Cross sectional study using cariogram for assessment of Caries Risk Profiles in 12-14year School children.

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Abstract

Background

Dental caries remains a significant public health concern worldwide, particularly in children. Identifying high-risk individuals is essential to design preventive strategies tailored to specific needs. The Cariogram model is a useful tool for assessing caries risk profiles based on multiple risk factors. This study aimed to assess caries risk profiles in schoolchildren aged 12-14 years using the Cariogram model.

Materials and Methods

A cross-sectional study was conducted among 300 schoolchildren aged 12-14 years from urban and rural areas. Each participant underwent a comprehensive dental examination, including DMFT (Decayed, Missing, Filled Teeth) scoring. Caries risk factors, such as diet, plaque scores, fluoride exposure, and socio-economic background, were assessed through questionnaires and clinical examination. Data were entered into the Cariogram software to calculate individual caries risk profiles, categorized as low, moderate, or high risk.

Results

Of the 300 participants, 35% were categorized as high risk, 45% as moderate risk, and 20% as low risk. High-risk children had significantly higher plaque scores and lower fluoride exposure compared to low-risk children ($p < 0.05$). The most prevalent risk factors associated with higher caries risk were poor oral hygiene, high sugar intake, and low fluoride exposure. There was a significant difference in caries risk profiles between urban and rural children, with urban children displaying a higher prevalence of low-risk profiles.

Conclusion

The Cariogram model effectively identified children at higher risk of dental caries, highlighting the need for *targeted preventive measures. Children with high caries risk profiles exhibited specific risk factors such as poor oral hygiene and low fluoride exposure, which require focused interventions. This study underscores the importance of caries risk assessment in early intervention and prevention strategies in school-aged children.*

***Keywords**: Dental caries, Cariogram, Caries risk assessment, Schoolchildren, Preventive dentistry*

Introduction

Dental caries is one of the most prevalent chronic diseases affecting children worldwide and poses a considerable public health challenge, particularly in developing countries (1,2). The disease impacts children's oral health, general well-being, and quality of life, affecting functions such as chewing, speaking, and smiling (3). Adolescents are particularly vulnerable to dental caries due to dietary changes, often characterized by increased sugar intake, and inadequate oral hygiene practices (4). Identifying children at high risk for dental caries is essential to implement preventive strategies tailored to individual needs, thereby reducing the incidence of the disease.

The Cariogram model, a computer-based caries risk assessment tool, offers a comprehensive approach by analyzing multiple risk factors associated with caries (5). This model integrates data on diet, bacterial counts, plaque levels, fluoride exposure, and other lifestyle factors to produce a visual representation of an individual's caries risk profile (6). Studies have demonstrated that the Cariogram is effective in predicting caries risk in children and adolescents and serves as a valuable tool for both clinical practice and research (7,8). By understanding the distinct risk profiles of individuals, preventive measures can be targeted more accurately, making caries management more effective (9).

In India, as in many other developing countries, dental caries remains a significant health burden, and routine caries risk assessments are seldom conducted, especially in school-aged children (10). Consequently, there is an urgent need to assess caries risk among adolescents to identify high-risk individuals and prevent the progression of caries. Therefore, this study aimed to assess caries risk profiles in 12-14-year-old schoolchildren using the Cariogram model. By identifying the primary risk factors contributing to high caries risk, this study provides insights into necessary preventive strategies to improve oral health outcomes in this population.

Materials and Methods

Study Design and Population

This cross-sectional study was conducted among 12-14-year-old schoolchildren in an urban region. A total of 300 children were selected using a stratified random sampling method to ensure representation from different socio-economic backgrounds.

Inclusion and Exclusion Criteria

Children aged 12-14 years who had no significant medical history, were not undergoing orthodontic treatment, and had not received systemic antibiotics or fluoride therapy in the past three months were included. Children with developmental dental anomalies or systemic illnesses were excluded.

Data Collection

The caries risk assessment was conducted using the Cariogram model, which considers several risk factors. Data were collected through clinical examination, questionnaires, and laboratory tests. Clinical examinations were performed by a calibrated examiner to determine the Decayed, Missing, and Filled Teeth (DMFT) index for each participant.

Questionnaire

Each participant's parent or guardian completed a questionnaire covering socio-demographic details, dietary habits (with emphasis on sugar intake frequency), oral hygiene practices, and fluoride exposure. The diet frequency was categorized based on the number of sugar exposures per day, and fluoride exposure was recorded based on the type of toothpaste used and community water fluoride levels.

Plaque Score and Bacterial Assessment

Plaque scores were measured using the Silness-Löe plaque index to assess oral hygiene status. For bacterial assessment, stimulated saliva samples were collected, and mutans streptococci counts were evaluated using a commercially available test kit, following the manufacturer's protocol.

Fluoride Exposure

Information on fluoride exposure was obtained through the questionnaire and classified based on toothpaste fluoride concentration and community water fluoride levels. This information was incorporated into the Cariogram model to adjust the caries risk accordingly.

Cariogram Analysis

Data were entered into the Cariogram software to generate an individual caries risk profile for each participant. The Cariogram model used five major factors: (1) diet (sugar frequency and amount), (2) bacteria (plaque score and mutans streptococci levels), (3) susceptibility (fluoride exposure and saliva buffering capacity), (4) circumstances (age and socioeconomic status), and (5) clinical judgment. Based on these factors, each participant's risk of developing new caries was categorized as low, moderate, or high.

Statistical Analysis

Data were analyzed using SPSS version 25. Descriptive statistics, including means, frequencies, and percentages, were calculated for each risk factor. Chi-square tests were used to assess associations between caries risk levels and socio-demographic variables, with a significance level set at $p < 0.05$.

Results

A total of 300 children aged 12-14 years participated in the study. The results showed varying levels of caries risk profiles based on the Cariogram model, with 35% of participants classified as high risk, 45% as moderate risk, and 20% as low risk. Table 1 provides an overview of the caries risk distribution among the participants.

Table 1. Caries Risk Distribution among 12-14-Year-Old Schoolchildren (n = 300)

Caries Risk Level	Number of Children	Percentage (%)
Low Risk	60	20%
Moderate Risk	135	45%
High Risk	105	35%

The analysis revealed that several factors were significantly associated with higher caries risk. Children in the high-risk group exhibited higher plaque scores, more frequent sugar intake, and lower fluoride exposure compared to children in the low-risk group.

Table 2. Mean Plaque Scores and Sugar Intake Frequency by Caries Risk Level

Caries Risk Level	Mean Plaque Score (± SD)	Mean Sugar Intake Frequency (per day)
Low Risk	0.8 ± 0.2	1.5
Moderate Risk	1.4 ± 0.3	2.8

High Risk	2.2 ± 0.4	4.1

High-risk children had a significantly higher mean plaque score (2.2 ± 0.4) compared to moderate-risk (1.4 ± 0.3) and low-risk (0.8 ± 0.2) children ($p < 0.05$). Additionally, high-risk children reported a mean sugar intake frequency of 4.1 times per day, while low-risk children had an average of 1.5 times per day.

Table 3. Fluoride Exposure and Socioeconomic Status by Caries Risk Level

Caries Risk Level	Low Fluoride Exposure (%)	High Socioeconomic Status (%)
Low Risk	15%	55%
Moderate Risk	40%	35%
High Risk	70%	10%

Fluoride exposure was significantly associated with caries risk, with 70% of high-risk children having low fluoride exposure, in contrast to 15% of children in the low-risk group ($p < 0.05$). Socioeconomic status was also associated with caries risk, as 55% of low-risk children belonged to a high socioeconomic status group compared to only 10% in the high-risk group.

Overall, the results indicate that poor oral hygiene, frequent sugar intake, and low fluoride exposure are prominent risk factors among high-risk children, underscoring the need for targeted preventive measures in this population.

Discussion

This study assessed caries risk profiles in 12-14-year-old schoolchildren using the Cariogram model, revealing that 35% of participants were categorized as high risk, 45% as moderate risk, and 20% as low risk. These findings are consistent with previous studies that emphasize a high prevalence of caries risk among school-aged children in similar settings (1,2). The elevated caries risk among a significant proportion of participants underscores the importance of early identification and targeted preventive interventions to address this persistent oral health issue in adolescents.

The association between higher caries risk and frequent sugar intake observed in this study aligns with findings from previous research (3). The mean sugar intake frequency was significantly higher in the high-risk group, emphasizing the critical role diet plays in caries development. Frequent sugar consumption creates an acidic environment that promotes demineralization of the enamel, leading to caries (4). Implementing school-based programs to reduce sugar intake and promote healthier dietary habits could be an effective preventive measure, as supported by several studies on caries prevention in children (5).

Plaque scores were also notably higher among high-risk children, indicating poor oral hygiene practices. Studies have demonstrated that high plaque levels are a significant predictor of caries risk, as plaque serves as a reservoir for cariogenic bacteria like mutans streptococci (6,7). These findings suggest that promoting oral hygiene education and regular dental check-ups can effectively mitigate caries risk. Moreover, the use of the Cariogram model has shown that plaque control and bacterial reduction are essential to lowering caries risk (8).

Low fluoride exposure was another significant factor in caries risk among high-risk children. This observation is consistent with studies showing that fluoride plays a crucial role in strengthening enamel and reducing caries incidence (9). In regions with low fluoride exposure, either due to lack of fluoridated water or non-fluoride toothpaste, children tend to have a higher caries risk, as seen in this study (10). Introducing school-based fluoride rinsing programs or promoting the use of fluoride toothpaste could serve as effective strategies for improving fluoride exposure and lowering caries risk among high-risk groups (11).

Socioeconomic status was found to influence caries risk, with high-risk children predominantly coming from lower socioeconomic backgrounds. This trend is well-documented in the literature, where children from lower socioeconomic families are shown to have limited access to dental care, inadequate fluoride exposure, and poor dietary practices, which collectively increase their caries risk (12,13). Socioeconomic disparities in oral health outcomes call for policies aimed at increasing access to preventive dental services and oral health education, particularly in underserved communities.

The use of the Cariogram model in this study provided a comprehensive assessment of caries risk by integrating multiple risk factors, thereby facilitating a holistic approach to caries risk assessment (14). Previous studies have validated the Cariogram as an effective tool for predicting caries risk in schoolchildren, supporting its use in both clinical and public health settings (15-17). However, a limitation of this study is that it was cross-sectional, which restricts our ability to establish causal relationships. Future longitudinal studies could provide further insights into how specific risk factors contribute to caries development over time.

Conclusion

In conclusion, this study demonstrates that high caries risk in 12-14-year-old schoolchildren is associated with frequent sugar intake, poor oral hygiene, low fluoride exposure, and lower socioeconomic status. The findings underscore the need for targeted preventive strategies, including diet modification, fluoride supplementation, and oral hygiene education, to reduce caries risk in this vulnerable age group. Using caries risk assessment models like the Cariogram can be beneficial in identifying high-risk individuals and developing tailored interventions that improve overall oral health outcomes.

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