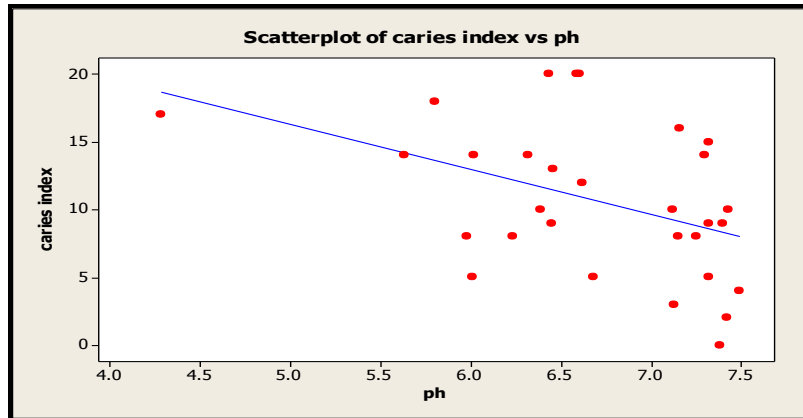
The deft values were considerably higher than those reported previously in similar age groups from other populations [9, 10, 11, 12, 13, 14, 15]. In a national survey of oral health in United Arab Emirates in 2001-2002 the mean caries index score of Fujairah was found to be 6.1 [2]. This is much lower than the average deft score found in our study. Our findings were more consistent with those of G. Ansari et al., and R. Hashim et al., who also carried out studies in the United Arab Emirates in 2005 and 2006 respectively [16, 17].

In our study, salivary flow rate was the parameter most difficult to evaluate. The problem arose due to the low age group of our subjects and their inability to follow instructions on expectoration of saliva. Within the scope of our study, no correlation was found between salivary flow rate and caries index (Figure B.1). This was consistent with the findings of Sakeenabi et al., (2011) [9]; Najat F., (2008) [10]; Bretas et al., (2008) [18] and Lumikari, (2000) [19] but in contrast with the observations of a few others like Preethi et al., (2010) [5]; Kaur et al., (2012) [6] and Koseki et al., (2004) [20].



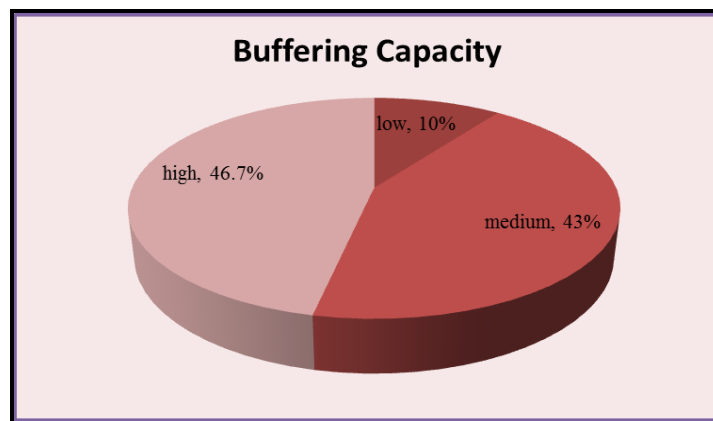
**Figure B.1:** Scatter Plot Showing Correlation of Salivary Flow Rate and Caries Index

The pH value of saliva ranged from 5.63 to 7.49 and the average pH of saliva in the group was found to be 6.69. A negative correlation was found between salivary pH and caries index in our study but this was not statistically significant (Figure B.2). Our results were parallel with those of Ahmadi M. et al., (2013) [21]; Tulunoglu et al., (2006) [22] and Leone and Oppenheim, (2001) [23] but in contrast with findings of Kaur et al., (2012) [6] and Najat F., (2008) [10] who reported a significant correlation between salivary pH and caries activity.

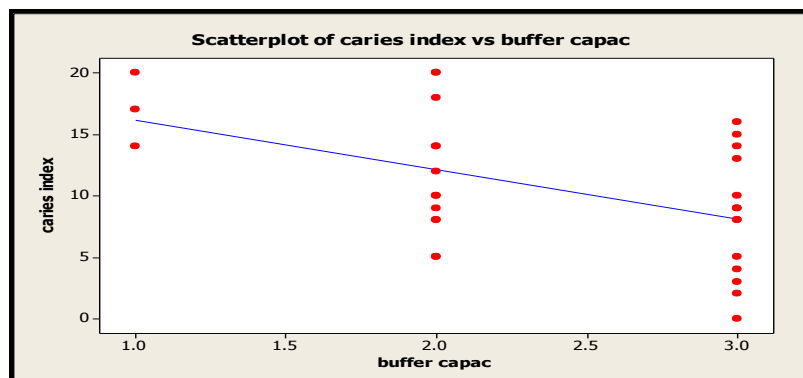


**Figure B.2:** Scatter Plot Showing Correlation of Caries Index and pH

Buffering capacity was categorized as high, medium and low. On analysis of results a significant negative correlation was found between caries index & buffering capacity- P-Value 0.006 (Figure B.3, B.4). This is consistent with the findings of numerous other studies including those of Sakeenabi et al., (2011) [9]; Preethi et al., (2010) [5]; Leone and Oppenheim, (2001) [23]; Bretas et al., [18] but in contrast with those of Najat F., (2008) [10].



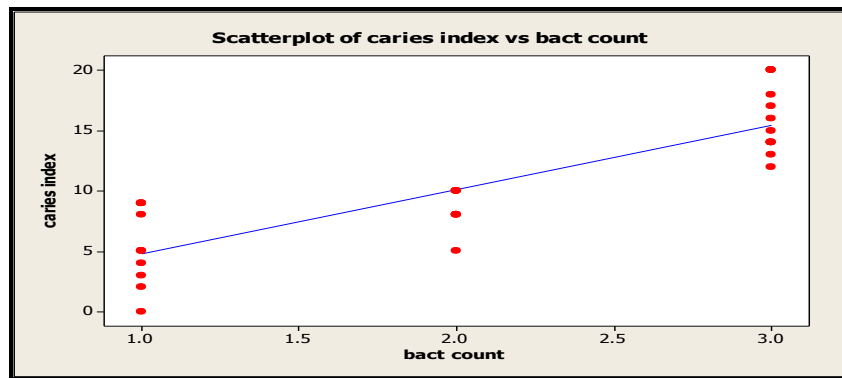
**Figure B.3:** A Pie Chart Showing the Percentage of Children Having High, Medium and Low Buffering Capacities



**Figure B.4:** Scatter Plot Showing the Correlation of Caries Index and Buffering Capacity

Streptococcus growth levels were categorized into heavy, moderate and low. A significant variation was found. A statistically significant positive correlation was found between caries index and Streptococcus mutans levels- P-Value 0.000 (Figure B.5). Our findings were parallel with those of

other similar studies, including, Sakeenabi et al., (2011) [9]; Najat F., (2008) [10]; Alaluusua et al., (1987) [24]; Russell et al., (1990) [25]; Granath et al., (1991) [26]; Hebbal et al., (2012) [27].



**Figure B.5:** Scatter Plot Showing Correlation between Caries Index and Bacterial Count (*S. Mutans* levels)

General regression and stepwise regression analysis were also carried out (Tables 2, 3, 4). It was found that assessing all the variables together did improve the correlation with caries index; however bacterial count had the most significant predictive value followed by salivary buffering capacity and these two factors contributed most towards the regression model.

**Table 2:** General Regression Analysis- Coefficients

Coefficients				
Term	Coefficient	SE Coefficient	T	P
Constant	-5.26411	7.60600	-0.69210	0.495
Salivary flow rate	0.66852	3.04153	0.21980	0.828
pH	1.45470	1.34737	1.07966	0.291
Buffering capacity	-2.22862	1.58822	-1.40322	0.173
Bacterial count	5.18567	0.72181	7.18427	0.000

**Regression Equation:**

$$\text{caries index} = -5.26411 + 0.668521 \text{ salivary flow rate} + 1.4547 \text{ pH} - 2.22862 \text{ buffering capacity} + 5.18567 \text{ bacterial count}$$

**Table 3:** General Regression Analysis- Analysis of Variance

Analysis of Variance						
Source	DF	Seq SS	Adj SS	Adj MS	F	P
Regression	4	663.777	663.777	165.944	19.1278	0.000000
Saliv. flow rate	1	69.329	0.419	0.419	0.0483	0.827813
pH	1	102.311	10.113	10.113	1.1657	0.290599
Buffering capacity	1	44.357	17.082	17.082	1.9690	0.172850
Bacterial count	1	447.780	447.780	447.780	51.6138	0.000000
Error	25	216.889	216.889	8.676		
Total	29	880.667				

**Table 4:** Stepwise Regression Analysis

Constant	-0.527
bact count	5.33
T-Value	8.75
P-Value	0.000
S	2.90
R-Sq	73.24
R-Sq(adj)	72.28
Mallows Cp	1.2

PRESS	273.021
R-Sq(pred)	69.00
Alpha- 0.25, N= 30, Forward Selection	

#### 4. Conclusion

Dental caries is a significant problem in the UAE and thus, it is beneficial to screen for caries risk factors. Identifying high risk populations can be a very important tool in formulating specific and more intensive oral health programmes. It can also aid dentists in carrying out appropriate preventive and interventional measures based on the risk status.

Testing of salivary parameters is an easy and quick method of assessing caries risk. Though the association found between caries prevalence and various salivary tests is inadequate to accurately identify caries risk at an individual level, the predictive and diagnostic value of these tests increases and becomes more significant at population level [28].

These salivary tests should be used in combinations or clusters for more accurate caries risk assessment. Further research should be aimed at finding easier and more accurate methods of assessing caries risk or modifying the current tests to increase their accuracy and thus improving the overall diagnostic value.

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