

# Evaluation of CRAFT as a Tool for Caries Risk Assessment in 3- to 6-year-old Children and its Validation against Alban's Test: A Pilot Study

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## ABSTRACT

**Introduction:** Dental caries is a multifactorial disease and a dynamic process that can be prevented and reversed during the early stage. Risk assessment is an important step in decision-making and treatment planning. There are no valid tools available for the Indian population. Caries risk assessment for treatment (CRAFT) is a chairside tool for caries risk assessment and management. Valid, reliable, economical, and chairside caries risk assessment tool is the need of the hour for general and pediatric dentists.

**Aim:** To evaluate CRAFT as a tool for caries risk prediction among 3-years to 6-years-old children and to validate it against Alban test.

**Materials and methods:** A pilot study was conducted, including forty 3-years to 6-years-old children. Salivary samples were collected and inoculated on B.C.G.-Dextrose Agar. Caries activity was assessed using Alban test. Their parents/guardians completed the CRAFT assessment in entirety.

**Results:** The data were tabulated and subjected to suitable statistical analysis. High positive correlation between CRAFT scores and Alban's test (Spearman's Rho = 0.874) was found.

**Conclusion:** CRAFT scores were highly correlated with Alban scores in 3- to 6-year-old children. CRAFT could be successfully employed as a reliable, economical, chairside, and clinically feasible risk assessment tool with further research on a larger sample size.

**Clinical significance:** CRAFT can provide a framework for the clinician for preventive care and enhance patient-participation for CRA.

**Keywords:** Alban's test, Caries risk assessment, Caries risk assessment for treatment, Early childhood caries.

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## INTRODUCTION

Early childhood caries (ECC) poses to be a major problem worldwide.<sup>1</sup> Dental caries is an initially reversible and chronic disease process with a known multifactorial etiology.<sup>2</sup> Primary prevention or treatment of early lesions is important for halting the progression of the lesions to irreversible caries.<sup>3</sup> This can be achieved by assessing the true caries risk of an individual. Various salivary tests have been used to detect caries activity based on the bacterial count or acidogenic potential.<sup>4</sup> Such tests establish the current caries activity but do not predict future risk.

"Risk is a probability that an event will occur."<sup>5</sup> Caries risk assessment (CRA) is "prediction of future caries based on the diagnosis of current disease by evaluation of risk and protective factors for making evidence-based clinical decisions." CRA should be included in a treatment plan in order to assist the clinician in the decision making process concerning treatment, recall appointments, and need for additional diagnostic procedures.<sup>6</sup> There are many CRA tools available for the developed nations, but the same is not validated for the Indian population.

A valid, reliable, economical, and chairside CRA tool for the Indian population, is needed.

### CRAFT—Conceptual Framework

"Caries risk assessment for treatment (CRAFT)" is a proposed simple, chairside, noninvasive, four-point approach proposed for the management of caries based on risk assessment. For ascertaining the caries-risk in children, parents can be interviewed using the CRAFT questionnaire. CRAFT is available as a physical and a digital tool.

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It includes four parameters: diet, decay, fluoride exposure, and other factors. Based on the available information, caries-risk can be determined over a range (very low/no, low, moderate, high). A green star is used to indicate "safety" while a red star for the "risk" (Fig. 1).

Based on the risk as ascertained from the CRAFT, age-appropriate home measures can be recommended from below.

- Reduce sugar intake to less than two exposures per day and preferably at meals.
- Stop bottle-feeding.
- Consider non-syrupy medicines (recommendation to consult the doctor for the same).

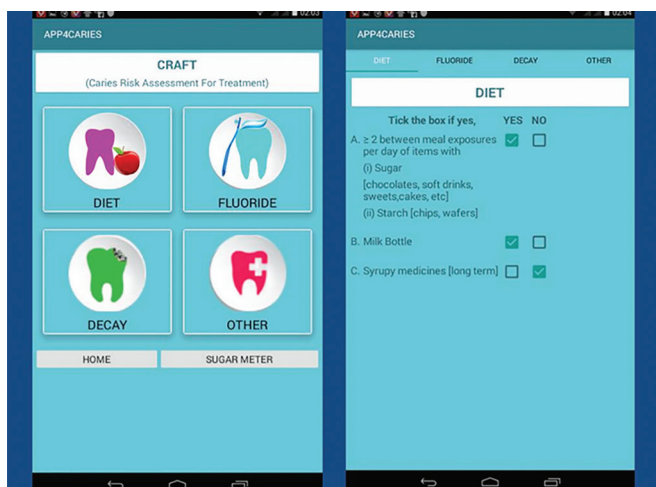


Fig. 1: CRAFT (screenshot of the digital tool)

- Use appropriate toothpaste (non-fluoride for less than 2-years-olds, junior fluoride for 2- to 6-year-olds, and regular fluoride for all above 6 years), and fluoride mouth rinse (for those above 6 years).
- Take treatment for untreated carious teeth of the child.
- Take treatment for untreated carious teeth of the parent/s.
- Consult your family physician/pediatrician/specialist regarding recurrent illnesses, allergies, etc.
- Strengthen the teeth enamel with the use of remineralizing agents (consult your dentist for the same).
- Use hydrating agents or sugar-free chewing gums (consult your dentist for the same).
- Have teeth alignment corrected (consult your dentist for the same).

Additionally, a treatment plan with the use of minimum interventional and restorative approaches can be integrated with CRAFT, as shown below:

Snyder test with Alban's modification<sup>7</sup> has been used extensively for the quantitative evaluation of acidogenic potential of the saliva.<sup>8</sup> It is an easily available and cost-effective method, which can be used in place of quantitative estimation of streptococcus mutans.

In children with different caries levels, caries activities may differ. Risk considerations are based on wider etiological factors and not just the present status of the activity. However, the (present) activity and (future) risk can be correlated to get a better picture in terms of susceptibility. Furthermore, an attempt to associate the two can help validate a newly developed tool, such as the one presented here, CRAFT.

Research on CRA tools in the Indian context is scarcely reported. The present investigation was carried out to assess the implementation of the new CRA tool CRAFT and its validation against the Alban's test in 3- to 6-year-old children.

## MATERIALS AND METHODS

Caries risk assessment for treatment (CRAFT) being a new CRA tool, a pilot study was planned. Ethical clearance was obtained from the institutional review board. Consent was obtained from the parents of children participating in the study. Fifty healthy children of age group 3 to 6 years were randomly chosen from those visiting the Department of Pediatric and Preventive Dentistry. Untoward contamination of the medium during the study led to

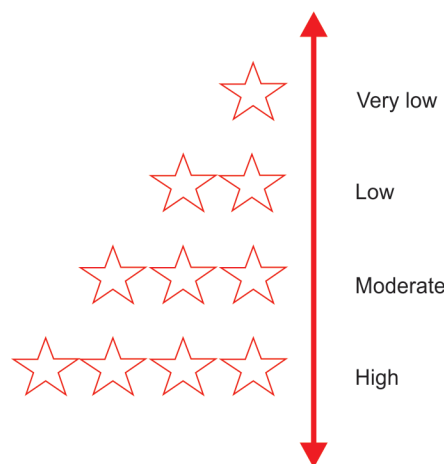


Fig. 2: CRAFT scores

the elimination of eight children leading to a final sample size of forty-two.

Healthy children age 2 to 6 years were chosen for the study. Children with a recent history of, or under antibiotic treatment were excluded from the study. The parents/guardians of all the fifty children were asked to complete the CRAFT assessment in entirety. The digital tool APP4CARIES was used in this study. Risk was assessed using CRAFT as very low, low, moderate, high (Fig. 2, Tables 1 and 2).

The Alban's test is a simplified substitute for the colorimetric Snyder test, which uses the lesser medium as compared to the Snyder's test. Alban's test was used to assess caries activity at various time points of observation. The preparation of the Snyder medium was done using commercially available—BCG-Dextrose Agar (Snyder Test Agar: HiMedia Laboratories Pvt Ltd, Mumbai). 65 g of the Snyder test agar was suspended in 1 L of distilled water. The mixture was boiled, and each Snyder test tube was dispensed with 5 mL of media and autoclaved at 121°C at 15 lbs, for 15 minutes. The contents of the tube were allowed to solidify

Table 1: CRAFT categories

Caries risk assessment for treatment (CRAFT)	
Diet	Decay status
<ul style="list-style-type: none"> <li>• <math>\geq 2</math> exposures per day of sugar or starch containing food items between meals (Yes/No)</li> <li>• Bottle feeding (Yes/No)</li> <li>• Long-term exposure to syrupy medicines (Yes/No)</li> </ul>	<ul style="list-style-type: none"> <li>• Present untreated caries (Yes/No)</li> <li>• Past treated caries (Yes/No)</li> <li>• Parent's caries status (Yes/No)</li> </ul>
Fluoride exposure	Other factors
<ul style="list-style-type: none"> <li>• Use of fluoridated toothpaste (Yes/No)</li> <li>• Use of fluoride mouthrinse (Yes/No)</li> <li>• Professional six monthly fluoride application (Yes/No)</li> <li>• Living in area with high/optimally fluoridated water (Yes/No)</li> </ul>	<ul style="list-style-type: none"> <li>• Conditions related to suppressed immunity (asthma, allergies, recurrent infections, etc.) (Yes/No)</li> <li>• Hypomineralization (Yes/No)</li> <li>• Malocclusion/crowding (Yes/No)</li> <li>• Hyposalivation (Yes/No)</li> </ul>

before storage in the refrigerator. Prior to saliva collection, Snyder tubes were rolled between hands to bring the temperature close to body temperature. Following this, the open end of the tube was momentarily exposed to flame to sterilize the tube opening and prevent any untoward sample contamination. Unstimulated, midmorning salivary samples were collected just sufficient to cover the superior surface of the medium. Evaluation of caries activity employing Alban's test was done on the basis of length of color change following incubation at 35°C to 37°C (95–99°F) every 24, 48, 72, and 96 hours (Table 3 and Fig. 3). Caries activity was assessed based on cumulative color change at the end of 96 hours. The caries activity was divided into 4 categories based on the color changes obtained in the Snyder tubes after 96 hours.

**Variables**

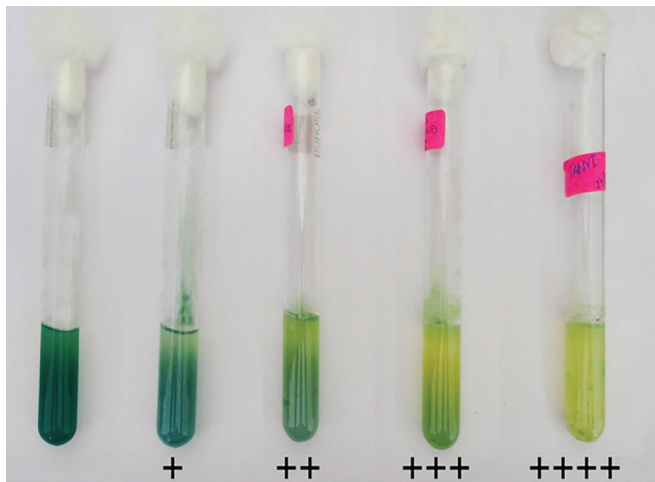
Both CRAFT score and Alban's score were recorded as categorical variables, but for correlation purpose, the same was converted to quantitative (continuous) variable.

**Table 2:** Example of CRAFT-based office recommendations

<i>Preventive measures in the office</i>	<i>Minimum interventional and restorative measures</i>
Fluoride application	Surface modification (making non-accessible surfaces accessible for easy plaque-elimination)
Pit and fissure sealants	Reduction and stabilization of caries activity with interim restorations
Oral prophylaxis	Sealing caries (sealants, preventive resin restorations, preformed metal crowns)
Dietary and hygiene advice and recalls	Partial/stepwise excavation and restorations (glass-ionomer and composite resins)

**Table 3:** Alban's scoring criteria

<i>Color change</i>	<i>Score</i>
No color change (negative)	–
Beginning color change (from top medium down)	+
One-half color change (from top down)	++
Three-fourths color change (from top down)	+++
Three-fourths color change (from top down)	++++



**Fig. 3:** Alban's scores based on color change

**Statistical Analysis**

Spearman's correlation test was used to establish the association between cumulative Alban's score at the end of 4 days and CRAFT scores.

**RESULTS**

Of the 42 children, 19 were girls and 23 boys. The mean age of children was 4.91 ± 0.91 years. About 33.33% (14) had High CRAFT scores, 50 % (21) of the participants had a Moderate CRAFT score, and 16.7% (7) had Low CRAFT scores, and 0% fell in the very low category (Table 4).

The mean cumulative score for Albans was 8.36 ± 3.93, with the lowest being zero to the highest of 17 (Table 5).

The cumulative Alban's score increased with an increase in the CRAFT score.

A scatter plot showing the linear relationship between CRAFT score and Alban's score (Spearman's Rho = 0.874; p < 0.001) showed a high positive correlation between the two (Fig. 4).

**DISCUSSION**

The study was conducted in the Department of Pediatric and Preventive Dentistry in Navi Mumbai. Children 3 to 6 years of age were recruited for the following reasons.

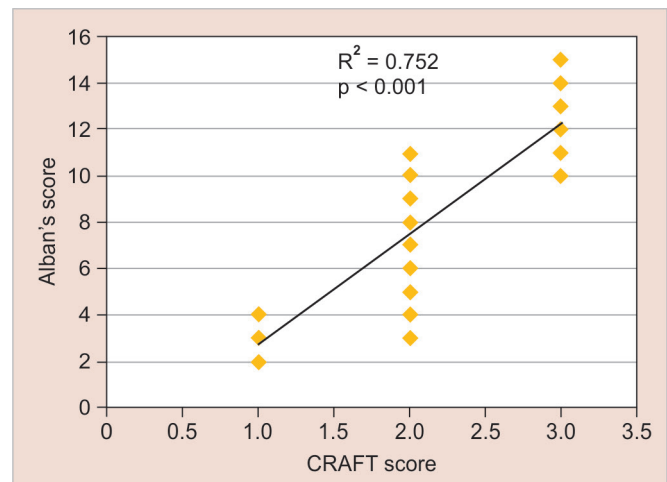
Children in this age group are easily accessible. By this age, all the primary teeth would have erupted, and more or less the dietary habits would have established. Risk-based caries management is

**Table 4:** CRAFT score distribution

<i>CRAFT score</i>	<i>Number of children</i>	<i>Percent</i>
Very low	0	0
Low	7	16.7
Moderate	21	50.0
High	14	33.3
Total	42	100.0

**Table 5:** Cumulative Alban's score

	<i>N</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Mean</i>	<i>Std. deviation</i>
Cumulative score	42	2	17	8.36	3.931



**Fig. 4:** Correlation between CRAFT score and cumulative Alban's score

important for this age group to prevent caries in the permanent dentition and would decrease the morbidity associated with caries.

The present study was a pilot investigation conducted that compared CRAFT, a novel tool, with the well-known Alban's test. Alban's test has been widely used in literature to measure the acidogenic potential, which is a proxy measure for the bacterial activity of caries-producing microorganisms like streptococcus mutans and lactobacilli.<sup>5</sup> We also considered using CRT (Ivoclar) bacteria, but the costs were found to be too high.

The overall CRAFT scores indicate that half of the participants (50%) fell in the moderate scores category. Also, there was no representation for the very low category. This is possibly due to the presence of the major etiological risk factors causing dental caries viz. diet rich in sugar, burden of untreated decay, low exposure to fluoride, and other factors such as infectious diseases, malnutrition, etc., in the study population. This is in accordance with other studies reported in the literature.<sup>9,10</sup> In developing countries like India, where the population has more opportunities to consume free sugars and other fermentable carbohydrates the prevalence of decay is increasing.<sup>11</sup> Very few children receive 6 monthly, fluoride application, moreover, they do not receive centralized fluoridated water supply.<sup>12</sup> CRAFT included the most important etiological factors as a customized preventive plan based on the four domains are evidence-based.

Existing untreated dental caries gives an estimate of the current bacterial load and caries activity.<sup>13</sup> In general, the best indicator of future caries risk is the past caries experience.<sup>14</sup> CRAFT includes both these components; also it includes vertical transmission of caries. The major reservoirs from which the infants acquire MS is their mother.<sup>15</sup> A study by Berkowitz concluded that the frequency of infant infection reduced 9 times when the colony-forming units reduced from  $10^5$  to  $10^3$ .<sup>16</sup> Presence of other risk factors such as crowding, low immunity, or hyposalivation further increases the caries risk.<sup>17-19</sup>

The mean Alban's score was 8.26 (2–15). Frequent snacking in between meals, existing untreated caries, hyposalivation, reduced immunity, and absence of regular use of topical fluorides may have resulted in high mean Alban's score. Caries risk and caries activity are both high in the presence of these etiological factors.

We got a statistically significant very high correlation, which confirms that children with high caries activity present with higher caries risk.

Various CRA tools such as CAMBRA, CAT, and Cariogram are amongst the widely used tools in the developed world.<sup>20</sup> Most of these tools have been tested for the developed nations, and their utilization in the Indian context has not been studied adequately.

Although Western literature reports socioeconomic factors, migrating population, ethnic backgrounds as important determinants for dental caries, the same for the Indian population have not yet been established.<sup>21,22</sup> The dietary habits, oral hygiene practices, dental care differ significantly in the Indian context. Furthermore, this tool is developed for the caries risk assessment of an individual and not as an epidemiological tool.

Various CRA tools have microbial activity test as an integral part of the system.<sup>23</sup> However, these tests not only increase the costs but also makes it more cumbersome and time-consuming for the dentist; hence, they were excluded from CRAFT. A very high correlation between CRAFT and Alban score emphasizes that although microbial testing is essential in most clinical situations if excluded, could still give sufficient idea about the caries risk.

## LIMITATIONS

This being a pilot study was based on a convenient sample, and therefore, there was no representation from the very low category of CRAFT scores. The categorical variables were quantified for statistical purposes. Moreover, the generalizability of a tool cannot be ascertained with a single investigation. Therefore, multicentric studies on large sample with different age groups are necessary to corroborate the claims made by us.

## CONCLUSION

In the present study, CRAFT and Alban test scores of 3- to 6-year-old children showed a very high correlation. CRAFT has potential as a caries risk assessment tool for the Indian population. Further prospective studies are needed to substantiate the claim.

## CLINICAL SIGNIFICANCE

Caries risk assessment is widely recommended for patient-tailored, prevention-focused caries management. CRAFT can provide a framework for the clinician for preventive care and enhance patient-participation in the same.

## MANUFACTURER NAME

Snyder test agar: HiMedia Laboratories Pvt Ltd, Mumbai.

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