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APPLICABILITY OF VARIOUS CARIES RISK ASSESSMENT PROGRAMMES ON WESTERN INDIAN CHILD POPULATION

Malonia Anupriya D*	MDS, PhD Scholar, Department of Conservative, Endodontics and Esthetic Dentistry, Ahmedabad Dental College and Hospital, Gujarat University *Corresponding Author
Chokshi Shraddha P	MDS, Professor, HOD & Ph.D. Guide, Department of Conservative, Endodontics and Esthetic Dentistry, Ahmedabad Dental College and Hospital, Gujarat University
Krushnangi Yagnik	MDS, PhD Scholar, Department of Conservative, Endodontics and Esthetic Dentistry, Ahmedabad Dental College and Hospital, Gujarat University

ABSTRACT

Aims: To evaluate the sensitivity and specificity of 3 CRA systems (CAT, CAMBRA & Cariogram) in predicting caries on Indian child population above 6 years. This in vivo study aimed to evaluate the validity of 3 caries risk assessment systems on Indian child population. **Settings and Design:** Children (n=109), 66 boys/43 girls, from similar socioeconomic and cultural background excluding children with severe medical conditions and unable to co-operate in the related procedures were included after parental consent. **Methods and Material:** All the participants were clinically examined for DMFT/deft, white spots, developmental lesions, plaque index and appliance and microbiological and salivary tests (pH, Flow rate, buffer capacity, S. mutans count). Caries risk was assessed using the CAT, CAMBRA and the Cariogram. The sensitivity (Se), specificity (Sp), the sum of (Se + Sp) and the balance between the two parameters Se/Sp were evaluated. **Statistical analysis used:** The data were analysed with Statistical package for social sciences (version 18). Chi-square tests were used for comparing proportions. **Results:** CAMBRA had extremely high Se (>98%) but low Sp (<18.4%), whereas CAT also had a high Se (95.4%) and but very low Sp (6.01%); the sensitivity/specificity of Cariogram was (84.8%/52.3%). The (Se +Sp) of CAT, CAMBRA and Cariogram was 101,117 and 137 respectively. Among all models, none reached a Se + Sp above 160%, although Cariogram with (Se + Sp) of 137% was closest to target. **Conclusions:** Although Cariogram reached the (sensitivity + Specificity = 137%) it still did not meet the criteria (>160%) for a useful tool which can be validated for the Indian population.

KEYWORDS : Caries Risk Assessment, CAT, CAMBRA, Cariogram.

INTRODUCTION:

As a universal juvenile disease, dental caries enforces consequential menace on the well-being of pre-school children and embodies a major monetary weigh down on families and civilization[1]. New epidemiological indications divulged a "silent pandemic" of untimely childhood caries and its distribution pattern – the chief caries burden is restricted to a minority of high-risk children [1,2,3,4,5]. An ideal CRA system ought to have high validity and sensibility, and it ought to also be simple to utilize in practice at a low cost [6].

The Swedish Council on Technology Assessment in Health Care reported in 2008 that current CRA modes have low correctness, but they are trustworthy in detecting those with a low risk of developing caries [7]. CRA ought to be frequently reiterated as an aid in the preventive and non-operative administration of the caries disease [8]. Several evaluation systems/ criteria have been recommended by professional establishments and academic institutions in the past decade [9,10,11,12].

The validity of a CRA is frequently measured by its sensitivity (Se) and specificity (Sp). For a CRA tool to be practically advantageous, it ought to attain a sum of Se and Sp (Se + Sp) of at least 160%. Current reports on the Se/Sp of above-mentioned CRA were scarce, exceptionally those from potential studies [13,14].

Currently, the clinical and communal practice of CRA is beset by the insufficiency of a model with simplicity and established specificity. Empirical estimation, which is not reliable, keeps on the principal way for clinicians to determine the caries risk for forming preventive and care schemes [14].

CRA models currently involve a combination of factors including diet, fluoride exposure, a susceptible host and micro-flora that interplay with a variety of social, cultural and behavioural factors which vary from population to population[15-18]. This in vivo study was carried out with an aim to evaluate the validity of 3 CRA systems on Indian child population.

Subjects and Methods:

Children (n=109) participating in the study, 66 boys/43 girls, from similar socioeconomic and cultural background. Exclusion Criteria of the study were children with severe medical conditions who unable to co-operate in the related procedures. Ethical Clearance was taken from the institute, and signed written consent was obtained from children's' parents.

All children were examined in supine position, with illumination using basic examination kit (mouth mask, gloves, mouth mirror, explorer, and probe). Radiographs were taken for all carious lesions. DMFT/ deft, white spot lesion, developmental defect (e.g., hypoplasia), dental appliance and oral hygiene status using Silness-Loe plaque Index was evaluated.

Patient was instructed to sit motionless, lean forward, void the mouth of saliva (starting time) and to chew on the inert elastic tied to the floss, to the pace of a metronome and every minute to spit saliva without swallowing any. The first two-minute collection was discarded. After chewing on inert elastic for 3 minutes, the pooled saliva in the floor of the mouth was collected using needleless aspirating syringe and taken as the salivary flow rate. The resting salivary pH was estimated using an indikrom pH paper, from saliva transferred in the borosil jar.

The salivary buffer capacity was measured as the amount of acid needed to lower the pH of saliva through a fixed pH interval. Initial pH of the 1 ml saliva was noted, citric acid of pH 2.5 was poured drop by drop using a small pipette and final pH checked till the pH of saliva dropped to a value of 3. This volume of citric acid used was taken as a measure of the buffering capacity. The sample was transported to the laboratory within 2 hours of collection, vortexed (15 sec) and diluted 1:1000 in isotonic saline solution prior to inoculation. The MSB was formulated. (0.2 units of bacitracin/ml of medium and 20% sucrose.

Children's caries risk was assessed by using the CAT, CAMBRA and the Cariogram. The data was analyzed with the Statistical package for social sciences (version 18).

RESULTS:

In order to test the validity of the CRA programmes, the sensitivity (Se) and specificity (Sp), was measured. Also, the sum of (Se + Sp) and the balance between the two parameters Se/Sp were evaluated. The results of the study showed the following **[Table 1]**

Table 1: CAT * CAMBRA Crosstabulation

			CAMBRA			Total
			Low	moderate	High	
CAT	Low	Count	10	6	23	39

		% within CAT	25.6%	15.4%	59.0%	100.0 %
		% within CAMBRA	83.3%	75.0%	25.8%	35.8%
		% of Total	9.2%	5.5%	21.1%	35.8%
	moderate	Count	0	1	4	5
		% within CAT	0.0%	20.0%	80.0%	100.0 %
		% within CAMBRA	0.0%	12.5%	4.5%	4.6%
		% of Total	0.0%	0.9%	3.7%	4.6%
	high	Count	2	1	62	65
		% within CAT	3.1%	1.5%	95.4%	100.0 %
		% within CAMBRA	16.7%	12.5%	69.7%	59.6%
		% of Total	1.8%	0.9%	56.9%	59.6%
Total		Count	12	8	89	109
		% within CAT	11.0%	7.3%	81.7%	100.0 %
		% within CAMBRA	100.0%	100.0%	100.0%	100.0 %
		% of Total	11.0%	7.3%	81.7%	100.0 %
Chi-Square Tests						
				Value	Df	P value
Pearson Chi-Square				23.320	4	0.0001

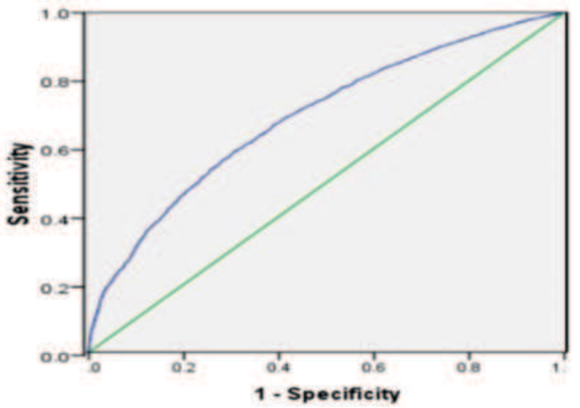
As shown in **[Table 2]**, with CAT and CAMBRA majority of children were categorised as high risk. In Cariogram, 23 out of 109 had more than 70% chance of avoiding caries. To evaluate the validity of each CRA programme the calculation of Se/Sp requires the determination of a cut-off point to categorise children dichotomously into "susceptible" and "non-susceptible". With CAT and CAMBRA, the cut-off point of "moderate risk" was considered.

Table 2: Validity of Caries Risk Assessment Programmes in Predicting Caries

	Prediction					
Cut off point of predicted risk	n	RR (95% CI)	Se	Sp	Se+Sp	Accuracy
CAT >=Moderate	5	1.89 (0.98-2.73)	95.4	6.01	101	71.2
	104					
CAMBRA >= Moderate	8	2.01 (1.14-2.89)	98.2	18.4	117	59.1
	101					
CARIOGRAM >=37.6%	92	2.16 (1.13-3.07)	84.8	52.3	137	80.5
	17					

Odds ratios and their confidence intervals (CI) were generated from logistic regression and were converted to relative risk (RR) Se= Sensitivity, Sp= Specificity

For Cariogram whose risk prediction is in a continuous scale (% chance), cut-off points established in previous studies through Receiver Operation Characteristics (ROC) analysis were used. **(Graph 1)**



CAMBRA had extremely high Se (>98%) but low Sp (<18.4%), whereas CAT also had a high Se (95.4%) and but very low Sp (6.01%). The sensitivity/specificity of Cariogram was (84.8%/52.3%).

The (Se +Sp) of CAT, CAMBRA and Cariogram was 101,117 and 137 respectively. Among all models, none reached a Se + Sp above 160%, although Cariogram with (Se + Sp) of 137% was closest to target. **[Table 2]**

The ROC analysis showed the area under curve for Cariogram as 0.751.

DISCUSSION:

The percentage of true high risk/low risk individuals among the selected group of high risk/low risk individuals is termed sensitivity/specificity of the risk predictive method [20]. Having perfect accuracy means that the predicted high-risk group would consist of only true high-risk individuals or only true low risk individuals. Unfortunately, no such marker is available for the assessment of caries risk. A certain proportion of errors have to be accepted with no rules of what the acceptable level of error might be [20].

In a risk model, the sum of sensitivity and specificity be at least 160% before a caries risk marker can be considered a legitimate candidate for targeting individualized prevention[21]. The risk models, although sophisticate, do not offer much value when predicting future developments in caries. A flawless indicator can only forecast future caries experience if the underlying circumstances stay consistent [20]. A skewed distribution of caries has been observed in many developed countries, with 25% of children bearing 75-80% of affected surfaces [22,23]. As concluded in a National Institutes of Health (NIH) conference, caries prevention should be timely targeted at high-risk individuals[24]. Since cumulative evidence has linked early childhood caries with caries in the permanent dentition [25,26] early and accurate selection of high-risk pre-schoolers through CRA for prevention and intervention is of great importance for cost-effective caries control. Considerable efforts in past decades have identified multiple caries risk factors, indicators, and protective factors [27,28,29,30]. Multifactorial modelling has been used to increase risk assessment accuracy; however, few models have met the requirement for a useful model, *i.e.*, sensitivity + specificity > 160% [13,14].

A computerized program, Cariogram, has been developed to streamline the CRA process, with multiple weighed factors and interactions[31]. Although Cariogram has been satisfactorily validated among Swedish schoolchildren [32] and the elderly [33] its validity in pre-schoolers was unsatisfactory[34].

While prediction models utilize all the potential factors to identify the at-risk children, risk models focus on the modifiable etiological factors conducive to tailoring preventive and treatment strategies. Theoretically, risk models have greater external validity and might be applicable in different populations[12].

The primary objective is to improve sensitivity and specificity of the prediction, so any fine predictor possible can be added to the model[12]. The programs trialed in this research mirror two sorts of risk assessment tools, proof-based reasonings (CAT [35] and CAMBRA), and an algorithm-driven application (Cariogram). In the former, vital risk elements and indicators were mixed into a list, and one's risk to caries is qualitatively rumoured, while in the latter, one's risk was calculated quantitatively through algorithms. Our findings back up a superior authority of an algorithm-driven program, as validated by the higher Se + Sp aspect of Cariogram of 137, with ROC curve showing 0.751 as the underline area, related to CAT and CAMBRA with (Se + Sp) of 101 and 117, individually. Algorithm-driven approach similarly was effectively utilized in the medicinal domain to foresee unceasing illnesses, like cardiovascular sickness (e.g., Framingham risk concept, QRISK, besides ASSIGN)[36].

Unquestionably, evidence-based programs like CAT and CAMBRA are beneficial educational instruments for elucidating the caries aetiology and dynamics to dental trainees and fledgling dentists [37]. Nonetheless, since seasoned dentists frequently can evaluate patients' caries risk to a certain accuracy (60–70%), a CRA program is advantageous only if it remarkably advances dentists' clinical insight.

Our findings show a sizable (Se) but low (Sp) of CAT and CAMBRA.

This resembles the result of a recently conducted study on CAT compared to four methodologies (CAT, CAT minus economic level, CAT minus economic level added mutans streptococci (MS) and MS alone for correctness and utility. CAT's outcomes displayed heightened sensitivity and negative predicting value but low specifying and positive predictive value. MS culture by itself displayed maximal blend of accuracy (sensitivity, 86.5%; specifying, 93.4%; PPV, 92.5%; NPV, 87.9%). Upon excluding the economic level element, CAT's efficacy improved.)

In CAMBRA, the exaggeration of child's caries risk might have aroused from the classification standard, under which, few single factors/indicators solely justify a "high risk" diagnosis. Via CAMBRA, a child automatically is defined as "high risk" if he/she has caries currently or in the quite recent past, has developing issues or hails from a family of low economic standard. These standards led to the overly enormous proportion of children categorized as "high risk" below CAT besides CAMBRA and inflation of lots of children's caries risk.

Noting strong sensitivity, CAT and CAMBRA might probably be handy under a few clinical circumstances where failure to identify and attend to any high-risk kid is seriously intolerable is the major concern. Nonetheless, the low Sp hence overestimation of risk resulting in over-treatment and misuse of resources.

Cariogram attained a reasonably good score, boosting the option of uncomplicated and low-priced CRA and the emphasis of psychosocial behavioural elements in reckoning ECC [41,42]. Though saliva flow rate and buffering ability were fitted in Cariogram's examination, but they can't be considered as beneficial caries prediction agents owing to sketchy measure of saliva flow and unusual salivary issues in small children. Petersson and colleagues looked into if adjusted Cariogram model (excluding salivary plus microbiological tests) could predict future caries as efficient as the entire risk model in a unit of children. It was closed that albeit Cariogram might yet be harnessed for caries foretelling among children at school and specifically to spot those with low risk, the predictive skill was notably hindered by exclusion of salivary tests. In general, incorporating biological tests did not promote Cariogram's performance.

Cariogram is tailored to provide CRA to all age brackets and is not meant for a special age cohort. Nonetheless, present evidence from this research besides alternative works pointed outright to an unmeeting performance of Cariogram in pre-schoolers. Since distinct risk elements may be at play in early childhood caries occurrences, it might be judicious to integrate several age-categorized factors into Cariogram besides recalibrate the in-built algorithms for its stronger applicability to young children. Embracing age exact risk indicators and factors, like infant nursing backdrop plus parental economic status, besides algorithms structured through broad-scale forthcoming study among pre-schoolers can notably heighten the performance.

From the present study, it shows that, only Cariogram approaches close to target (Se +Sp) of 160. Therefore, cannot be fully accepted as a suitable model for western Indian population. So far there has been only one prediction study reaching the desired combination of (Se + Sp) of 160% but how the specific factors can be used to predict risk in any population is unclear.

CONCLUSION:

After statistically evaluating the data CAMBRA and CAT reached a balance of sensitivity/specificity of (95.4%/6.01%) and (98.2/18.4%) respectively. Although Cariogram reached the (sensitivity + Specificity = 137%) it still did not meet the criteria (>160%) for a useful tool.

Since the predictive validities of a model depend strongly on the caries prevalence and characteristics of the population, there is a need to calibrate a new model which can be validated for the Indian population.

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