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Original Research Article

Role of saliva buffer capacity for caries risk assessment in adults using a reduced cariogram model

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ABSTRACT

Introduction : A reduced cariogram model is a simplified version of the original cariogram which simplifies the analysis by focusing on fewer parameters, making it easy to use in clinical and research settings. One of the key components in "cariogram model" is the buffering capacity of saliva, which plays a pivotal role in maintaining oral pH balance.

Aims & Objective: To investigate the role of "salivary buffer capacity" for caries predictive ability of "reduced cariogram model" in adults.

Materials and Methods: A sample of 90 patients were included in this study. The cariogram variables were collected through a questionnaire, clinical and salivary examinations. The outcome measure was computed as a "chance to avoid caries in the near future," which was expressed in percentage. The eight cariogram variables computed were caries experience, related diseases, diet frequency, plaque amount, fluoride program, saliva secretion, saliva buffer capacity, and clinical judgment. The data were calculated in two ways: "cariogram with eight variables" and "cariogram with seven variables", excluding saliva buffer capacity.The patients were then allocated into three caries risk categories according to their chance of avoiding caries in the near future, as follows: 0–40% chance to avoid caries =high caries risk, 41–60% chance to avoid caries = medium caries risk, and 61–100% chance to avoid caries = low caries risk in both models i.e "cariogram with eight variables" and "cariogram with seven variables". Comparison between the two was done.

Results: When eight variables were considered the p value was 0.150 and when only seven variables were considered the p value was 0.001 which is statistically significant indicating the saliva buffer capacity has an influence in the caries risk assessment of an individual.

Conclusion: Saliva buffer capacity had a significant role in altering the caries risk of an individual in a "reduced cariogram model".

1. Introduction

Dental caries remains a significant public health concern, particularly among adults. Accurate assessment of caries risk is essential for the development of effective preventive strategies and personalized treatment plans. Cariogram, a widely recognized tool in caries risk assessment, offers a visual representation of an individual's caries risk profile by integrating various factors such as diet, bacterial load, oral hygiene, and fluoride exposure. However, the complexity of the full cariogram model can sometimes be a barrier to its practical application in clinical settings, leading to the development of a reduced version that focuses on the critical risk factors. [1–5]

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A reduced cariogram model is a simplified version of the original cariogram which simplifies the analysis by focusing on fewer parameters, making it easy to use in clinical and research settings.

One of the key components in "cariogram model" is the buffering capacity of saliva, which plays a pivotal role in maintaining oral pH balance. Saliva acts as the first line of defense against the acids produced by cariogenic bacteria in the oral cavity. By neutralizing these acids, saliva helps to prevent demineralization of tooth enamel and promotes remineralization, thereby reducing the risk of caries development.

The buffering capacity of saliva is influenced by various factors, including the flow rate, composition of electrolytes, and the presence of bicarbonates, phosphates, and proteins. A higher buffering capacity indicates a greater ability of the saliva to neutralize acids, which is crucial in mitigating the risk of dental caries. Conversely, a lower buffering capacity can lead to prolonged acidic conditions in the mouth, increasing the susceptibility to caries.

When the cariogram model was used without saliva samples, school children caries prediction accuracy was greatly reduced, even though the majority of these kids never had dental cavities before. There isn't enough evidence of this among adults, though. It is still difficult to determine the caries risk of this population because the majority of adult patients who visit clinics have already had dental caries. But whether a screening cariogram model without saliva testing may take the place of the full-blown cariogram model is unknown, especially for adult patients with a history of dental cavities.[3,6]

In the context of the reduced cariogram model, evaluating the buffering capacity of saliva provides valuable insights into an individual's caries risk profile.

2. Materials and Methods

A sample consisted of 90 patients visited, Department of Conservative and Endodontics of Drs. Sudha& Nageswara Rao Siddhartha Institute of Dental Sciences. Patients age ranging from 18-50 were included in this study. Patients on regular medication, who did not provide informed consent, had a diagnosis of psychiatric disease or were completely illiterate, had undergone radiation therapy were excluded from the study. Patients were consecutively enrolled after informed consent was obtained, with consent forms signed by the patients. This study protocol was approved by the Ethics Committee of Drs. Sudha & Nageswara Rao Siddhartha Institute of Dental Sciences.

The study employed a cross-sectional design in which data regarding the cariogram variables were collected through a questionnaire, clinical and salivary examinations. The outcome measure was the computed "chance to avoid caries in the near future," expressed as a percentage.

2.1. Procedure

The questionnaires were completed by the patients, and data were retrieved regarding general health, self and professionally applied fluorides (fluoridated toothpaste, fluoride mouth rinse, fluoride varnish, etc), and dietary habits (frequency of meals, sugar content). The levels of salivary buffer capacity (SBC), was determined using the commercial chair-side kits (Saliva-Check BUFFER kit by GC Figures 1 and 2). The salivary buffering test was performed according to the instructions of the manufacturer. The clinical examination was conducted by one single examiner in a dental chair with optimal light using a mouth mirror, an explorer, and a periodontal probe. All teeth were examined while dry and clean.

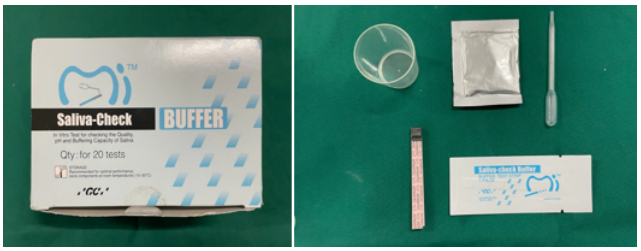

Figure 1: Saliva buffer kit by GC

The following clinical parameters were recorded: dental plaque by the simplified Plaque Index;[7] gingivitis by the Gingival Index;[8] dental caries by DMFT/S Index (D = decayed, M = missing due to caries, F = filled, T = permanent teeth, S = tooth surfaces) according to the World Health Organization (WHO) 1987 caries criteria.[5,9]

Figure 2: Plaque disclosing agent by GC

The data were calculated in two ways: cariogram with eight variables and cariogram with seven variables. The eight cariogram variables computed were caries experience, related diseases, diet frequency, plaque amount, fluoride program, saliva secretion, clinical judgment and saliva buffer capacity (Figure 3). Salivary buffer capacity was excluded in cariogram with seven variable model. (Figure 4)

2.2. Caries risk category

In cariogram model, scores range from 0 to 3 for each risk factor, with each score representing different levels of risk. Lower scores across factors indicate a lower caries risk, while higher scores suggest a need for targeted preventive or restorative actions.

Caries Experience	2
Related Diseases	0
Diet Contents	0-3
Diet Frequency	1
Plaque Amount	1
Mutans Streptococci	0-3
Fluoride Program	2
Saliva Secretion	0
Buffer Capacity	1
Clinical Judgement	1

Figure 3: Cariogram generated in case of fight variables

The patients were then allocated into three caries risk categories according to their chance of avoiding caries in the near future,[1] as follows:

1. 0–40% chance to avoid caries =high caries risk.
2. 41–60% chance to avoid caries = medium caries risk.
3. 61–100% chance to avoid caries = low caries risk.

3. Results

When the low risk category was compared between 7 and 8 variables there was statistically significant difference between the groups (Tables 1 and 2)

When the high risk category was compared between 7 and 8 variables there was statistically no significant difference between the groups (Tables 3 and 4)

Caries Experience	2
Related Diseases	0
Diet Contents	0-3
Diet Frequency	1
Plaque Amount	2
Mutans Streptococci	0-3
Fluoride Program	2
Saliva Secretion	0
Buffer Capacity	0-2
Clinical Judgement	1

Figure 4: Cariogram generated in case of seven variables

4. Discussion

Determining that dental caries is a disease is the first step in creating a non-invasive or minimal intervention treatment plan.

A susceptible host and cariogenic bacterial plaque maintained by a high-sugar diet are necessary for dental caries. The acid produced by the bacteria fermentation of the carbohydrates lowers the neutral pH of the oral environment and damages the enamel. As a result of the calcium and phosphate ions being leached out, demineralization occurs, destroying the enamel's subsurface and producing dental caries.[10]

Dental caries prevention relies on a multifaceted approach combining personal oral hygiene practices, dietary modifications and professional intervention. In addition to personal practices professional preventive measures play a vital role. Regular brushing with fluoride tooth paste, flossing and pit and fissure sealants provide additional protection for high caries risk individuals.

The process of predicting future caries development prior to the onset of the disease is known as caries risk assessment. One of the main pillars of patient-centered caries care is caries risk assessment, which helps the clinician make decisions about treatment, appointment

Table 1: Data regarding all risk categories

	Low	Medium	High
8 variables	31	37	22
7 variables	5	63	22

Table 2: Comparison between 7 and 8 variables for Low Category

Variables	N	Mean Rank	Sum of Ranks	Mann – Whitney U test	P value
7	5	31.50	157.50	12.500	p<0.001***
8	31	16.40	508.50		
Total	36				

**Mann- Whitney U test, Statistical significance level set as p<0.05*

Table 3: Comparison between 7 and 8 variables for medium category

Variables	N	Mean Rank	Sum of Ranks	Mann – Whitney U test	P value
7	63	44.78	2821.00	805.00	p<0.007**
8	37	60.24	2229.00		
Total	100				

**Mann- Whitney U test, Statistical significance level set as p<0.05*

Table 4: Comparison between 7 and 8 variables for high category

Variables	N	Mean Rank	Sum of Ranks	Mann – Whitney U test	P value
7	22	21.02	462.50	209.50	p<0.429
8	22	23.98	527.50		
Total	44				

**Mann- Whitney U test, Statistical significance level set as p<0.05*

recall, and the necessity for further diagnostic tests.[11,12]

In addition to being very accurate and precise, the ideal risk assessment model should be simple to use in day-to-day operations and make use of low-cost risk indicators that can be reliably evaluated. In addition to accurately identifying individuals with minimal risk, the predictive technology should be sensitive enough to detect as many people with an actual caries risk as possible.

Several methods for predicting and assessing caries risk have been created. None has outperformed the others, although they are all intended to assess a patient's or a population's caries risk as precisely as possible.[13,14] The Cariogram, which is regarded as one of the most accurate models for estimating a person's risk of dental cavities, was employed in this study.

The cariogram model is truly comprehensive and illustrates the relative importance of various background factors in an individual risk profile. Cariogram provides a structured, visual, and interactive approach that not only assesses patient's caries risk but also educates and motivates them to take charge of their oral health. Through this proactive model, patients benefit from enhanced understanding, prevention-focused care and better long term oral health outcomes.[15,16] The significance of cariogram for adults include comprehensive caries risk assessment, customised preventive strategies, behavioural motivation and patient education and also targeted interventions for high risk individuals.

The goal of this study is to determine whether or not the reduced cariogram model would be useful in the absence of the saliva buffer capacity test. This simplified model emphasizes the importance of saliva in maintaining oral health, particularly in adult populations where age-related changes in salivary function can alter caries risk. By incorporating saliva buffering capacity into caries risk assessment, we can more accurately identify individuals at higher risk and tailor preventive measures accordingly.

There are ten caries related factors according to the program: Caries experience, Mutans streptococci count, Related general diseases, Fluoride programme, Diet contents, Saliva secretion, Diet frequency, Saliva buffer capacity, Plaque amount and Clinical judgement.

The Cariogram, a pie circle-diagram is divided into five sectors, in the following colours: green, dark blue, red, light blue and yellow indicating the different groups of factors related to dental caries.[2]

The green sector shows an estimation of the 'Actual chance to avoid new cavities'. The green sector is 'what is left' when the other factors have taken their share.

The dark blue sector 'Diet' is based on a combination of diet contents and diet frequency.

The red sector 'Bacteria' is based on a combination of amount of plaque and mutans Streptococci.

The light blue sector 'Susceptibility' is based on a combination of fluoride program, saliva secretion and saliva buffer capacity.

The yellow sector 'Circumstances' is based on a combination of past caries experience and related diseases.

Performing all ten parameters in a full cariogram assessment can be challenging in a clinical setting due to several practical issues. Some parameters require specialised tests that may not be accessible in every dental office, particularly those with limited resources. So a reduced cariogram model uses a fewer, more manageable set of parameters to provide a more accurate assessment without the full complexity of the original model.

Performing a saliva buffer capacity test chair side is generally feasible however it can present with challenges including the need for specialized equipment, potential time consumption and associated costs.[4] The other two parameters that necessitate specialised equipment are the mutans Streptococci count and dietary content assessment, which involves measuring the lactobacillus counts, making them difficult to conduct in a clinical set up.

Two cariogram models were generated for each patient included in the study. One cariogram model was generated with seven variables and other cariogram model was generated using eight cariogram variables including the saliva buffer capacity. The data showed statistical significance when seven variables were included.

When the saliva buffer parameter was included in the cariogram model it was favouring towards the low caries risk but when this saliva parameter was excluded, the cariogram model was favouring more towards the medium risk.

This suggests that excluding the salivary buffer capacity parameter may lead to an over estimation of an individual's caries risk. The high caries risk category remained unchanged whether seven or eight variables were included.

5. Conclusion

1. Saliva buffer capacity has a significant role in altering the caries risk assessment of an individual.
2. When saliva buffer capacity parameter is included in the reduced cariogram model, the caries risk status of the individual can be estimated in a more realistic way thereby minimizing overtreatment or undertreatment.

6. Source of Funding

None.

7. Conflict of Interest

The authors deny any conflicts of interest related to this study

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