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RESEARCH ARTICLE

EFFECTIVENESS OF CARIOGRAM IN ASSESSING CARIES RISK AMONG 12 YEAR OLD SCHOOL GOING CHILDREN AT PUDUCHERRY– A CROSS SECTIONAL STUDY

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ABSTRACT

Background: Risk assessment is an essential component in the decision- making process for the prevention and management of dental caries. Cariogram® is a computer-based program which was developed to depict caries risk of a person graphically using various factors.
Aim and objective: The present study was aimed to compare the effectiveness of Cariogram® in caries risk assessment among 12 year old school children in Puducherry.
Material and Methods: The study was done among 60 school going children of 12 years old in Puducherry. The patients were divided into two groups - a high caries group (Decayed, missing and filled teeth index score of 2 and more) and a low caries group (DMFT score of 0 and 1). Data were collected according to standardized pattern developed by Petterson (2005). The results in the Cariogram® software were represented as percentage in five components and analyzed using appropriate statistical tests.
Results: The mean of actual chance to avoid new caries between high caries group and low caries group was 50.50 and 82.27 respectively which was statistically significant. The mean of bacterial component in Cariogram was 17.07 in high caries group and 5.73 in low caries group. Remaining three component of Cariogram model - diet, susceptibility and Circumstances were also favorable for the low caries group than the high caries group.
Conclusion: This study demonstrates that the Cariogram® was effective in assessing the caries risk among school going children in Puducherry.

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INTRODUCTION

Despite a decline in dental caries prevalence worldwide, it remains one of the most common chronic diseases in childhood (Chan *et al*, 2005). In India, children comprise 40% of a rapidly growing population and the prevalence of dental caries varies from 33.7%-90% in children population (Hedge *et al*., 2005). According to WHO Oral Health Country/ Area Profile Programme (CAPP) database Caries prevalence in India among the 12 year old indicator age group is 3.4 D_3MFT, where D_3 represents open cavitations or more severe form of caries (WHO, 2013). The distribution of dental caries is more polar in India with most of the disease being experienced by certain vulnerable groups, making it imperative to identify those most at risk. Risk assessment is an essential component in the decision- making process for the prevention and management of dental caries.

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The idea of caries risk assessment is to identify those persons who will most likely develop caries and provide these individuals proper preventive and treatment measures (Petersson *et al., 2010*). Accurate prediction of caries risk help in directing targeted preventive actions to those who are at high caries risk, before cavities could develop. Unsurprisingly, if the chief etiological factors could be identified, appropriate individualized treatment can be carried out with good results (Bratthall *et al*., 2004). Though various factors in combination have demonstrated strong association with future caries, no single test has been able to predict accurately an individual's caries susceptibility. Although the best tool to predict future caries is past caries experience, it is not particularly useful in young children due to the importance of determining caries risk before the disease is manifest (Petersson *et al., 2010*).. The search for acceptable, accurate and cost-effective strategies for identifying high risk individuals has been intensified and multiple risk factors and indicators have been proposed as targets.

The pioneering work of Bo Krasse and his team at the Dental School in Goteborg laid the foundation for the development of a comprehensive model of the caries risk profile for use in the management of dental caries. Building on this work, Douglas Bratthall and coworkers at the Dental School in Malmo had attempted to make the practical application of risk assessment more accessible by developing a computer-based caries risk assessment model (Alian *et al*., 2006). Relevant information regarding the patient were collected, scored according to a standardized protocol and then entered into a computerized program called Cariogram®. According to the built in formula, the program presented a pie diagram where bacteria presents as redsector, diet as dark bluesector and 'Susceptibility' as light blue sector. The yellow sector 'Circumstances' was based on a combination of past caries experience and related diseases. The four sectors takes their share and what was left appears as a green sector and represents the actual chance to avoid new cavities (Bratthall *et al*., 2005, Ruiz-Miravet *et al*., 2007)). The predictive ability of Cariogram® in assessment of caries risk has been well demonstrated in earlier studies conducted by Petersson and Bratthall (2005) with acceptable outcome. It has also been particularly useful in populations with high disease prevalence (Petersson *et al*., 2002). However very few literature is available on the effectiveness of Cariogram to predict caries model in low caries group population. With the decline of caries prevalence worldwide and the concentration of caries among certain vulnerable groups, it is necessary to assess the effectiveness of Cariogram® among different population. Hence this present study was aimed to evaluate the effectiveness of Cariogram® in caries risk assessment among 12 year old low caries and high caries group school going children in Puducherry.

MATERIALS AND METHODS

This cross sectional study was approved by the ethical committee of Ragas Dental College and Hospital. The study population consisted of sixty 12 year old school going children from a Government Aided High School in Puducherry. The children were divided into two groups based on decayed, missing and filled teeth index (DMFT) as a high dental caries group (DMFT $\geq$ 2) and a low dental caries group (0 and 1 DMFT) with 30 children in each group (http/www.db.od.mah.se/car/data/risk). The study was conducted during March 2012 by a single trained examiner (training for using the Cariogram® application was done by referring the Self explanatory Cariogram, Internet Version 2.01, 2004 Manual,by D. Bratthall, G Hansel Petersson, JR Stjernsward) (Nagaraj *et al*., 2014). On a single day 10 children were examined and their salivary samples are collected. The factors like Caries experience, Related Disease, Diet content and frequency, Plaque amount and fluoride program were assessed by using the methods as explained by the Cariogram® manual. Personal interviews and examinations were conducted at the school with the assistance provided by the teachers and parents. A structured questionnaire was used in Diet chart assessment wherein inputs obtained from the students were counterchecked from their respective parents.

Salivary and Microbiological Factors

After the clinical examination and interview of diet and fluoride factors, stimulated salivary samples were collected between 9.30-11.30 am during the school hours. The subject was asked to refrain from eating for one hour before collection for the estimation of salivary secretion rate, Buffer capacity was assessed using GC saliva Check kit as suggested by the instruction provided in the product manual. For the microbial assessment, saliva was collected in a sterile 1ml disposable syringe and injected in a previously labeled sterile bottle containing 4ml of transport medium (Thioglycollate media) and transported to the lab immediately. The samples were processed on the same day.

Laboratory procedure

The samples of saliva and the media were uniformly mixed using a cyclomixer. The sample was vortexed (for15 sec,) and diluted in the ratio1:1000 in isotonic saline solution prior to inoculation. One loop (1/1000th ml of sample) was inoculated to Mitis salivarius agar selective for *Streptococcus* mutans with potassium tellurite medium, bacitracin and 20% sucrose and on Rogosa Selective Lactobacillus agar for Lactobacillus and then incubated for 48 – 72hours at 37°C. After 72 hours colony characteristics were studied and the number of colony- forming units of S.mutans (CFU/ml) and Lactobacilli (CFU/ml) in the saliva was determined using a colony counter (Hedge *et al* 2005, Nagaraj *et al*., 2014).

Creation of Cariogram: With all the information available, scores were entered into the Cariogram® programme and all the five components of the Cariogram® were expressed in percentage value as pie chart (Saravanan *et al*., 2003).

Statistical analyzes: Data was entered into the Microsoft excel and analyzed by using Statistical Package for Social Sciences(SPSS) software 17. Differences between the Nine factors of Cariogram® between the groups were assessed by using Mann Whitney U test by and the mean percentage of Cariogram® components were assessed for statistical difference by using Student't' test. For all the tests significance level was kept as $p< 0.05\%$.

RESULTS

This study was conducted to find the effectiveness of Cariogram® in assessing the caries risk among Low caries group and High caries group school going children by comparing the results of various components of Cariogram® among the two groups. Table 1 demonstrates the various characteristics of Cariogram® among the study population. Among the nine factors assessed, caries experience, Lactobacillus count, plaque amount and Salivary secretion were statistically different between the two groups. There were no related disease which influences caries process among the two groups. All the participants where using only fluoridated tooth paste and they didnot use any other fluoride supplement or underwent any fluoride programme for caries prevention. Diet frequency of the study participants were almost similar for both groups with 4-5 meals per day (83.3% for high caries group and 86.7% low caries group).

Lactobacillus count was higher in high caries group than for low caries group which was statistically significant. 53.3% low caries group had normal salivary secretary rate of more than 1.1 mL/ min, whereas High caries group had low salivary secretion of 0.9- 1.1 mL/ min (40.3%). All the participants had an adequate buffer capacity of pH >6.0. The Table 2 demonstrates that the mean percentage of the five components of the Cariogram® which was statistically different among the two groups. The mean of actual chance to avoid new caries was 82.27% in the low caries group and it was only 50.50% for the high caries group.

Table 1. Distribution of various Factors in Cariogram

Factors	Score	High Caries group	Low caries group	p value #
	0	0%	60%	
Caries Experience	1	0%	0%	0.001*
	2	16.66%	40%	
	3	83.33%	0%	
Related disease	0	100%	100%	-
Diet frequency	0	16.7%	13.3%	0.720
	1	83.3%	86.7%	
Plaque amount	0	16.7%	10.0%	
	1	23.3%	40.0%	0.000*
	2	46.7%	43.3%	
	3	13.3%	6.7%	
Fluoride program	2	100%	100%	-
Lactobacillus Count	0	50%	76.7%	0.034*
	1	33.3%	16.7%	
	2	16.7%	6.7%	
Saliva Secretion	0	23.3%	53.3%	0.034*
	1	40.3%	23.3%	
	2	33.3%	23.3%	
	3	3.3%	0%	
Saliva buffer capacity	0	100%	100%	0.305
Mutants Count	0	0%	30.0%	0.553
	1	26.7%	60%	
	2	40.0%	10%	
	3	33.3%	0%	

Mann Whitney U was used.

Table 2. Five components of the Cariogram®

Cariogram Components	High caries Group	Low Caries group		P value*
	MeanPercentage ± SD	Mean Percentage	SD	
Actual Chance to avoid new cavities	50.50 ± 18.045	82.27	12.717	.000
Diet	7.37 ± 4.909	2.83	1.783	.000
Bacteria	17.07 ± 7.620	5.73	5.017	.000
Susceptibility	16.60 ± 11.010	6.80	5.242	.000
Circumstances	8.37 ± 1.884	2.20	2.280	.000

*Student't'test was used.

All the components of Cariogram® were favorable for the low caries group than the high caries group which was also highly statistically significant.

DISCUSSION

This study was conducted among 12 year old school children with high and low caries to evaluate the caries profile using Cariogram®. The age group of 12 year old was chosen as this is a WHO global monitoring age for dental caries. Only children with permanent dentition were selected in order to avoid discrepancies between mixed and permanent dentition with regard to microbial counts as stated by Schlagenhauf *et al*, 1990. In the present research patients clinical judgment was set throughout as 1 (Ruiz-Miravet *et al*., 2007). In the present study all the five components of Cariogram® were found to be statistically higher for high caries group when compared to low caries group. On assessment of individual factors, the frequency of diet did not differ significantly among the study population. In a study by Chifor *et al* 2014, they were not able to identify any correlation between saliva characteristics and diet. Further there existed no difference in the buffer capacity and the Streptococcus mutants count between the two groups. According to a study by Walsh LJ *et al*, if pH of saliva increases, it suppress the growth of acid uric micro organism particularly mutants streptococci which was also observed in our study also. However the Lactobacilli colony was statistically higher in the high caries group along with higher plaque level which could be due to poor oral hygiene practices which was in accordance with the study conducted by Frechero *et al*. 2015 and Abiola (2009) *et al*. 2016.

The results of this study has to be interpreted with the following limitations – Because of a cross sectional design the temporality of this association could not be assessed. Further this study was conducted on a convenient sample on school going children which cannot be generalized to all school going children.

Conclusion

The results of the study shows that Cariogram® can be used as a viable tool to categorize children based on their caries risk. This would assist in a target group approach wherein limited resources can be targeted to a higher risk population on a priority basis, thereby reducing the caries risk.

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