Research Article

Comparative Evaluation of 3 Caries Risk Assessment Tools for Children with Early Childhood Caries

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Abstract

Background: Caries risk assessment is the determination of the likelihood of the incidence of new carious lesions. Individualized risk assessment of an infant or toddler will help both the health care provider and parent/caregiver to identify the factors associated with early childhood caries, so that a preventive plan can be developed.

Aim: To compare three different caries risk assessment tools, Caries-risk Assessment Tool (CAT), Caries Management by Risk Assessment (CAMBRA) and Cariogram® for children with/without Early Childhood Caries (ECC).

Methods: A prospective comparative study design comprising of 44 children under 71 months of age and diagnosed with/without ECC were included. Oral examination to record oral hygiene score and dmft was done followed by saliva collection to estimate flow rate, pH, buffering capacity and microbial analysis. Unpaired 't' test was used for statistical analysis.

Results: CAT assessed 90.9% of the subjects and CAMBRA assessed 45.5% of the subjects as having high risk of developing dental caries thereby overestimating caries risk, whereas Cariogram® estimated 59.1% of subjects as having high risk after a comprehensive evaluation.

Conclusions: CAT and CAMBRA overestimated caries risk whereas Cariogram® evaluated caries risk appropriately.

Keywords: Caries Risk Assessment; Cariogram; CAMBRA; CAT; ECC

Abbreviations

CAT: Caries-risk Assessment Tool; CAMBRA: Caries Management by Risk Assessment; ECC: Early Childhood Caries

Introduction

Dental caries is a multifactorial disease and it remains the most prevalent chronic childhood disease in the U.S., five times more common than asthma and seven times more common than hay fever [1].

In many countries the prevalence of dental caries in children and adolescents has markedly regressed over the past years. However, epidemiological studies show an uneven distribution of dental caries [2] where highest caries levels are seen in the Latin American and European countries, and lowest levels are seen in the Middle East, Southeast Asia, Africa and North America [3].

The progression of dental caries is influenced by a number of factors which can be protective or pathologic. It results from any disturbance in the equilibrium between protective factors and pathological factors [4]. Protective risk factors include salivary flow and salivary component and extrinsic sources of fluoride, calcium and phosphorous. Pathological risk factors include cariogenic

microflora, dietary components (including frequency and type of carbohydrate ingested), salivary dysfunctions and morphological abnormalities of the tooth.

At any one time, the direction of the caries balance can be tipped towards caries progression and demineralization of the tooth mineral, or towards repair of the tooth mineral by remineralization as a result of one or more protective factors. The eventual outcome of progression, reversal or status quo determines whether an individual tooth surface becomes cavitated. This concept forms the basis for risk assessment and for caries management based upon risk assessment [5].

Caries risk assessment is the determination of the likelihood of the incidence of new carious lesions during a certain time period. It also involves the likelihood that there will be a change in the size or activity of the lesions already present [2]. Individualized risk assessment of an infant or toddler will help both the health care provider and parent/caregiver to identify the factors associated with early childhood caries, so that a proactive preventive plan can be developed. The specific information gained from a systematic assessment of caries risk, guides the dentist in the decision-making process to establish treatment and preventive protocols for children with oral disease and for those deemed to be at risk. To achieve the best management and outcomes for good oral health, the caries risk assessment should be done as early as possible-preferably before the onset of disease. Caries risk assessment and subsequent management of the disease in children is crucial due to the known fact that caries in the primary dentition is a strong predictor of caries in the permanent dentition [6,7].

There are various tools available to assess the caries risk. Some of them are the AAPD Caries Risk Assessment (CRA) tool, ADA Caries Risk Assessment tool (CAT), Caries Management by Risk Assessment tool (CAMBRA), Cariogram®, etc. However, the risk assessment by these tool vary even when carried out on the same patient. It is important to identify the CRA tool that will predict the risk to a greater accuracy for effective prediction.

As dental caries is a preventable disease, it is important for dental professionals to identify the caries risk of an individual at an early age so that the debilitating effect of caries can be avoided.

Purpose of the Study

The purpose of this study was to evaluate the effectiveness of CAT, CAMBRA and Cariogram®, in the prediction of caries risk of children with ECC.

Materials and Methods

A prospective comparative study was conducted after obtaining ethical approval from the Ethics Committee of M. S. Ramaiah Dental College and Hospital. According to the study done by Gao Xiaoli., *et al.* the sensitivity and specificity of caries risk assessment tools used in their study was 83.7% and 62.9% respectively. Expecting similar results, using precision of 88% power and 97% confidence interval, a sample size of 44 subjects was selected below the age of 71 months diagnosed with/without ECC were included in the study. The inclusion criteria was children up to 71 months of age with/without early childhood caries and the exclusion criteria were: 1) Children who were uncooperative, 2) Children with systemic disorders who could not cooperate for the study and with any other concomitant diseases or syndromes and 3) Children who had been on antibiotic therapy in the past 3 months.

44 children who fulfilled the inclusion and exclusion criteria were selected from Amora Montessori, House of Children, Bengaluru and included in the study after obtaining informed consent from the school authorities and parents.

Oral examination: The selected children were then clinically examined by a single observer for dental caries status utilizing the WHO Oral Health Survey criteria (1997) for dental caries. Examination was carried out using mouth mirror and CPI probe under natural light. OHI status was recorded using Silness and Loe index. 3 - 4 ml of unstimulated saliva was collected between 9 am and 12 pm on the day of saliva collection, at least 1 hour after the consumption of any food or drink. Any pre-existing saliva was swallowed before the collection period. The saliva collection was performed with the children seated, their heads tilted slightly forward and with their eyes open. The saliva was collected for a span of 3 minutes. Saliva was subsequently allowed to drip off the lower lip into a sterile container, and the subjects were asked to spit out the contents of the mouth at the end of the collection period. Following collection of the sample, it was processed. The salivary pH was done using a calibrated pH meter, flow rate for ml/min and buffering capacity were estimated using Dentobuff® strips and *Streptococcus mutans*

and *Lactobacillus* cultures were done. For the microbial analysis, i.e. the collected saliva samples were subjected to microbial procedures to culture *Streptococcus mutans* and *Lactobacillus* on Mitis Salivarius Bacitracin agar and Rogosa agar respectively at the Department of Biotechnology, M S Ramaiah Institute of Technology, Bengaluru.

Statistical analysis

Data was collected and compiled into an Excel spreadsheet. It was analysed using IBM SPSS version 15.0 software. Mean with standard deviation was used for descriptive statistics and unpaired Student 't' test and Chi-square test were used for statistical analysis. The p value < 0.05 was considered as statistically significant.

Results

Using CAT, it was observed that 9.1% and 90.9% of subjects had moderate and high risk respectively of developing dental caries. Using CAMBRA, it was observed that 54.5% and 45.5% had moderate and high risk respectively of developing dental caries. Using Cariogram®, it was observed that 40.4% and 59.1% had moderate and high risk respectively of developing dental caries. No change in the caries risk status was observed at 6 month follow up period using the 3 tools. Table 1 shows a comparison of the 3 tools.

Discussion

Risk assessment procedures used in medical practice usually have sufficient data to accurately quantitate a person's disease susceptibility and allow for preventive measures [7]. By definition, risk is aimed at assessing developments in the future. However, risk can be assessed only on the basis of symptoms present at, or having manifested themselves by the time of assessment [2].

Dental caries is one of the most prevalent diseases that has afflicted humans since the introduction of refined and processed food. Dental caries remains the most prevalent chronic childhood disease in the United States [1,8]. Early childhood caries is defined as the presence of one or more decayed, missing or filling primary tooth in a child aged 72 months or younger [9]. Signs of ECC can be detected soon after the eruption of the first tooth and its progression can be stopped provided that the risk indicators are identified and preventive oral measures are implemented. It is for this reason that, the American Dental Association, the American Academy of Pediatric Dentistry, and the American Academy of Pediatrics have recommended that children should see a dentist by age 1 and a Dental Home be established [10].

Caries risk	Baseline						6 month follow up					
	CAT		CAMBRA		Cariogram®		CAT		CAMBRA		Cariogram®	
	n	%	n	%	N	%	n	%	n	%	N	%
Low Risk	0	0.0	0	0.0	0	0	0	0.0	0	0.0	0	0
Moderate Risk	4	9.1	24	54.5	18	40.9	4	9.1	24	54.5	18	40.9
High Risk	40	90.9	20	45.5	26	59.1	40	90.9	20	45.5	26	59.1

Table 1: Table showing caries risk assessment comparing CAT, CAMBRA and Cariogram®.

CAT-CAMBRA: p < 0.001, CAT-Cariogram®: p = 0.001, CAMBRA-Cariogram®: p = 0.200.

Various CRA tools are available which can be used to determine the caries risk of an individual, like ADA and AAPD caries risk assessment tool, CAMBRA, Cariogram®, NUS-CRA, etc.

The AAPD introduced the Caries-risk Assessment Tool in 2002, to serve as a concise, practical tool to assist both dental and non-dental health care providers in assessing levels of risk for caries development in infants, children, and adolescents. It is designed to be used by both dental and non-dental healthcare providers. This is a simple tool, but has demerits; it classifies subjects by the highest risk category where a risk indicator exists (i.e. the presence of a single risk indicator in any area of the "high-risk" category is sufficient to classify a child as being at "high risk" the presence of at least 1 "moderate-risk" indicator and no "high-risk" indicators results in a "moderate-risk" classification; and a child designated as "low risk" would have no "moderate-risk" or "high-risk" indicators) [11]. Because of this reason, it overestimates the caries risk. This means that there would be unnecessary utilization of resources to treat children in the high and moderate risk categories.

The Caries Management by Risk Assessment Tool (CAMBRA) was introduced in 2003 by a group of experts who convened at a consensus conference held in Sacramento, California, in April 2002. This tool is based on the caries imbalance concept. The balance amongst risk factors and protective factors determines whether dental caries progresses, halts, or reverses [12]. This is another effective tool in determining caries risk but, like CAT it overestimates the caries risk.

It was Dr Bratthall who developed the concept and formula for the Cariogram®. It was first launched officially in November 1997 after extensive trials. It is a graphical picture that illustrates the individual's risk for developing new caries in an interactive way, simultaneously expressing the extent to which different etiological factors of caries affect the caries risk for a particular patient [13].

In this study, using CAT 90.9% of subjects had high caries risk. This result is in accordance with the study by Gao, Lo, Chu and Hsu [14] where they observed that the CAT overestimates the caries risk of preschool children in Hong Kong. It was also observed by Yoon and colleagues [15] that the CAT had high sensitivity but low specificity and positive predictive value. In another study conducted by Nainar and Straffon in a dental school environment, it was observed that because of its high sensitivity, CAT overestimated the caries risk, which is in par with the present study. They also concluded that, this is a viable tool which can be used by dental practitioners [11].

Using the CAMBRA proforma it was observed that, 54.5% of the children had medium risk and 45.5% had high risk. No change in the caries risk status was observed at the 6 month follow up period. This observation is in accordance with the results obtained by Gao, Lo, Chu and Hsu13 where they observed that CAMBRA had low specificity but high sensitivity, meaning that again, like CAT, it overestimated the caries risk. Similar results were obtained by Gao., *et al*. in 2003 [16].

In a randomized controlled trial conducted by Cheng., *et al*. [17] they observed that because caries is a multifactorial disease, CAMBRA intervention transmitted more of its anti caries effect through the combined action on multiple mediators than through any single variable. In another study done by Sudhir., *et al*. [18] to evaluate whether CAMBRA can be used to predict caries risk in 12 - 13 year old institutionalized children, it was concluded that CAMBRA was

highly predictive in determining the caries risk. Therefore, CAT and CAMBRA can be used by dental and non-dental professionals to estimate the caries risk of children and effectively plan preventive measures.

Using Cariogram® it was observed that 40.9% of subjects were estimated to have moderate risk of developing dental caries and 59.1% high risk of developing dental caries, but no change in caries risk was observed at the 6 month follow up period. Contrary to the present study, a study conducted by MM Mitha., *et al*. [19], on 12 - 13 year old government and private school children, observed that government school children had a 56% chance of avoiding caries and had medium risk of developing caries whereas private school children had a 66% chance of avoiding caries and were at low risk of developing caries. They concluded that, Cariogram® was effective in assessing the caries risk.

Limitation of the Study

The limitations of the present study are that a small sample size of 44 subjects was selected and no intervention other than oral health education was carried out. This could be one of the reasons for the unaltered caries risk status.

Conclusion

The following inferences were derived from this study:

- Caries-risk Assessment Tool and CAMBRA overestimated the caries risk because a single finding in the high risk category estimated the child as having high caries risk.
- Cariogram® effectively measured the caries risk, as it takes several factors which could affect dental caries into consideration.
- Since Cariogram® gives a pictorial representation of caries risk, it can be used as an oral health educational tool for children and their parents.

Acknowledgements

Conflict of Interest

The authors declare no conflict of interest.

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