

Development and Refinement of the Indian Caries Risk Assessment Tool for Children <6 Years of Age

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ABSTRACT

Aim and background: Early childhood caries (ECC) is a significant oral health problem in India. Personalized care based on individual or group risk has become a key aspect of dental caries prevention and management. However, an appropriate tool for caries risk assessment (CRA), taking into consideration the protective and risk factors for ECC specific to the Indian population, does not exist. This study aimed to report on the development and refinement of an evidence-based CRA tool for Indian children <6 years of age through consultation and feedback by dental professionals.

Materials and methods: Stakeholder consultation sessions were conducted with 65 participants, which included dental professionals and postgraduate residents. A survey questionnaire was also used to collect feedback on the initial draft of the newly developed Indian CRA tool. Predominant preferences and recommendations for improvement were taken into consideration, and the data were descriptively analyzed.

Results: The consultation sessions were conducted separately with three groups. A total of 80% of participants also completed the survey questionnaire. Survey questionnaire results reveal that 82.7% considered the current proposed questions in the Indian CRA tool to be sufficient, while 86.5% indicated that the tool would be understandable by parents. Overall, the majority of respondents (96.2%) agreed on the importance of the drafted Indian CRA tool for tailoring anticipatory guidance and treatment for individual children.

Conclusion: The newly developed CRA tool for Indian preschool children will be a useful resource for dental practitioners to assess young children's individual caries risk levels and assist with providing a personalized preventive service to children. The developed tool was refined based on dental professional feedback and was found to be a user-friendly, simple, practical, and evidence-based approach.

Clinical significance: This study developed the first evidence-based CRA tool for preschoolers in India. Researchers drafted and then refined the tool through consultation with stakeholders. The final CRA tool is evidence- and algorithm-based, easy to use, and considers the risk factors specific to ECC of the Indian preschool population.

Keywords: Child, Dental caries, Pediatric dentistry, Preschool, Risk assessment.

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INTRODUCTION

Early childhood caries (ECC) is defined as the presence of one or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child under the age of six.¹ ECC has a significant negative impact on a child's oral health, including an increased risk of new cavitated or incipient lesions in both deciduous and permanent teeth,^{2,3} hospitalizations and emergency medical care,^{4,5} costly treatments,⁶ missed school days,⁷ a decline in learning ability,⁸ and decreased oral health-related quality of life.⁹ Risk assessment is a valuable tool in this regard, with numerous risk tools and models available in the literature,¹⁰ unfortunately, in the context of India, an appropriate tool for caries risk assessment (CRA) with consideration to risk factors for Indian children does not exist.¹¹

The recent systematic review by Khan et al.¹² investigated risk factors for ECC in Indian preschoolers. This systematic review revealed that there is considerable variation in the prevalence of ECC depending on the age-group and region studied (16–92.2%). Overall, the systematic review revealed that there is a high prevalence of ECC among Indian children. This highlights the importance of and need for an early risk assessment with the aid of a specific CRA tool for children in India.

Bratthall and Petersson have classified CRA models into two categories, namely "risk models" and "prediction models." Prediction models use past caries experience to predict individuals at risk,

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whereas risk models identify existing risk factors for future caries. A CRA tool considers past caries experience, socioeconomic, and biological factors. The first two factors may be predictors but are not true risk model factors. The true risk model factors are biological factors.¹³ The use of risk and prediction models such as Cariogram¹³ and Caries Management by Risk Assessment (CAMBRA)¹⁴ has shown success in preventing and managing caries based on

individual risk levels. However, these models may not be applicable to all populations due to differing characteristics. Hence, different countries or populations may require their own tailored CRA tools due to variations in factors, including epidemiology, cultural and socioeconomic considerations, healthcare infrastructure, and access to care and available resources.^{15,16} While there is a general consensus among these tools regarding the majority of risk and predictor factors, they vary slightly to accommodate the specific characteristics of the local population, caries prevalence, and patient age.¹⁶

In India, there is currently no specific evidence-based tool available. The development of a CRA tool for Indian children must consider the unique etiological characteristics of caries in this population and, at the same time, meet the ideal requirements for a successful CRA tool (i.e., designed to be simple, easy to complete) and become a part of standard practice.¹¹

Our team undertook considerable preparatory research, including two systematic reviews,¹² (timeline attached, Fig. 1A). The first focused on risk factors for ECC, specifically for the Indian population (PROSPERO ID: CRD42022306234)^{12,17} and the other reviewing from a global perspective (PROSPERO ID: CRD42021276029).¹⁷ Multiple sociodemographic, behavioral, and clinical factors were examined and carefully chosen for inclusion in the CRA tool based on their reported correlation with caries risk. The selected factors encompassed aspects such as snacking frequency, feeding behavior, oral hygiene practices, as well as social determinants of health, notably including low socioeconomic status.¹² Combining the two systematic reviews, an evidence-based Indian CRA tool for children <6 years of age was framed for consultation (Fig. 1B). The purpose of this study was to report on the refinement of the initial draft of the evidence-based CRA tool for Indian children <6 years of age through consultation and questionnaire feedback with dental professionals.

MATERIALS AND METHODS

Stakeholder consultation sessions were undertaken following SRQR guidelines¹⁸ to obtain feedback from oral health professionals in India to assist in the refinement of the initial draft of the CRA tool for Indian preschoolers, which was drafted after combining two systematic reviews. The consultation sessions were conducted separately with three focus groups (i.e., faculty, postgraduate residents, and private practitioners). Participants were given the initial draft of the tool and were asked for feedback and initial impressions, which were taken down as written notes by the team. Combining the notes, a questionnaire was framed to obtain feedback for refinement. E-mail invitations were sent to the same participants who had participated in the consultation sessions, that is, 65 in number. Those who understood our objectives and expressed interest in participating were recruited. Feedback was obtained from participants *via* a cross-sectional survey, in a similar format to how Schroth et al. obtained healthcare provider feedback¹⁹ for the development of the Canadian CRA tool for children <6 years of age.²⁰

As a questionnaire for feedback, six questions were framed as a short survey to provide an overall impression of the draft (Fig. 2). The survey questionnaire covered topics including time taken to complete the tool, ease of parents in understanding the questions, naming the new tool, etc. Stakeholders were requested to complete the short survey to test and help refine the initial draft of the newly developed CRA tool.

Stakeholder sessions were conducted with dental professionals at the start of 2023, similar to Schroth et al.¹⁹ The first group had 22 participants, who were faculty from the Departments of Pediatric and Preventive Dentistry (PPD), Community Dentistry (PHD), and Conservative and Endodontic Dentistry (ENDO) from the dental schools of North, Central, and West India. The second focus group included 20 participants, who were private practitioners, representing Southern and Northern parts of India. The third focus group involved 23 participants, who were postgraduate dentistry residents; 14 from the Department of PPD and nine from the Department of PHD.

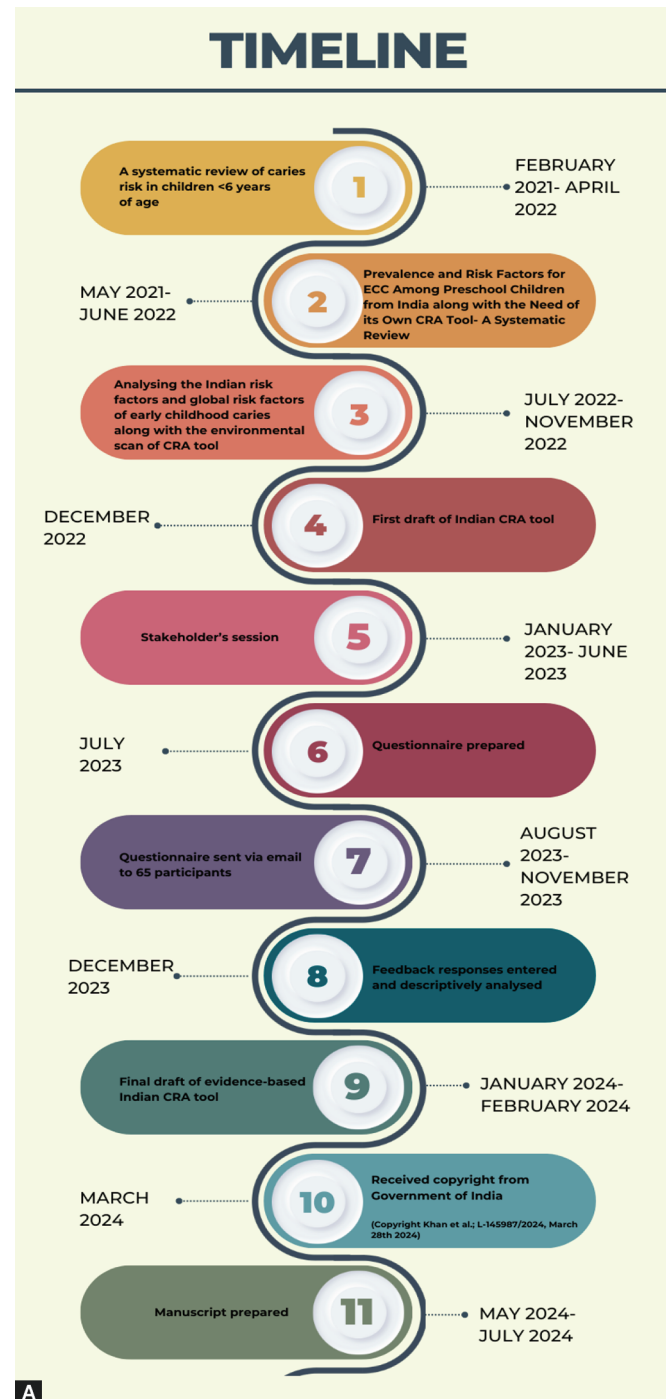


Fig. 1A: Timeline

RISK FACTORS	HIGH RISK	LOW RISK	COMMENTS
<p>SOCIODEMOGRAPHIC/BEHAVIORAL</p> <p>Child's age (≥ 24 months of age)* Child's family has low socioeconomic status* Parents/caregiver have low education level* Child has underlying medical condition/systemic problem † Child has a frequent and in-between meals sweet/snacking habit Parents/caregivers had /have caries experience † Infant feeding behavior (Bottle /breastfeeding>12 months duration, bedtime. on demand, frequent, sugar added) ** Child's nutrition compromised **</p>			<p>*Increase in age, increases caries susceptibility. Unclear how to assign risk group *Modified Kuppuswamy scale Score=5 *Modified Kuppuswamy scale. Score 1 or 2</p>
<p>PROTECTIVE</p> <p>Child has regular dental visits Child brushes daily with toothpaste (Under parents/caregiver supervision) Child has fluoride exposure (Toothpaste, community water, professional application)</p>			
<p>CLINICAL</p> <p>Child has past caries experience ++ Child has cavitated /non-cavitated caries lesion (white spot) ++ Child has visible plaque on teeth Child has visible developmental defect /enamel hypoplasia</p>			

Fig. 1B: Initial draft of Indian CRA tool (<6 years) **Based on risk factors from Indian literature; † Based on the environmental scan; †† Based on a systematic review

1. How much time did you take to complete the tool?
2. Were the questions posed to parents clear to understand?
3. Was it easy and practical to categorize the patients with count of check in either category?
4. Are the current questions sufficient or any relevant information missing in either category of the CRA tool?
5. What name would you suggest to the new tool?
6. Is the use of the CRA tool important for tailored anticipatory guidance and treatment?

Fig. 2: Focus group questions

The Departmental Board Committee was informed about the development of the initial draft of the Indian CRA tool and also about the refinement through questionnaire survey and the need to obtain provider feedback. The committee deemed this to be a quality improvement activity. Therefore, ethics approval was not required by the Institutional Research Ethics Board. Informed consent was obtained from all the participants. The data was entered and descriptively analyzed using IBM SPSS Statistics for Windows software, version 22 (IBM Corp, Armonk, NY, USA). Predominant preferences and recommendations for improvement to the draft of the CRA tool were taken into consideration with a number of checkpoints of agreement.

RESULTS

A total of 65 participants agreed to help refine the tool and were recruited into this project. Fifty-two participants returned the completed survey, yielding a response rate of 80%. Among survey respondents, postgraduate residents (40.4%) were the prominent participants, while faculty members and private practitioners were 38.4 and 21.1%, respectively. Table 1 shows the breakdown of survey participants. A total of 22 provider participants in the first group, 20 completed the survey, taking the tally to >90%. Table 2 shows the percentage distribution and number of responses by the respondents. Based on the oral health provider feedback, the initial draft of the Indian CRA tool was refined as below (Fig. 3).

Figure 3- Indian Caries Risk Assessment Tool for Children < 6 years of age

Name of the child		
Date of recruitment		
Date of Birth		

Factors	Yes	No
Family has difficulty in meeting the basic needs (Low income), low dental health literacy	<input type="checkbox"/> (1)	<input type="checkbox"/> (0)
(One or more –please tick all that apply)	<input type="checkbox"/> (1)	<input type="checkbox"/> (0)
<input type="checkbox"/> Child has a habit of taking sweets in-between the meals		
<input type="checkbox"/> Child has a habit of bottle feeding for > 12 months of duration		
<input type="checkbox"/> Child has a habit of bedtime bottle feeding		
<input type="checkbox"/> Child has a habit of taking sugary liquids (Juice, milk with sugar)		
Child's nutrition is compromised (Abnormal by weight and age)	<input type="checkbox"/> (1)	<input type="checkbox"/> (0)
Teeth cleaned with brush (or gauze for infant) by parent/ caregiver	<input type="checkbox"/> (0)	<input type="checkbox"/> (1)
Child has a 6 monthly routine dentist visits	<input type="checkbox"/> (0)	<input type="checkbox"/> (1)
Child is exposed to fluoride (Paste, Water, Professional application)	<input type="checkbox"/> (0)	<input type="checkbox"/> (1)
Child has visible plaque on teeth	<input type="checkbox"/> (1)	<input type="checkbox"/> (0)
Child has visible enamel developmental defect (Hypoplasia), (White spot lesion), past evidence of treatment	<input type="checkbox"/> (1)	<input type="checkbox"/> (0)
Overall caries risk status - High Risk	<input type="checkbox"/>	(Score ≥ 4)
Low Risk	<input type="checkbox"/>	(Score <4)

Recommendations to be shared with parents/ caregivers: If high-risk patient, then advice for treatment and estimation of mutans streptococci level in addition to the following:

- Parent/Caregiver would do the brushing, twice a day for children < 6 years of age
- If deft = 0, for 0–3 years of age- use non-fluoridated toothpaste.
- If deft > 0, for 0–3 years of age— use smear layer (rice-grain sized) of fluoride toothpaste
- If deft > 0, for 3–6 years of age— use pea-sized amount of fluoride toothpaste
- Cut down on the frequency / in-between sugar intake
- After each intake, rinse the oral cavity with water
- Avoid bedtime feeding with milk or sweetened liquid
- Weaning off the bottle by 12 months of age

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Fig. 3: Indian CRA tool for children <6 years of age

Table 1: Breakdown of survey participants

Participants breakdown	No. of respondents (n = 52)	% of respondents (n = 52)
Faculty		
PPD	15	28.8%
ENDO	2	3.8%
PHD	3	5.8%
Postgraduate residents		
PPD	14	26.9%
ENDO	0	0%
PHD	7	13.5%
Private practitioners	11	21.1%
Total	52	

Pediatric and preventive dentistry (PPD), conservative and endodontic department (ENDO), community dentistry (PHD)

Table 2: Percentage and number of responses by the focus group

Survey responses	No. of respondents (n = 52)	% of respondents (n = 52)
Questions posed to parents are clear		
Yes	45	86.5%
No	7	13.5%
Easy and practical to categorize with count of check		
Yes	3	5.8%
No	49	94.2%
Current questions of the draft are sufficient		
Yes	43	82.7%
No	9	17.3%
Name of the tool		
Indian CRA tool (<6 years of age)	28	53.8%
Indian caries assessment tool (<6 years of age)	13	25%
Caries assessment tool for Indian population (<6 years of age)	11	21.1%
Tool was quick to complete		
Yes	39	75%
No	13	25%
CRA tool is important for tailored anticipatory guidance and treatment		
Yes	50	96.2%
No	02	3.8%

DISCUSSION

Caries risk assessment tool helps to uncover the risk factors during visits and leads to tailored anticipatory guidance that eventually helps parents in reducing their child's future risk of developing caries.¹² Our feedback survey supported it with an agreement of 96.2%, and 86.5% agreed that the questions of the draft were clear as well as sufficient for risk factor identification. The dental professionals, as the focus group in our study, provided valuable and constructive feedback to make desired and relevant changes. 82.7% of respondents agreed that current questions were sufficient. According to 94.2%, it was not easy and practical to categorize the patients with a count of check. As for 75% of the respondents, the tool was quick to complete. Based on these constructive feedbacks, the initial draft of the CRA model was refined, and the final CRA model is presented in Figure 3.

The findings of our work are similar to the ideal characteristics of a CRA tool, such as quick-to-complete, easy and practical questions to identify risk factors, and clear cutoffs for risk levels. To optimize the cost-effectiveness of CRA, expensive salivary microbial tests have been reserved for high-risk individuals only.²¹ Also, the salivary and microbiological tests are meant to be a part of a comprehensive assessment and not for screening purposes.²² In the refined Indian CRA tool, we have worked with the algorithm approach. Algorithm-based CRA systems evaluate factors in a weighted manner and have advantages in terms of increased objectivity and improved accuracy.^{13,21}

Caries risk assessment tools are not without limitations. The risk factor questions are not evidence-based and are developed by panels rather than on systematic review. This is why our team undertook two systematic reviews before the main initial draft. Of the different tools used, only a handful are validated, and very few are modified by a feedback study. Apart from our

present work, a Canadian and British study have also reported on feedback taken from nondental health care professionals¹⁹ and testing of tools intended for dental health care professionals,²³ respectively. The newly refined Indian CRA tool is undergoing a pilot validation too.

STRENGTHS AND LIMITATIONS

The present research is one of the few conducted studies where feedback has been obtained for the refinement of the CRA tool from participants for whom the tool was designed. As a strength, the tool was drafted after a meticulous search through two systematic reviews on protective and risk factors significantly responsible for the causation of ECC, hence an evidence-based CRA tool. As a limitation, selection bias could have been present as we went with participants who responded to the invitation, so the selected sample was not representative.




CONCLUSION

An Indian CRA tool for children <6 years of age was developed for dental professionals and refined by feedback from them. This tool has the potential to prevent ECC by addressing the Indian-specific risk factors, hence promoting better oral health for Indian children.

Clinical Significance

This study developed the first evidence-based CRA tool for preschoolers in India. Researchers drafted and then refined the tool through consultation with stakeholders. The final CRA tool is evidence- and algorithm-based, easy to use, and considers the risk factors specific to ECC of the Indian preschool population.

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