Caries Risk Assessment in Pediatric Dental Care: A Systematic Review


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Abstract

Caries risk assessment is essential for the prevention, diagnosis, and treatment of the disease to improve children's oral health. In this systematic review, we aim to summarize previously published studies about the effects of risk assessment of dental caries in pediatric patients and the different risk factors for developing them. For that, a systematic electronic database search was conducted for relevant studies published, from inception till 26th June 2020, in seven databases. Finally, we included eight papers for this systematic review. The sample size of the included studies ranged from 128 to 3,810 individuals. The mean male percentage was 55%, ranging from 38% to 100%. All of the included studies had a cross-sectional study design. In this study, we reviewed the different risk factors for dental caries in pediatric patients. Despite all studies agreed that most risk factors include oral hygiene, dietary habits, proper parenting, and dental medical history, the socio-economic status risk factor was a point of debate. Moreover, different CRATs have been reported with a variety of sensitivity and validity scores. Validating these tools will require studies with large sample sizes and comparing the effect of these tools on different populations.

Keywords: Caries; Risk; Assessment; Children; Pediatric

Introduction

Dental caries disease, which is formerly known as baby bottle tooth decay, or nursing bottle caries, now a day, the AAPD adopted the term ECC to better reflect its multifactorial etiology.

(ECC) is defined as the presence of one or more decayed (with or without cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child under the age of six [1]. The definition of sever early childhood caries (S-ECC) is any sign of smooth-surface caries in child younger than three years of age [1]. Specifically, 8% of children aged between three to five years of age account for 75% of ECC and the rate is increasing within this age [2-4]. The prevalence of the disease is the highest among other childhood
chronic diseases in the US. It is even seven times more prevalent than hay fever and five times than asthma. Moreover, it is more common in children within racial or ethnic minorities [5-7].

Caries risk assessment is essential for the prevention, diagnosis and treatment of the disease to improve children’s oral health. Risk factors essential for the assessment are mostly obtained from interviewing children’s parents. A plan for preventive care can be developed by risk assessment tools to help parents and dentists how to prevent the occurrence of ECC by a better understanding of the risk factors. This plan will help dentists in processing treatment and prevention decisions that are essential to protect children from the harmful effects of dental caries [8]. However, to obtain the best use of it, the risk assessment should be carried out early before the disease onset to achieve a favorable outcome. Applying risk assessment models to prevent ECC in this age is necessary for a sound permanent dentition process [9,10].

Risk models involve different factors including a susceptible host, diet, fluoride exposure, and the adaptation of microfloras with various social, behavioral, and cultural factors [11]. The commonest risk indicators include caries lesions, on-teeth plaque visibility, low salivary outflow, increased sugar intake, and other factors like the socio-economic level of the patient, the ability to seek medical care, and other demographic factors [11]. Many caries risk assessment methods (CRAMs) have been reported [12,13]. Furthermore, various caries risk assessment tools (CRATs) as American Association of Paediatric Dentistry Caries Assessment Tool (AAPD CAT), Caries Management By Risk Assessment (CAMBRA), and Cariogram have been developed based on these CRAMs [11,14,15]. However, many factors should be considered when applying these instruments as validity, reliability, and the degree of responsiveness [16]. Hopefully, these tools will help in better prediction of dental caries in children at high risk of developing complications.

Aim of the Study

In this systematic review, we aim to summarize previously published studies about the effects of risk assessment of dental caries in pediatric patients and the different risk factors for developing them.

Methods

Search strategy and study selection

The study process was conducted following the accepted methodology recommendations of the PRISMA checklist for systematic review [17]. A systematic electronic database search was conducted for relevant studies published, from inception till 26th June 2020, in seven databases including Google Scholar, Scopus, Web of Science (ISI), PubMed, Cochrane Central Register of Controlled Trials (CENTRAL), Embase and CINAHL using keywords, medical subject (MeSH) terms. In databases not supporting MeSH terms, combinations of all possible terms were used. Moreover, We conducted a manual search of references from the included articles by searching the primary studies that had cited our included papers and scanning references of the relevant papers in PubMed and Google Scholar to avoid missing any relevant publications [18].

We included all original relevant studies, which are discussing Caries risk assessment in the pediatric population. Papers were excluded if there was one of the following exclusion criteria: pilot studies, duplicate records, data could not be reliably extracted or incomplete reports, abstract only articles, thesis, books, conference papers. Moreover, studies with adult populations were excluded. Title and abstract screening were done independently by four reviewers. Then, three independent reviewers performed a full-text screening to ensure the inclusion of relevant papers in our systematic review. Any disagreement was resolved by discussion and referring to the senior author when necessary.
Data extraction

Two authors developed the data extraction sheet using the Microsoft Excel software. Data extraction was performed by three independent reviewers using the excel sheet. The fourth independent reviewer performed data checking to ensure the extracted data accuracy. All the disagreements and discrepancies were resolved by discussion and consultation with the senior author when necessary.

Quality assessment

Three independent reviewers evaluated the risk of bias in included studies. The risk of bias in non-randomized studies - of interventions (ROBINS-I) was used to assess the quality of each included study [19]. Any discrepancy between the reviewers was solved by discussion.

Results and Discussion

Search results

We searched for included studies in 6309 records using the title and abstract screening method after the exclusion of 2698 duplicated records. The process resulted in the inclusion of 280 papers for a further full-text screening assessment. Manual search trials did not result in the inclusion of any new study. Finally, we included eight papers for this systematic review (Figure 1).

![Figure 1: Flowchart of the search and screening process.](image)

Study characteristics and quality of the included studies

The sample size of the included studies ranged from 128 to 3,810 individuals. The mean male percentage was 55%, ranging from 38% to 100%. All of the included studies had a cross-sectional study design (Table 1). The results of risk bias assessment are summarized in figure 2.

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**Figure 2: Summary of risk of bias assessment.**

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Sample size</th>
<th>Male %</th>
<th>Age Mean (SD)</th>
<th>Aim</th>
<th>Main findings</th>
<th>Overall risk of bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seetha, 2019 [20]</td>
<td>India</td>
<td>531</td>
<td>49.7</td>
<td>50.9 months (SD 12.6)</td>
<td>To allow risk scoring by childcare providers without clinical examination in order to guide dental referral in a community setting.</td>
<td>CRA-RT is a simple, valid, and reliable novel risk scoring system for ECC, to be used in a nondental, nonmedical setting. The proposed tool contains those behavioral risk or protective factors, the presence or absence of which could be assessed by interviewing the mother. The quick and easy risk scoring pattern with a cut-off score can guide the dental referral of preschool children by childcare providers in a community setting.</td>
<td>Serious</td>
</tr>
<tr>
<td>Goodwin, 2017 [21]</td>
<td>UK</td>
<td>128</td>
<td>53</td>
<td>12.8</td>
<td>To identify reliable and simple dietary risk factors for caries experience</td>
<td>the consumption of free sugars before bedtime may be an important risk factor for adolescent caries into dentine experience.</td>
<td>Low</td>
</tr>
<tr>
<td>Farsi, 2013 [22]</td>
<td>Saudi Arabia</td>
<td>407</td>
<td>37.8</td>
<td>4 to 5</td>
<td>to identify characteristic features of Saudi preschoolers at high risk for caries and to report the most significant caries risk predictors</td>
<td>Most of the Saudi children are at high risk for caries. Previous caries experience, enamel demineralization and socioeconomic status are the most significant caries risk predictors. These groups should be targeted for inclusion in caries prevention programmes.</td>
<td>Serious</td>
</tr>
<tr>
<td>Ghanim, 1998 [23]</td>
<td>Saudi Arabia</td>
<td>446</td>
<td>44.6</td>
<td>4.13 (±0.83)</td>
<td>To evaluate the significance of variables such as oral hygiene, dietary habits, socio-economic status, and medical history of a child in assessing the level of caries risk and to generate a caries prediction model for preschool Saudi children.</td>
<td>Risk factors for dental caries have been identified and a caries prediction model has been developed for Saudi pre-school children. The prediction model, if verified, may provide with guidance in identifying high caries risk Saudi preschool children as targets for preventive programmes.</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

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Table 1: Characteristics of the included studies.  
SD: Standard Deviation.

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In the past, surgical interventions were widely used for dental caries management. Recently, it has been well known that such procedures do not impact the development of the disease. Moreover, some damages resulting from these procedures are irreversible and lead to permanent cavitation. Therefore, there has been an urgent need to develop more safe and conservative measures for protection from the harmful effects of dental caries [28]. Many CRATs building-up attempts have been approached. Investigators have looked up different factors like demographics, cultures, microbiological profiles and dietary habits to establish a valid and sensitive prediction model for early detection and prevention of dental caries, but with limited significance [29]. Other approaches were developed to depend on one or two factors in estimating the risk of developing dental caries [30-36]. However, it was concluded that such approaches were not sufficient to be used for risk assessment [29]. On the other hand, other investigators relied on including various risk factors [37-39]. Recently, various CRATs have been reported by many studies [11,14,15,24,25,40]. However, the validity, and reliability of these tools are still questionable.

In this systematic review, our search process resulted in eight eligible studies that discussed different risk assessment procedures for dental caries in pediatric patients. Of these studies, four of them [20,23,26,40] included pre-school children only, two studies [24,25] included children between 6 - 8 years old. Only Goodwin., et al. [21] included patients aged 11 - 12 years old, while Sarmadi., et al. [27] was the only study that included all age ranges between 3 - 19 years. It is believed that the validity of the assessment models, that have proved efficient when applied to a certain population, cannot be applied as a valid instrument for another different population with different characteristics. Mejare., et al. [12] found that the results for using a risk assessment model for a certain population significantly differed when applied to another population. On the other hand, Beck., et al. [41] results showed validity for the model that he used with children when applied to a different population. Moreover, many studies focus on this age range for validating CRATs because of the nature of various factors that these patients witness as the feeding practices, the maternal and infantile oral health attitudes, and parenting behaviors [42].

There is no doubt that the assessment process is a long-term process and needs long follow-up periods for validating the results. We found that only Gao., et al. [26] and Chaffee., et al. [25] depended on the longitudinal observation of their patients. Gao., et al. [26] aimed at developing novel CRATs based on bio-physiological, medical, and personal habits. The novel tool was reported to have higher sensitivity when compared to the cariogram, a widely used CRAT for assessing CRA in children [14]. On the other hand, six studies [20,21,23,24,27,40] used interview-based reports for the validation of the risk factors that were previously reported to be of value in assessing the risks of dental caries in children. Seetha., et al. [20], however, conducted a cross-sectional study for building-up a new model that is based on interviewing patients’ mothers, and other factors. The authors of this study reported that the tool was efficient in terms of dental caries intervention by early referral of children at high risk [20]. Al Ghanim., et al. [23] developed a tool with high predictive ability, sensitivity, and specificity. The tool showed statistical significance in debris index, frequency of consumption of soft drinks, consuming sweetened milk in bottles, frequency of sweets intake, and child’s age at the first dental visit.

Regarding the assessment tools used by the included studies, Chaffee., et al. [25] relied on the CAMBRA tool and found that a high rate of children was at high risk of developing caries. Although authors reported a high sensitivity rate of 83.6% which is consistent with other studies [25,43], the validity of the tool is still questionable because of not having the recommended minimum score of combined sensitivity and specificity, according to Christian., et al. [44]. Goodwin., et al. [21] used the International Caries Detection and Assessment System (ICDAS) for the assessment of sugar consumption before bed. The results showed statistical significance in sugar consumption before bed, but no significance was recorded for between-meals, and total sugar consumption [21]. Besides, using the AAPD, Farsi., et al. [40] reported the frequency of sugar exposure per day was statistically significant between the absent and present caries children. The same author found no significance in water fluoridation and general health condition. Al Ghanim., et al. [23] also found a statistical significance in the frequency of sweet consumption. Almost all studies showed a correlation between children’s oral health, dietary habits, and medical history. However, there were contradictions on the significance of the socio-economic status of the child and his family. When Farsi., et al. [40], Gao., et al. [26], and Chaffee., et al. [25] found the socio-economic status to be statistically significant, Al Ghanim., et al. [23], and Alhabdan., et al. [24], did not.

Limitations to our study include the different methodological approaches that were used by the included studies. Moreover, limitations to the sample size and population selection should be considered together with validating the risk assessment results in different sets of populations.

Conclusion

In this study, we reviewed the different risk factors for dental caries in pediatric patients. Despite all studies agreed that most risk factors include oral hygiene, dietary habits, proper parenting, and dental medical history, the socio-economic status risk factor was a point of debate. Moreover, different CRATs have been reported with a variety of sensitivity and validity scores. Validating these tools will require studies with large sample sizes and comparing the effect of these tools on different populations.

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Conflicts of Interest

No conflicts related to this work.

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