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# CARIES RISK ASSESSMENT IN CHILDREN USING CARIOGRAM® IN A BRAZILIAN CITY: PILOT STUDY

*Uso do cariogram® na avaliação do risco de cárie em crianças em um município brasileiro: estudo piloto*

*El uso del Cariogram® en la evaluación del riesgo de caries niños de un municipio brasileño: estudio piloto*

Original Article

## ABSTRACT

**Objective:** To analyze the risk of dental caries in 12-year-old children through the use of Cariogram®. **Methods:** Descriptive study conducted with 31 children, aged 12 years, in a public elementary school in a city of the Brazilian Northeast, in 2009. Data was collected regarding caries experience and related systemic disease; presence of sugar in the diet and intake frequency; Streptococcus mutans biofilm growth and bacterial counts; use of fluoride products, salivary flow and buffering capacity. All this data was inserted into Cariogram®, in order to obtain a profile of individual caries risk and the ability to prevent new carious lesions. **Results:** It was found that 78% (n=24) of the children had individual risk of dental caries in the intermediate and high levels; 45% (n=14) of the participants had less than a 50% chance of avoiding new cavities. Furthermore, 6.45% (n=2) of the children had less than 75% possibility of avoiding new carious lesions, i.e., they featured high risk of caries development, and 12.90% (n=4) had a possibility of more than 75%, being characterized as low risk of developing such injuries. There were positive associations ( $p < 0.05$ ) between the presence of sugar in the diet and salivary flow, in which subjects with cariogenic diet had decreased salivary flow. **Conclusion:** A caries risk pattern was found in the intermediate and high levels, with susceptibility above 10% and possibility of avoiding new caries lesions under 50%.

**Descriptors:** Dental Caries; Dental Caries Susceptibility; Risk Assessment.

## RESUMO

**Objetivo:** Analisar o risco de cárie dentária em crianças de 12 anos de idade por meio da utilização do Cariogram®. **Métodos:** Estudo descritivo realizado com 31 crianças de 12 anos de idade de uma escola pública de ensino fundamental em um município do Nordeste brasileiro, no ano de 2009. Coletaram-se dados referentes à experiência de cárie e doenças sistêmicas relacionadas; presença de açúcar na dieta e frequência de ingestão; quantidade de placa e contagem de estreptococos do grupo mutans; uso de produtos fluoretados, fluxo salivar e capacidade tampão. Todos estes dados foram inseridos no Cariogram® para que se pudesse obter um perfil de risco de cárie individual e a capacidade de evitar novas lesões. **Resultados:** Verificou-se que 78% (n=24) das crianças apresentaram riscos individuais de cárie nos níveis intermediário e alto; 45% (n=14) dos participantes apresentaram menos de 50% de chance de evitar novas lesões de cáries. Ainda, que 6,45% (n= 2) das crianças apresentavam possibilidade de evitar novas lesões de cárie menor que 75%, ou seja, configuravam em alto risco de desenvolvimento de cárie; e 12,90% (n= 4) apresentavam uma possibilidade maior que 75%, sendo caracterizado como baixo risco de evitar estas lesões. Houve associações positivas ( $p < 0,05$ ) entre presença de açúcar na dieta e fluxo salivar, em que indivíduos com dieta cariogênica apresentavam fluxo salivar diminuído. **Conclusão:** Verificou-se um padrão de risco de cárie nos níveis intermediário e alto, com susceptibilidade acima de 10% e possibilidade de evitar novas lesões de cárie inferior a 50%.

**Descritores:** Cárie Dentária; Suscetibilidade à Cárie Dentária; Medição de Risco.

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## RESUMEN

**Objetivo:** Analizar el riesgo de caries dentaria en niños de 12 años de edad con la utilización del Cariogram®. **Métodos:** Estudio descriptivo realizado con 31 niños de 12 años de edad en una escuela pública de enseñanza fundamental de un municipio del Nordeste brasileño en 2009. Se recogió datos sobre la experiencia de caries y enfermedades sistémicas relacionadas; presencia de azúcar en la dieta y frecuencia de ingestión; cantidad de placa y recuento de estreptococos del grupo mutans; el uso de productos fluorados, flujo salival y capacidad de tapón. Todos los datos fueron inseridos en el Cariogram® para obtener un perfil de riesgo de caries individual y la capacidad de evitar nuevas lesiones.

**Resultados:** Se verificó que el 78% (n=24) de los niños presentaron riesgos individuales de caries en los niveles intermedio y alto; el 45% (n=14) de los participantes presentaron menos del 50% de oportunidad de evitar nuevas lesiones de caries. Además, el 6,45% (n= 2) de los niños presentaron la posibilidad de evitar nuevas lesiones de caries abajo del 75%, es decir, presentaron riesgo elevado de desarrollo de caries; y el 12,90% (n= 4) presentaron una mayor posibilidad que el 75% caracterizando el bajo riesgo en evitar estas lesiones. Hubieron asociaciones positivas ( $p<0,05$ ) de la presencia del azúcar en la dieta y el flujo salival en la cual los individuos con dieta cariogénica presentaron flujo salival disminuido. **Conclusión:** Se verificó un patrón de riesgo de caries en los niveles intermedio y alto con susceptibilidad mayor que el 10% y posibilidad de evitar nuevas lesiones de caries menor que el 50%.

**Descriptores:** Caries dental, Susceptibilidad a Caries Dentarias, Medición de Riesgo.

## INTRODUCTION

Along the years, a continuous and sustained improvement has been observed in living and health conditions of populations. In general, this is due to political, economic, social and environmental progress allied to advances in the various interfaces of public health<sup>(1)</sup>. Such progress is related to the new way of thinking and acting on health, coming to aggregate several aspects: social, physical and psychological<sup>(2)</sup>, allowing a shift in paradigms founded on a new proposal that incorporated health promotion as the fundamental axis<sup>(3)</sup>.

From that new logic, health promotion has become an important strategy for coping with health issues, since specific actions of health care produced no impact on the welfare of individuals and social groups<sup>(4)</sup>. The last decades of the twentieth century have shown a significant development of health promotion, whether in its theoretical foundation, as in the formulation of innovative strategies for implementation<sup>(5)</sup>. This fact reverberated directly in improving the population's quality of life in their

unquestionable relationship with the ethical commitments of politics and the Brazilian health system<sup>(6)</sup>.

When considering the oral health, major changes had been perceived<sup>(7)</sup>. This new form of thinking and acting grounded a new proposal for the health teams' performance and gave rise to important results, including the incorporation of lightweight technologies and the adoption of complementary tools for diagnostics and study of risk factors in populations. Based on these tools, studies of different authors verified a trend of decreasing prevalence of caries in children aged 12 years from all regions of the world, including Brazil<sup>(8-11)</sup>.

It is noteworthy that, for the adoption of specific measures for the prevention of dental caries acceptable strategies are needed, with feasible accuracy and cost-effectiveness for the identification of high-risk individuals; and which could simultaneously address the multiple risk factors<sup>(12)</sup>. In the majority of the studies, prediction is expressed in terms of specificity and sensitivity. Even if any variable individually reaches the proposed level of precision, the caries experience is a more powerful individual predictor for determination of future decay. In this view, the aim of the predictors is to determine the individual risk of developing caries, before the formation of caries cavity<sup>(12)</sup>.

Risk factors for tooth decay development can be studied from a computer program, named Cariogram®<sup>(13)</sup>. Cariogram® consists of an interactive educational program developed for better understanding of the multifactorial aspects of dental caries, and is intended to encourage the introduction of preventive measures, before the onset of new lesions. Patients are classified based on diet, dental plaque, caries experience, bacteria count, and salivary secretion, being the results presented on a graph of risk profile. The program was validated for both children and elderly patients, and a significant relationship between the Cariogram® data and the caries increment has been reported in the literature<sup>(14-16)</sup>. The program also demonstrates the chance of caries occurrence, and the extent that these factors can reach<sup>(17)</sup>. It has been particularly useful in populations with a high prevalence of the disease<sup>(18)</sup>.

The objective of this study was to analyse the risk of dental caries in children aged 12 years through the use of Cariogram®. To investigate the possibility of avoiding new caries lesions also constituted the authors' interests.

## METHODS

This is a descriptive pilot study of quantitative approach, with procedures of clinical examination, questionnaire, estimates of the oral hygiene, and saliva

sample of schoolchildren aged 12 years enrolled in a school of the Municipal Public Network of Sobral-CE in 2009.

Among the criteria for inclusion of schoolchildren in this study, we mention: be effectively enrolled in the educational institution; belong to the group of children aged 12 years (age index of the World Health Organization - WHO); be present at school on at least one of the days scheduled for the exam. At the end of the screening, 31 children fulfilled the stipulated criteria and were included in the study.

To carry out the study, participants were contacted and evaluated in their free school shift in a classroom designed to collect data during the survey period. Data collection followed the order of execution of the survey, namely a questionnaire, clinical examination for detection of caries experience, Simplified Oral Hygiene Index (OHI-S), and collection of saliva sample.

Regarding the proposed index, the OHI-S<sup>(19)</sup>, preferably used in epidemiological investigation of prevalence and clinical trials, was used in this study aiming to analyse the oral health status of each participant.

A single experienced dental surgeon carried out all phases of the research and all the examinations were blind. Still, the study investigator had prior training in both the field research, as well as in the laboratory phase, in addition to calibration of the instruments used in the present study.

Structured questionnaires were applied, as described in the Cariogram<sup>®</sup> Manual available in Portuguese language<sup>(12)</sup>, to parents or guardians. Information about the use of fluoride products, diet - the presence and frequency of sugar intake, and related systemic diseases was also collected.

Oral clinical examination was held in a school chair under natural illumination, with the objective of assessing the oral health conditions determining the caries experience and the OHI-S. In each test were used mouth mirror #5, explorer, and wooden spatula. The clinical criteria established by the WHO (20) were utilized.

Data on the caries experience was detected by the DMFT index, where decay (D) is defined as the presence of undermined enamel; pits and fissures with enamel opacity, patches of decay or the presence of softened tissue; restorations presenting recurrence; in cases of doubt between decay and indicated extraction, the tooth was considered decayed. The tooth extracted due to tooth decay was identified as missing tooth (M), while the tooth with carious lesion reaching the pulp chamber was understood as tooth with indicated extraction. Tooth presenting definitive restorative material was classified as filled tooth (F), and, in case of doubt between filled and decayed tooth, it was considered filled. The sound teeth were those in which carious lesions or restorations were not existent. In case of

doubt between the solidity and the presence of caries, the tooth was considered healthy; as well as teeth with fissure sealants were incorporated among the healthy component<sup>(20)</sup>.

For quantification of dental biofilm the registration of the OHI-S was initially used. For this, the surfaces of the following teeth were examined: buccal of upper right first molar (16B); buccal of upper right central incisor (11B); buccal of the left upper first molar (26B); lingual of the left lower first molar (36L); buccal of the left central incisor (31B) and lingual lower right first molar (46L). In the absence of teeth required for the exam, or if they were decayed or restored, those were replaced by the subsequent tooth<sup>(21)</sup>.

Samples of stimulated saliva were obtained by chewing 1cm<sup>3</sup> paraffin block, and dispensed directly into sterile Falcon tubes. At the end of the procedure, each tube was closed and sealed with parafilm and transported to the Laboratório Integrado de Biomoléculas - LIBS (*Integrated Laboratory of Biomolecules*) of the Federal University of Ceará - Sobral Campus (UFC - Sobral) immersed in ice in coolers to reduce the formation of bubbles and foam. All the material collected was used for the measurement of pH and culture in biological media. To undergo saliva collection, the patient should be fasting for 1 hour prior to the collection, avoiding hygiene of the oral cavity. Determination of the salivary flow was conducted using a 20 mL graduated cylinder<sup>(22)</sup>.

The buffer capacity of saliva was measured with the aid of a pH meter (Micronal<sup>®</sup>) with glass electrodes and digital display previously calibrated with standard solutions with pH=7 and pH=4. For the final measurement, three consecutive measurements of the pH of each sample were performed.

For determination of viable cell count of *Streptococcus mutans*, the standard counting viable colonies (CFU/ml) was performed, and the final results in CFU/ml of saliva was obtained through the conversion of the amount inoculated (0.1ml) and the dilution factor. This experimental phase was held in the Microbiology Laboratory of the Federal University of Sobral.

All data was recorded on spreadsheets produced by the investigator and the results entered into the Cariogram<sup>®</sup> database, in order to obtain an individual profile of caries risk<sup>(13)</sup>. The decay profile was estimated by the program and submitted on a pie chart, from sectors, expressed in percentages: (1) Circumstances, yellow sector - based on caries experience and related systemic diseases; (2) Diet, dark blue sector - based on the presence of sugar in the diet and frequency of intake; (3) Bacteria, red sector - based on plaque amount and mutans streptococci count; (4) Susceptibility, light blue sector - based on the use of

Table 1 - Distribution of 12-year-old schoolchildren according to individual variables used in CARIOGRAM®. Sobral-CE, 2009.

Variable		N	%
<b>Caries experience</b>			
0	DMFT*/ dmft = 0 (free of caries and without restorations)	8	25.8
1	DMFT */ dmft <3 (better than normal for age)	10	32.3
2	DMFT / dmft = 3 (normal for age)	03	9.7
3	DMFT / dmft > 3 (worse than normal for age)	10	32.3
<b>Related diseases</b>			
0	Healthy patient	31	100
1	Disease that contributes to increase in caries risk	-	-
2	Disease affecting the salivary secretion	-	-
<b>Presence of sugar</b>			
0	Very low in sugar, balanced diet	-	-
1	Low presence of sugar and non-cariogenic diet	06	19.4
2	Moderate consumption of sugar, diet with high sugar content	17	54.8
3	High sugar intake, cariogenic diet	08	25.8
<b>Frequency of ingestion/ day</b>			
0	Maximum consumption of three times/day	20	64.5
1	Maximum consumption of five times/day	11	35.5
2	Maximum consumption of seven times/day	-	-
3	Maximum consumption above seven times/day	-	-
<b>Amount of biofilm</b>			
0	Absence of deposits	-	-
1	Deposits on more than 2/3 of the tooth surface	04	12.9
2	Deposits on more than 1/3 but not more than 2/3 of the tooth surface	14	45.2
3	Deposits on more than 2/3 of the tooth surface	13	41.9
<b>Colony-forming unit</b>			
0	1 – 20 UFC/mL	16	51.6
1	21 – 100 UFC/mL	10	32.3
2	Ø 100 UFC/mL	05	16.1
<b>Fluoride use</b>			
0	Fluoridated toothpaste, mouthwashes and varnishes (frequent)	-	-
1	Fluoridated toothpaste, mouthwashes and varnishes (infrequent)	03	9.7
2	Only fluoridated toothpaste	28	90.3
3	No fluoride	-	-
<b>Salivary Flow</b>			
0	Normal salivary secretion: above 1.0 mL / min	14	45.2
1	Low salivary secretion: 0.7 to 1.0 ml / min	08	25.8
2	Very low salivary secretion: 0.1 to 0.7 ml / min	09	29.0
3	Xerostomia: less than 0.1 mL / min	-	-
<b>Buffering capacity</b>			
0	Normal buffering capacity: pH above 6.0	31	100.0
1	Reduced buffering capacity: pH of 4.5 to 5.5	-	-
2	Low buffering capacity: pH below 4.0	-	-
<b>Caries Risk</b>			
0	No risk	-	-
1	Low risk	07	22.6
2	Moderate risk	13	41.9
3	High risk	11	35.5
<b>TOTAL</b>		31	100.0



products that contain fluoride, salivary flow and buffering capacity; and, (5) actual possibility of avoiding new cavities, green sector. Ultimately, the subjects were classified into high, intermediate and low risk.

The data entered in SPSS® 18.0 identified the frequencies of individual variables in order to analyse the participants' profile. The following results were consolidated through the intersection of the variables, and translated into specific interpretations, as for the actual possibility of avoiding new caries lesions and susceptibility to further injury. All the statistical analysis was performed considering the grouping of statistically similar ages in relation to caries experience in the age group of 12 years, the test of association between variables being the two-tailed Chi-square, with  $p < 0.05$ .

This research was approved by the Ethics Committee in Human Research of the State University of Acaraú Valley under number 703/CEP-UVA, in compliance with the Resolution 196/96 of the National Health Council of the Ministry of Health. Submission followed an authorization from Sobral City Hall and permission from the Board of the educational institution for research execution in view of the use of physical space and mobilization of school staff.

## RESULTS

To identify the individual caries risk of children at the age of 12 years, data was displayed in a table (Table I) for subsequent classification and percentage distribution, as provided by Cariogram®. No child had balanced diet with low sugar intake, and frequency of ingestion remained from three to five times a day. All the children had dental biofilm. It is important to emphasize the low frequency of use of additional methods of fluoride, less than 10% of the sample, and the low level of salivary flow in the majority of the sample.

When testing the association between variables, positive associations were observed between the presence of sugar in the diet and salivary flow. In such situation, individuals with cariogenic diet showed decreased salivary flow; as well as between the presence of sugar in the diet and its frequency of ingestion ( $p = 0.000$ ).

When categorizing the individuals according to DMFT index and based on parameters established by the WHO, 26% ( $n = 8$ ) the study participants were free from caries and without restorations. However, the number of children with DMFT greater than 3 in the studied age was worrisome. In general, DMFT remained below 3 for 58% ( $n = 18$ ) of the children. However, when assessing the susceptibility to tooth decay, only 32.3% ( $n = 10$ ) of the participants showed susceptibility lower than 10% (Figure 1).

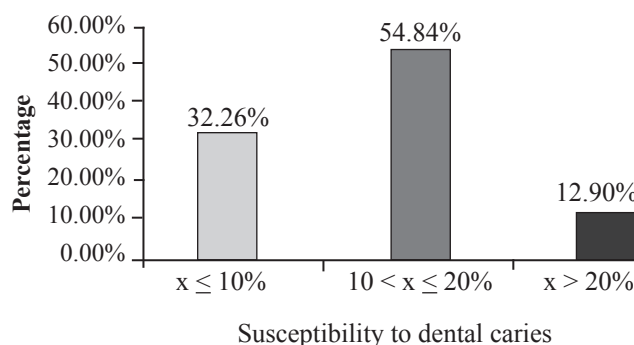


Figure 1 - Distribution of the susceptibility to dental caries with CARIOGRAM®, in 12-year-old schoolchildren. Sobral-CE, 2009.

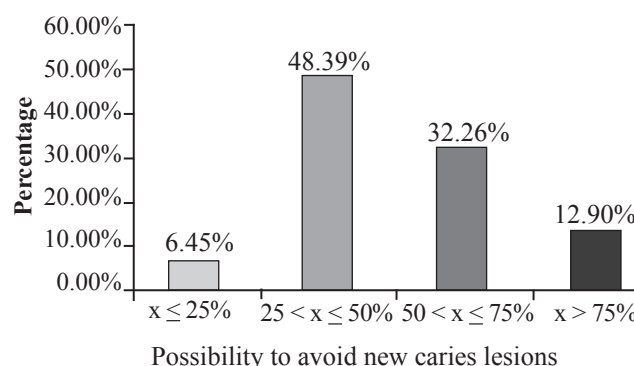


Figure 2 - Distribution of the possibility to avoid new caries lesions with CARIOGRAM®, in 12-year-old schoolchildren. Sobral-CE, 2009.

The individual caries risk, as proposed by the Cariogram® tool, was divided into low and high, added a third level - intermediate. Such classification is strongly linked to the possibility of avoiding new caries lesions. It was thus found through this study that 77% ( $n=24$ ) of the participants had caries risk in intermediate and high levels, and 45% ( $n = 14$ ) of them had less than 50% chance to avoid further caries lesions (Figure 2). Other information, related to the percentage possibility of avoiding new caries lesions, may be observed in Figure 2.

## DISCUSSION

The main findings of the current study refer to the high susceptibility to tooth decay presented by the research subjects when using Cariogram®. It is important to mention that the results were obtained by means of the consolidation of relevant information for diagnosis, e.g., history of caries, related diseases, presence and frequency of sugar in the

diet, amount of dental biofilm, use of fluoride, salivary flow, buffering capacity, and caries risk.

Dental caries is a multifactorial disease with several well-known<sup>(23)</sup> components. The purpose of determining the caries risk is to investigate possible strategies to be adopted by more susceptible individuals and groups for the promotion and maintenance of oral health, and grievance prevention<sup>(13)</sup>. In this sense, this evaluation is important even among people who already present symptoms of the disease, since it allows the determination of the type and intensity of treatment to be developed. Furthermore, it allows the organization of oral health services and maximizes the productive potential of teams in pursuit of comprehensiveness and accessibility<sup>(24)</sup>.

A method for assessing the risk of caries should be founded on the various factors involved; if possible, it should be sensitive enough to reach the maximum possible detection of subjects, but also be able to identify those at low risk<sup>(19)</sup>.

Having in view the evaluation of individual risk of caries in patients, some tools have been developed and tested. In 2002, an instrument for assessing caries risk - Caries Risk Assessment Tool (CAT), developed by the American Academy of Pediatric Dentistry, featured purpose of applicability in pediatrics<sup>(25)</sup>. In the next year, a consortium of organizations in Dentistry developed the Caries Management by Risk Assessment (CAMBRA), treatment management tool based on caries risk assessment. This tool is currently in use in Dentistry courses in the states of California, Oregon, Washington, Nevada, and Arizona in the United States<sup>(26)</sup>. It is worth highlighting the evolution of the concept of caries as indispensable for the development of specific recording and evaluation methods<sup>(23)</sup>.

The risk of tooth decay faces microbiological factors, salivary properties, and clinical variables. Other features, however, like the presence of systemic diseases, use of dental services, behavioural and dietary habits are also important to identify risk of future decay. Cariogram® thus presents itself as an important technological tool with the advantage of its dynamism and ease of use. Several clinical studies have been published since its development and it has been applied in children as well as in adults and elderly<sup>(12,14,16-17,27-34)</sup>. It is also validated and translated into Portuguese<sup>(35)</sup>.

The circumstances that lead to an individual caries risk, according to Cariogram®, emphasize the experience of caries and the presence of diseases that may directly impact on the increase of caries and in the weakness of the individual<sup>(13)</sup>. In the present study, no interferences were observed due to the onset of diseases. All children were found healthy, without any systemic changes.

A relevant component to subsidize this analysis is the previous caries experience of an individual or group. Therefore, the WHO recommended the DMFT index, whose value expresses the average decayed, missing and filled teeth in a group of individuals<sup>(20)</sup>, to measure and compare the experience of dental caries in populations. In the present study, diverse experience of caries was perceived, with higher prevalence of better DMFT index than the normal for age.

Studies demonstrate that there was a reduction in dental caries in children at 12 years<sup>(8-11)</sup>. However, it is worth mentioning that regional differences, sometimes attributed to whether or not there is access to fluoridated water<sup>(36)</sup>, in addition to important differences between population groups of different socioeconomic status<sup>(37)</sup>, influence greatly in the results found in each region. In the current study, it is important to mention that the participants do not hold large regional differences and, in general, have the same access to fluoridated water and similar socioeconomic levels.

By the year 2000, WHO recommended the DMFT index at most equal to 3 for 12- year-old children. For this age, in Brazil, according to the latest epidemiological survey, the lowest indexes were found in the Southeast and South regions, while in the Northeast this value reached 2.63 teeth with dental caries experience<sup>(11)</sup>. In this research 42% of the students were found presenting higher than expected index (DMFT > 3), contrary to WHO recommendations for this age group and exceeding the regional average for caries experience<sup>(11)</sup>. In this opportunity, it is important to mention that these values refer to oral health records of schoolchildren in the municipal public network. That suggests a relation between the socioeconomic and cultural level and the caries experience, according to results obtained in another study<sup>(38)</sup> performed in the Northeast region, in the city of João Pessoa-PB, where the index in public schools became evident as twice the index presented in the educational institutions of the private network. In public schools, the prevalence of caries was 51.6%, while in private institutions there was a record of 9.3%<sup>(38)</sup>.

It is worth mentioning that the high index occurring in this study reflects the number of individuals who are more susceptible to develop new lesions. Among all the participants, 67% retained susceptibility greater than 10% (Figure 1) and 55% had the possibility of avoiding new caries lesions lower than 50% (Figure 2). Upon realizing this, people who have experience of caries should be constantly monitored. Depending on the caries activity, there is a need to adopt strategies for health promotion and submission to effective methods for prevention of dental caries<sup>(35)</sup>.

Bearing in mind the previous goals and the degree of heterogeneity in the response to them in the various

populations of the world, new goals were proposed for 2020, for adaptation in terms of percentage reductions in DMFT index at age 12, with special emphasis on the 'D' component<sup>(39)</sup>. In this study setting, one must consider that the municipality investigated in the current study aggregates relevant resources for strengthening the National Oral Health Policy. This was translated by the number of Oral Health Teams (OHT) deployed, and the growing number of forums for discussion relating the role of these professionals in various fields. It is thus possible that such considerations would accomplish the reduction of DMFT index in this age group.

From the microbiological point of view, in individuals who consume large amounts of sucrose, the composition of the biofilm is modified and its cariogenic potential increases due to the predominance of lactobacilli and mutans streptococci<sup>(40)</sup>. Of the schoolchildren at issue who made sugar intake over five times a day, about 25.8% had a high sugar intake, characterized as cariogenic diet, with a positive association between these variables. It is known that dietary habits are difficult to be evaluated and modified and this reflects the difficulty in controlling the health-disease process of dental caries, when diet is the main risk factor<sup>(41)</sup>.

It is important to mention the human oral cavity as a stage for a complex microbiota in a dynamic network of more than 700 species of microorganisms, including bacteria, fungi, protozoa and mycoplasmas in different sites<sup>(40)</sup>. For each of these niches, there is still a specific sensitivity to harmful agents of a species. This can be influenced mainly by specific adhesion to certain substrates, especially in the case of early colonizers of the oral cavity. Other bacteria involved in later stages of this process may be able to adhere not only to the oral surfaces, but also to other bacteria, which are already adhered to the surfaces, and thereby contribute in biofilm formation<sup>(40)</sup>.

In the current study, interesting data was observed on the presence of biofilm (bacterial plaque) and the amount relating to Colony Forming Units per milliliter of saliva (CFU/mL). The mutans streptococci are complex bacterial species of the *Streptococcus* genus, closely related, including *S. mutans*, *S. sobrinus*, *S. cricetus*, *S. rattus*, *S. ferus*, *S. downei* and *S. macacae*, the first two being the species most commonly found in the oral cavity. The biofilm located at specific sites of the teeth is, after becoming mature, able to produce a variety of local irritants, which over time invariably dissolve the tooth<sup>(40)</sup>.

In this sense, the evaluation of the salivary levels of the bacteria is an important tool for the early identification of individuals with high biological risk for the development of dental caries. Almost 88% of the students in the present study showed an amount of biofilm in much of the tooth surface,

ranging from over 1/3 to 2/3 of this. In this perspective, it is advised the disordering of this bacterial formation through proper control of oral biofilms, relevant to both prevention of caries and the periodontal disease.

One of the ways to estimate the caries risk is to quantify streptococci from saliva, because these microorganisms are numerically associated to the caries process. Streptococci are considered early colonizers, being necessary a given time interval, at least 24 hours without adequate mechanical removal, so that occurs the formation of a layer of biofilm clinically able to be evidenced<sup>(21)</sup>. From the evaluated parameter, 16% of the children investigated in this study showed high counts of streptococci. Susceptibility to dental caries is related also to the use of fluoride, salivary flow, and buffering capacity. The use of fluoride in drinking water, toothpastes and additional methods in the form of professional application (mouthwashes with fluoride, fluoride gels or varnishes) is considered a measure of great importance in the prevention of dental caries<sup>(42-44)</sup>.

Fluoride varnishes have been described as the most convenient for professional use of topical fluoride in preschool children based on the premise that they are easy to apply and well tolerated. Due to their capability to form a film, which adheres to tooth surfaces, the coating can remain in contact with the tooth enamel for several hours<sup>(42)</sup>. It was observed in this research a very low use of additional methods of professional application of fluoride, and the use of fluoridated toothpaste was established as the most widely used material. In a study about the presence of fluoride in toothpastes used among Brazilian children it was found that the majority of toothpaste (96%) contained fluoride, and 84% of the total fluoride concentration was found in accordance with the stated on the packaging, besides the fact 78% of them present levels of total soluble fluoride greater than or equal to 1000 ppm, ranging from 422.3 to 1432.3 ppm F<sup>(45)</sup>.

Another component, the saliva, plays the role of coating of the buccal mucosa tissue, assisting in the maintenance of an effective barrier against external injuries, including the caries disease. Salivary constituents assist in maintaining mucosal integrity by hydration of the oral tissues, as well as in lubrication, mechanical cleaning, forming the bolus, communicative function, antibacterial, antifungal and antiviral activities, neutralizing strong acids and bases, dental healthiness, by means of the post-eruptive maturation and demineralization - remineralization processes<sup>(46-48)</sup>.

Among the salivary tests, salivary flow and buffering capacity of saliva are noteworthy because they are easy to perform, rapid, inexpensive and are inversely related with caries experience<sup>(47)</sup>. In the case of bacteriological tests, the counts of lactobacilli and mutans streptococci in saliva



remain the most appropriate techniques for assessing caries risk<sup>(13,47)</sup>.

It is important to mention that the salivary flow and buffering capacity have a low impact on Cariogram®, with regard to the prediction of new carious lesions, and this can be described as a disadvantage of this tool. The importance of salivary tests in Cariogram® is related to the age of the sample; that is, older populations present impaired secretion rates, so the tests assume greater importance<sup>(48)</sup>. In this respect, it is important to mention that Cariogram® filled a criterion for good model for determining risk, since it provided the detection of high risk of caries in children at 12 years of age with dynamism and ease of use.

All this data justify a review of the strategies for health promotion adopted for this group of students. Therefore, it would be necessary to aggregate resources and unite efforts for the reversal of the health scenario observed in this social equipment.

As a practical suggestion, Cariogram® might be used by technicians and administrators of oral health field, in order to help planning preventive actions and oral health promotion in terms of minimization of aggravating factors in the health-disease process. From it, it would be possible to outline care and assistance programming in oral health in schoolchildren of the public network at the individual level.

However, it must be stressed that it is not possible to generalize the results. In a different population, with another behaviour, the factors involved in the process of caries development, the results could be different. It is emphasized that the present study has limitations such as the small sample size, which may influence the statistical analysis, and the impossibility of comparison with other groups of different socioeconomic and cultural levels.

## CONCLUSION

When analysing the risk of dental caries in children at 12 years of age enrolled in a public school in Sobral, Ceará, through the use of Cariogram®, there was a pattern of caries risk in the intermediate and high levels. By means of this tool, a worrisome profile was observed among the study participants, since a significant sample maintained susceptibility above 10% and possibility to avoid new carious lesions lower than 50%.

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