REVIEW ARTICLE

Assessment of Dental Caries Using Various Caries Risk Assessment Tools

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ABSTRACT

The recent increase in the prevalence of dental caries among young children has highlighted the need for a more systematic approach to prevent caries in children at a younger age. Oral health education and diet advice should be incorporated into each child, encourage early identification of high caries risk children and caries risk assessment should be done for children attending the dental clinic for dental assessment or emergency care, using the Caries Risk Assessment tools. Risk assessment tools have been proposed to identify children who require intensive interventions to prevent or minimize caries experience for their accuracy and clinical usefulness.

Keywords: Dental caries, Oral health, Risk assessment tools

INTRODUCTION

Dental caries is an infectious, communicable disease, which results in the destruction of teeth caused by acid-forming bacteria found in dental plaque. Caries progression or the balance between protective and pathological factors in the mouth determines reversal of dental caries. The development of the carious lesion is episodic, with periods of demineralization alternating with periods of remineralization.[1]

In 2003, the American Academy of Pediatric Dentistry defined early childhood caries (ECC) as the presence of one or more decayed (noncavitated or cavitated), missing (due to caries), or filled tooth surfaces in any primary tooth in a child up to 71 months of age or younger. The factors responsible for ECC include a susceptible host, fermentable carbohydrate diet, presence of dental plaque, and a high number of

cariogenic microorganisms such as *Streptococcus mutans, Lactobacillus,* and most importantly, time. Dietary habits, socioeconomic status, working status of mother, oral hygiene habits, and frequent intake of medications are certain risk factors for this condition.[2]

A key factor for planning any preventive program is to accurately assess a person's risk of developing a disease.[3] Dental caries is the single most common chronic disease of childhood, occurring 5 times as frequently as asthma as and 7 times more common than hay fever. The American Academy of Pediatrics (AAP) indicates that dental and oral diseases continue to plague children and, in particular, the very young children and when left untreated results in pain, bacteremia, high treatment costs, reduced growth and development, speech disorders, and premature tooth loss with its sequelae of compromised chewing, and harm to the permanent dentition.[4] The caries-risk assessment should be done as early as possible preferably before the onset of disease to achieve the best management and outcomes for good oral health. Caries-risk assessment and subsequent management of the disease in children are crucial due to the known fact that caries in the primary dentition is a strong predictor of caries in the permanent dentition.[5] Risk assessment tool estimate caries risk, identify the primary etiological factors, provide an inventory of the patient's current preventive practices, and serve as a guide for selecting specialized preventive care tailored to that individual's needs.[6]

CARIES-RISK ASSESSMENT TOOLS

A major component of both primary and secondary prevention of ECC is early detection efforts, such as screening methods and risk assessment tools to identify individuals at highest risk. Risk assessment is defined as an estimation of the likelihood that an event will occur in the future. As such, development of effective risk assessment methods is essential to resolving the nation's "oral health crisis." Effective risk assessment should be the first step in implementing a comprehensive intervention protocol for identifying characteristics related to ECC to help identify those at risk and to clarify their oral health intervention needs.[7]

ECC risk assessment models should incorporate evaluation of a multiple of ECC-related factors, including

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diet-related behaviors, fluoride exposure, susceptibility of the individual, socioeconomic status, cultural influences, and oral health behaviors. Through inclusion of the etiological factors related to ECC, risk assessment tools can help to determine the likelihood of caries incidence (i.e., emergence of a new cavitated or incipient lesion) or the likelihood that there will be a change in the activity or size of lesions already present (i.e., disease process will progress, be arrested, or reverse). With this ability, the risk assessment tool can help clinicians identify caries in its earliest state (i.e., white spot lesion) and consequently assist in the prevention of progression to frank cavitation.[8]

Effective ECC risk assessment allows the dental clinician to determine the balance of protective factors appropriate for treatment of disease at varying levels of risk, thereby assist in planning the design and implementation of a targeted approach in the management of the disease process.[8]

According to the AAPD, risk assessment is as follows:
1. Fosters treatment of the disease, as opposed to only treat the outcome of the disease.
2. Furthers understanding of the disease factors relevant for a specific patient, and aids in individualization of prevention efforts.
3. Assists in determining appropriate preventive or restorative treatments.
4. Anticipates the likelihood of caries progression or stabilization.[8]

Diet Assessment of Caries-risk tool

This caries-risk assessment tool was developed at the University of Iowa. This tool was designed to assist oral health-care professionals efficiently assess diet-related factors associated with caries and to facilitate conversations regarding dietary advice with patients. The tool provides a simple method of diet assessment by evaluating responses to questions regarding a number of meals/snacks consumed daily, meals/snack structure, sugared beverage intake (quantity and frequency), length of exposures, and drinking style. Although it incorporates several important dietary risk factors for ECC, this tool does not evaluate nondietary risk factors. Therefore, it would need to be used in conjunction with another caries-risk assessment tool to provide a comprehensive assessment.[9]

The food diary or diet diary is recorded during 3 or 7 consecutive days. From among the recorded days, both weekdays and weekend days should be represented. Subjects asked to keep a diet diary needs clear instructions to record the quality and the amount of food consumption. Exact descriptions of the time, type, brand, and preparation method of all foods and drinks are needed. The amount consumed is asked to be recorded using ordinary household measures such as glasses, cups, or tablespoons. Pictures of portions can be used for further assistance. The method is used for prospective purposes and is the best method for dietary counseling. The method is suitable for scientific purposes, accurate (provided the patient records thoughtfully and accurately) and allows recording of nutrient intake at 10% accuracy level. A disadvantage is that it is time-consuming to record and analyze.[10]

One useful method of dietary assessment for the evaluation of an individual's dietary intake is a 24-h recall. 24-h dietary recall is an interviewer-administered dietary assessment tool designed to gather information about food and beverage intake patterns through open-ended questions. Completion of the 24-h dietary recall involves asking a patient to recall and state all foods, beverages, and snacks consumed during the previous 24 h, from the time they arose from bed to the time they went to sleep. 24-h diet dietary recall evaluates the associations among caries experience and intakes of dairy foods, sugared beverages, and nutrients, and overall diet quality in young children. It is beneficial as it is easy, can be used in all age groups of children and reflects intake of the previous day, so participants are less likely to alter eating behavior.[9]

Radford *et al*. (2009) observed that utilization of a 24-h dietary recall allowed for the collection of detailed dietary intake data for one full day. However, the limitation of capturing a single day's intake was that it did not account for fluctuations in dietary intake patterns over the course of several days. In addition, the accuracy of 24-h dietary recalls may be challenged, as they rely on an individual's memory to recall all foods/beverages consumed. As the traditional multiple-pass 24-h recall is time-consuming, and information collected may not be relevant to ECC, this method of dietary assessment is not ideal for use in ECC risk assessment.[11]

Moynihan and Petersen also revealed that most important factor in the relationship between the dietary regimen and dental caries was the frequency of the use of sugary materials and not its quantity. They also found that diet containing vegetables and fruits, which contain Vitamin C such as tangerine and oranges; and dairy products such as milk and yogurt provided the body with enough calcium which could be important in the prevention of dental caries.[12]

Alm *et al*. also reported through a longitudinal study that the habit of eating snacks during early childhood is related to a high rate of dental caries at the age of 15 years.[13] In a study conducted by Llena and Forner study, it was revealed that eating too much starch, and sugary snacks led to more cases of dental caries in children.[14]

Biria *et al*. conducted a study on dietary habits and caries experience among 9-year-old school children using 7-day diet diary, and they assessed a wide variety of snacks, and their dietary habits were related to their dental caries experience. They observed that the use of caramel cream and cookies increased the risk of caries while eating oranges decreased the risk of formation of dental caries in both deciduous and permanent teeth.[15]

Caries Management by Risk Assessment (CAMBRA)

Another risk assessment tool that has been developed for ECC prevention is the CAMBRA. This tool was specifically designed for use within a busy dental practice to assess the risk of caries among children age 0–5 years. This tool is a single-page questionnaire [Figure 1] that includes sequential assessment of five key areas of assessment through parent's interview and clinical examination: Caries risk indicators (i.e., previous caries in child or parent, socioeconomic status, and dental home status); caries risk factors (biological and behavioral); protective factors (non-biological); protective factors (biological); and caries risk indicators/factors (i.e., physical assessment of caries risk). If several of these disease indicators are present, clinicians are instructed to perform a bacterial culture to identify the presence of oral bacteria commonly associated with ECC, *mutans streptococci* (MS) and lactobacillus, on both the mother/primary caregiver and child to assess the need for antibacterial therapy.[7]

Although the CAMBRA is brief and easy to administer, it incorporates a very limited dietary assessment component. In addition, the clinical utility of the CAMBRA for caries prevention may be limited by the lengthy preventive treatment and recall recommendations provided for children who score at low risk. This limitation may prevent early identification of rapidly changing factors that may significantly affect caries risk.[16]

According to Freitas *et al*., high and moderate caries risk classifications identified using CAMBRA were the most observed among children treated. White spots on smooth surfaces were the most frequent dental caries indicators, and visible biofilm on the tooth surface and community water fluoridation were the most observed risk and protection factors, respectively.[17]

According to Sudhir *et al*., CAMBRA was valid and highly predictive in determining the caries risk among institutionalized children. Children who were categorized into moderate and high-risk groups at baseline developed a significantly higher new increment of caries at follow-up, which confirmed the validity of the tool.[18]

Cariogram

A third caries risk assessment tool is a computer-based software program called Cariogram. This tool was designed to address the multifactorial nature of ECC by illustrating the interactions between nine key factors related to caries risk. The software guides the clinician through a collection of data by prompting the clinician to assign a risk score to each of the key variables, including diet, plaque, caries experience, bacterial counts (accessed through salivary testing), and saliva secretion. The Cariogram software then illustrates the interaction of these in a colorful pie chart to facilitate discussion between clinician and regarding ways to reduce caries risk [Figure 2]. By providing a visual representation of caries risk, the Cariogram program may provide a unique opportunity for patient engagement and education. However, the Cariogram risk scores are largely based on clinician interpretation and judgment, thus increasing the potential for scoring inconsistency. In addition, the Cariogram program has been critiqued for being costly and time-consuming to administer, as it requires the purchase of specialized software, use of a computer, and incorporates salivary MS testing.[19]

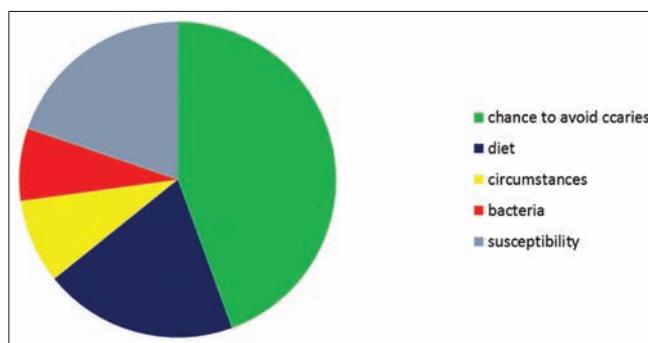**Figure 1:** Caries management by risk assessment (CAMBRA 0–5) (Francisco *et al.* 2007)

Figure 2: Cariogram risk assessment (Bratthall and Hansel Petersson, 2005)

Kemparaj *et al.* conducted a study on caries-risk assessment among school children in Davangere city using cariogram and found that cariogram to be an effective program and had advantages such as making recommendations for preventive care and increasing patient motivation. The cariogram model has been evaluated for both children and adult population. It is a useful pedagogic tool for dentists, dental hygienists, and assistants in discussing with patients about their caries risk. The cariogram complements the current trends toward computerized record keeping and management.[20]

Jakupi *et al.* observed that the assessment of the dental caries risk is a very important clinical step, especially when using the Cariogram model, which in many ways can lead to the use of specific preventive measures.[21]

According to Sudhir *et al.*, cariogram is valid and highly predictive in determining the caries risk among institutionalized children. In this study children who were categorized into moderate and high-risk groups at baseline developed a significantly higher new increment of caries at follow-up, which confirmed the validity of the tool.[22]

AAPD Caries-risk Assessment Tool (CAT)

A fourth caries-risk assessment tool is a most commonly used. This tool is designed to be a simple to use that could be easily integrated into the existing patient health record. The CAT is a one-page assessment form (actually several forms, each age-specific) which characterizes caries risk in regard to a number of recognized risk factors, including biologic/behavioral factors, protective factors, and clinical findings [Figures 3-5].[8]

Nainar and Straffon (2005) observed that most students agreed that the CAT instrument was easy to understand (86%), simple to apply (76%), useful for prescribing radiographs (76%), and useful for determining preventive procedures (84%). 80% of students indicated that they were likely to use the CAT instrument in their clinical practice.[23]

According to Yoon *et al.* (2012), the screening for ECC using salivary MS cultures and variations on the CAT is promising approaches for children to provide early and intensive intervention to prevent or minimize caries experience.[24]

The tool includes recommendations for treatment planning based on calculated risk and incorporates risk factors from clinical conditions, environmental characteristics, and general health conditions. The CAT evaluates risks according to socioeconomic status, diet (sugar and beverage consumption), special health care needs, recent immigrant, fluoride use, oral hygiene, dental home, presence of active white spot lesions or enamel

Figure 3: Caries-risk assessment form for 0 to 3 years old (For Physicians and Other Non-Dental Healthcare Providers)

Figure 4: Caries-risk Assessment form for 0 to 5 years old (For Dental Providers)

Figure 5: Caries-risk Assessment Form for ≥6 years old (For Dental Providers)

defects, salivary flow, and restorations.[8]

Despite its widespread use, the predictive utility of the CAT has not, until recently, been clinically validated. A recent evaluation of the clinical utility of the CAT tool for successful identification of children at risk for caries, concluded that the CAT alone, was not as accurate or clinically useful as MS testing for assessing caries risk. Moreover, the CAT, like several of the other ECC risk assessment tools, incorporates a limited dietary assessment component.[24]

CONCLUSION

All tools appear to be promising for early identification and targeted intervention for ECC reduction and oral health promotion. Future applications of these tools are warranted to investigate the potential for promoting

positive behavior changes to reduce ECC risk and promote disease prevention. If rates of ECC and disease-associated outcomes are to be effectively diminished, early identification of children at risk of this highly prevalent oral health condition is essential.

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