

Caries risk assessment in dental students from Iasi, Romania

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Summary

Different caries risk prediction models have been developed in recent years. The Cariogram is a new concept that illustrates graphically the multifactorial background of dental caries and assess an individual's caries risk profile more correctly than other risk prediction methods.

Objectives: The aims of this study was to assess the dentistry students caries risk by means of the Cariogram software and examine the relationships between the caries related factors and the risk of caries determined by this program.

Methods: Data were collected from 112 dentistry students in grade five from the Faculty of Dental Medicine in Iasi, Romania, by clinical examination, saliva sampling and a dietary questionnaire. The caries risk of each individual, expressed as the chance to avoid new caries, was then obtained by drawing up the Cariogram.

Results: Past caries experience, *Streptococcus mutans* counts, fluoridation programme and buffer capacity of the saliva are the main factors included in the Cariogram that showed significant correlation with the caries risk determined by this software. Other variables that the Cariogram does not include directly, such as DMFT, DMFS and the plaque index, also showed high correlation with caries risk.

Conclusions: The predictive variables which make the greatest contribution to the caries risk assessment are: *Streptococcus mutans* count, DMFT index and the buffer capacity of the saliva. Cariogram is a useful pedagogic tool for dentists, dental hygienists and dental assistants in discussions with patients about their caries risk.

Key words: Cariogram, caries risk assessment, caries related factors.

Introduction

Dental caries has a multifactorial aetiology in which there is an interplay of three principal factors: the host (saliva and teeth), the microflora (plaque), and the substrate (diet), and a fourth factor: time [1]. There is no single test that takes into consideration all these factors and can accurately predict an individual's susceptibility to caries. The risk of dental caries can be evaluated by analysing and integrating several causative factors. These include caries experience, fluoride use, extent of plaque present, diet, bacterial and salivary activity and social and behavioral factors.

In order to predict caries risk many models have been developed in recent past years, but none of them had proved really effective.

Cariogram is a new way in which to illustrate the interaction between caries related factors. This educational interactive program has been developed for better understanding of the multifactorial

aspects of dental caries and to act as a guide in the attempts to estimate the caries risk. This program can be used in a clinical set up or for various educational purposes [2, 3, 4, 5, 6, 7].

The main purpose of the Cariogram is to demonstrate the caries risk graphically, expressed as the "Chance to avoid new caries" in the near future. It also illustrates to what extent various factors affect this "Chance". A further purpose of this program is to encourage preventive measures to be introduced before new cavities could develop.

The aims of the Cariogram are: illustrates the interaction of caries related factors, illustrates the chance to avoid caries, expresses caries risk graphically, recommends targeted preventive actions, can be used in the clinic and can be used as an educational program.

The objectives of this study were to assess the caries risk in dentistry students from five academic year, in Iasi, expressed by the likelihood of avoiding new caries in the future year, using the

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Cariogram computer program and to study the correlations between different caries related factors that make up the Cariogram, and the risk of caries it determined.

Material and Methods

Study subjects

The cross sectional study population comprised 112 students in dentistry, from five academic year, 71 women and 41 men, Faculty of Dental Medicine from Iasi, Romania.

Dentistry students from five academic year, in Iasi, were invited to complete a questionnaire during community dentistry lectures on their general health, particularly any type of systemic or chronic illness that could directly or indirectly affect oral health, oral hygiene habits, especially the frequency of tooth brushing and the use of fluoridated toothpaste and mouthwashes, tobacco and/or alcohol use.

All students were examined clinically at the Dental Clinic School according to the WHO criteria [8]. No radiographs were taken. The following clinical and paraclinical parameters were recorded:

DMFT index and DMFS index

Conducted visual-tactile examinations were made, using dental explorers and mouth mirrors for the counting of decayed, missing, and filled (DMF) permanent teeth (T) and permanent teeth surfaces (S).

Plaque Index, PI, according to Silness and Loe (six teeth: 16, 12, 24 and 36, 32, 44). PI assesses the amount of plaque in the cervical part of the tooth. Four sites on each tooth are recorded, buccal, lingual and proximal surfaces. The Index for the four surfaces is summarized and split by 4, which gives an index for the tooth. If the index for all teeth are summarized and split by the number of included teeth, we get the index for the patient.

Saliva tests

Estimation of the rate of flow of stimulated saliva

A paraffin pellet is given to the patient to chew for 30 seconds, then to spit out the accumulated saliva or swallow it. The patient then continues to chew for five minutes, with the accumulated saliva collected continuously into a measuring glass. Time could be reduced if secretion rate is high, prolonged if rate is low. After 5 minutes, the amount of saliva is measured and the secretion rate calculated as ml/min.

Evaluation of the saliva buffer capacity

Dentobuff Strip is a quick and easy way to determine salivary buffering capacity (Ivoclar-Vivadent CRT Buffer - Caries Risk Test Buffer). An indicator system incorporated in the test strip changes color, clearly showing the buffer capacity of the saliva. In order to assess the pH of saliva, we followed the below steps:

1. Place a Dentobuff test strip, test pad facing up, on an absorbent surface like a paper towel, without touching the test pad.

2. Use the enclosed pipette to apply a drop of stimulated saliva to the test pad, enough to cover the entire pad.

3. After exactly 5-minute reaction time, compare the colour that has developed on the test pad with the Dentobuff Strip Colour Chart

The salivary *Streptococcus mutans* and *Lactobacillus* counts were made with the Ivoclar-Vivadent CRT Bacteria - (Caries Risk Test Bacteria), placing the vial with the sample carrier in an incubator at 37°C for 48 hours and comparing the two colonies (*Streptococcus mutans* and *Lactobacillus*) with the growth model provided by the manufacturer.

The *Cariogram diagram* for each individual was obtained. For each factor, the examiner has to obtain the information from the clinical examination or by performing complementary tests and from the completed questionnaire and dietary record. This information is assigned a value on a scale from 0 to 3 (0 to 2 for some factors) according to predetermined criteria. 0 is the most favourable score and the maximum, 3 (2 in some cases), indicates an unfavourable risk [9]. The variables used in order to obtain the Cariogram and the values assigned to them are shown in *Table 1*. The Cariogram is shown as a pie chart with five sectors, which represent the different groups of factors linked to dental caries.

The Diet sector is based on a combination of content and frequency of intake.

The Bacteria sector is based on a combination of the quantity of plaque and the *Streptococcus mutans* count.

The Susceptibility sector is a combination of exposure to fluoride, saliva secretion and salivary buffer capacity.

The Circumstances sector shows the combination of caries experience and systemic illnesses. The last sector shows the estimated Chance to avoid caries [9, 10, 11].

Table 1. Variables used in Cariogram program

Sector	Variable	Data used	Score
Circumstances	Caries experience	DMFT, DMFS and new caries lesions in the last year	0: DMFT=0 1: good oral health status 2: normal oral health status 3: new caries in the past year
Circumstances	Related disease	Questionnaire on general health	0: No disease 1: Disease/conditions, mild degree (moderate influence on caries) 2: Severe degree, long-lasting (strong influence on caries)
Diet	Diet content	Sugar content of diet (diet questionnaire) and <i>Lactobacillus</i> count	0: Very low fermentable carbohydrate, $\leq 10^3$ colony-forming units (CFU)/ml 1: Low fermentable carbohydrate, noncariogenic diet 10^4 CFU/ml 2: Moderate fermentable carbohydrate content 10^5 CFU/ml 3: High fermentable carbohydrate intake inappropriate diet $\geq 10^6$ CFU/ml
Diet	Diet frequency	Number of intakes/day	0: Maximum three meals/day (including snacks) 1: Maximum five meals/day 2: Maximum seven meals/day 3: More than seven meals/day
Bacteria	Plaque amount	Silness-Löe Plaque Index (PI)	0: Extremely good oral hygiene, PI <0.4 1: Good oral hygiene, PI = 0.4-1.0 2: Less than good oral hygiene, PI=1.1-2.0 3: Poor oral hygiene, PI > 2.0
Bacteria	Streptococcus mutans count	CRT Bacteria (Caries Risk Test) culture	0: Strip mutans class 0 1: Strip mutans class 1 2: Strip mutans class 2 3: Strip mutans class 3
Susceptibility	Fluoridation program	Oral health questionnaire	0: Fluoride toothpaste plus constant use of additional measures 1: Fluoride toothpaste plus infrequently additional F measures 2: Fluoride toothpaste only 3 = Avoiding fluorides, no fluoride
Susceptibility	Saliva secretion - amount	Stimulated saliva	0: Normal saliva secretion, > 1,1ml/min 1: Low, 0.9 - 1.1 ml stimulated saliva/min 2: Low, 0.5- 0.9 ml saliva/min 3: Very low, Xerostomia, <0.5 ml saliva/min
Susceptibility	Saliva buffer capacity	CRT Buffer (Caries Risk Test Buffer)	0: Adequate, Dentobuff blue; Normal or good buffer capacity, Saliva end - pH > 6.0 1: Reduced, Dentobuff green; Less than good buffer capacity, Saliva end- pH 4.5-5.5 2: Low, Dentobuff yellow; Low buffer capacity, Saliva end - pH <4.0

In the present study, a Cariogram chart was drawn up for each of the individuals examined, after collecting the relevant data concerning the cariogram variables, with 1 as the score for Clinical judgement in all cases in order to give a standard value.

The caries risk of each individual who entered this study was expressed as percentages of Chance to avoid caries in the Cariogram model. An example of the Cariogram of one individual is shown in Figure 1.

Results

The mean DMFT was 4.98 (2.98-5.66), with the D component averaging 1.99 (0.74-3.03), M 1.00 (0-3.00) and F 2.37 (1.58-3.96). The mean value for DMFS was 7.28 (4.55-11.36), with the D component averaging 2.25 (0.75-3.75), M 4 (0-8) and F 2.99 (1.31-6.52). The mean value of the plaque index was 1.37 (0.23-1.99) and the mean volume of stimulated saliva was 1.19 ml/min (1.10-1.52). The buffer capacity of the saliva was high in 55% of the sample, medium in 39.9% and low in 5.1%.

The levels of *Streptococcus mutans* and *Lactobacillus* counts are presented in Figure 2

The caries risk obtained in each sector was 8.0% (4.92-9.98) for Diet, 7.65% (4.77-8.02) for Bacteria, 9.35% (6.28-10.11) for Susceptibility and

5.22 (3.44-6.76) for Circumstances.

Overall, the caries risk was 28.88% (19.34-32.29) and the chance to avoid caries 71.12% (67.71-80.66).

The Pearson index was used to study the correlation between the different variables and the risk obtained for each sector (Table 2-5); highly significant correlation was obtained for all the variables except related diseases.

Table 2. Correlations between different variables in the cariogram and the risk from circumstances sector

Variables	Risk From Circumstances
DMFT INDEX	0.603* (0.000)
DMFS INDEX	0.538* (0.002)
Caries experience	0.985* (0.000)
Related diseases	0.021 (0.867)
Pearson correlation coefficient * significance level < 0.01	

Table 3. Correlations between different variables in the cariogram and the risk from diet sector

Variables	Risk From Diet
Diet content	0.534* (0.001)
Diet frequency	0.522* (0.002)
Pearson correlation coefficient * significance level < 0.01	

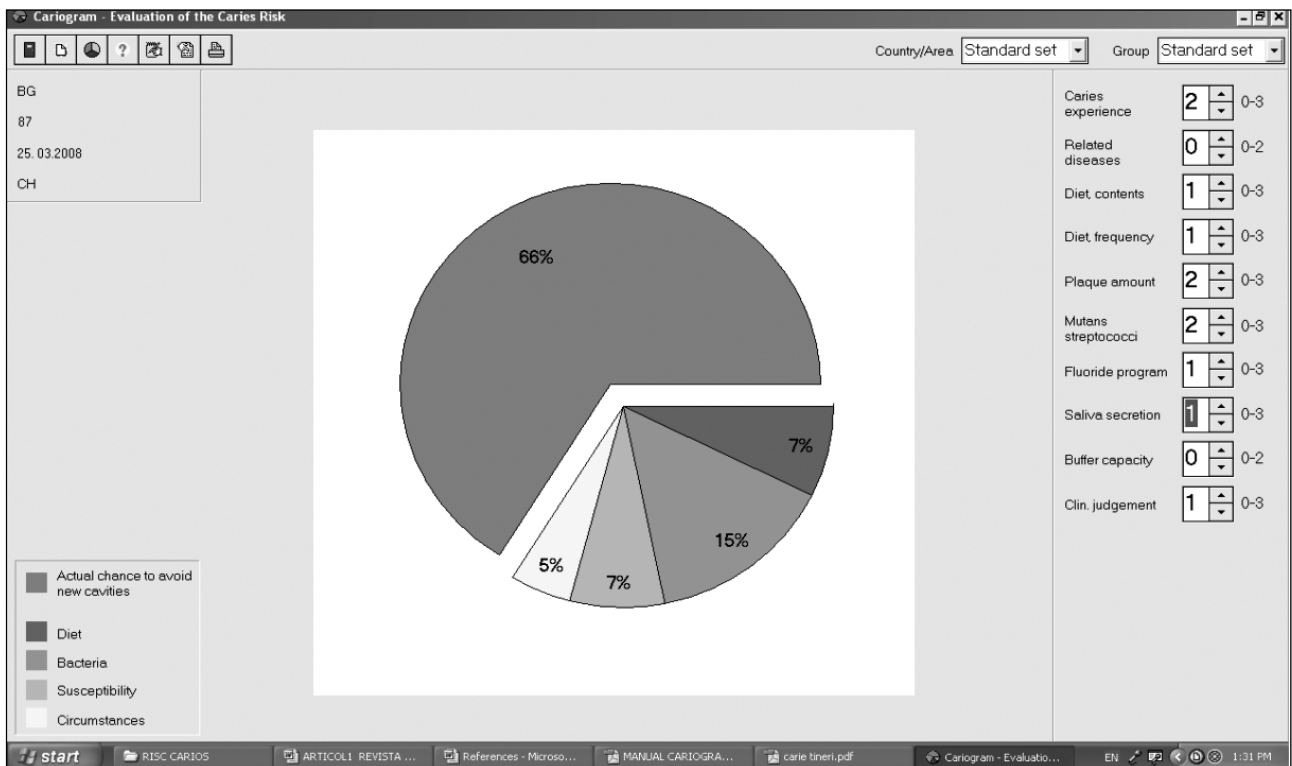


Figure 1. Cariogram caries risk diagram of one of the students in the study group.

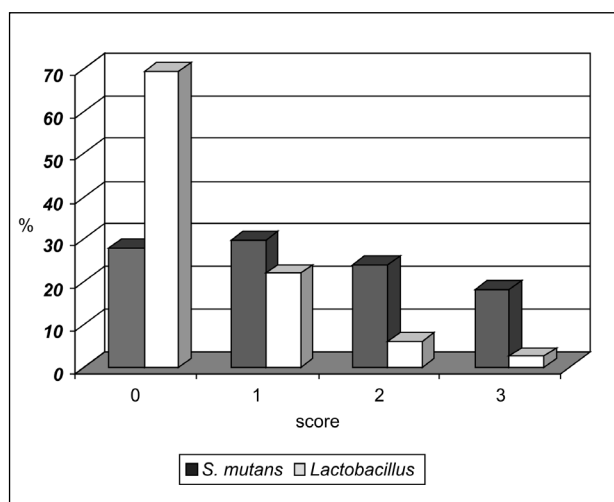


Figure 2. The levels of Streptococcus mutans and Lactobacillus

Table 4. Correlations between different variables in the cariogram and the risk from bacteria sector

Variables	Risk From Bacteria
Dental plaque amount	0.534* (0.001)
<i>S. mutans</i> count	0.953* (0.001)
Plaque index	0.498* (0.000)
Pearson correlation coefficient	
* significance level < 0.01	

Table 5. Correlations between different variables in the cariogram and the risk from susceptibility sector

Variables	Risk From Bacteria
Fluoridation program	0.434* (0.003)
Saliva secretion rate	0.453* (0.001)
Saliva buffer capacity	0.698* (0.000)
Pearson correlation coefficient	
* significance level < 0.01	

Discussion

Cariogram is a new way in which to illustrate the interaction between caries related factors. This educational interactive program has been developed for better understanding of the multifactorial aspects of dental caries and to act as a guide in the attempts to estimate the caries risk. This program can be used in a clinical set up or for various educational purposes.

The main purpose of the Cariogram is to demonstrate the caries risk graphically, expressed as the "Chance to avoid new caries" in the near future. It also illustrates to what extent various factors

affect this Chance. A further purpose of this program is to encourage preventive measures to be introduced before new cavities could develop.

Cariogram – aims

- Illustrates the interaction of caries related factors.
- Illustrates the chance to avoid caries.
- Expresses caries risk graphically.
- Recommends targeted preventive actions.
- Can be used in the clinic.
- Can be used as an educational program.

This program cannot replace the personal and professional judgement of caries risk made by the examiner. However, it may give valuable hints and may even serve as a basis for discussions with the patient regarding various risk factors and preventive strategies. In other words, it does not take over the judgement or the responsibilities of the examiner, but may serve as a valuable tool in the clinical decision-making.

The main objectives of this study was to assess the dentistry students caries risk by means of the Cariogram software and examine the relationships between the caries related factors and the risk of caries determined by this program. In this way we assessed the caries risk of the students during the Community Dentistry lectures in order to evaluate accurately and to discuss the caries risk related factors as target for preventive actions that can be directed to those having a high caries risk, before cavities could develop. Our results are in agreement with those obtained by Miravet and Fontana [12, 13]. Past caries experience, *Streptococcus mutans* counts, fluoridation programme and buffer capacity of the saliva are the main factors included in the Cariogram that showed significant correlation with the caries risk determined by this software. Other variables that the Cariogram does not include directly, such as DMFT, DMFS and the plaque index, also showed high correlation with caries risk.

The factors included in the Cariogram have been given different "weights". This means that the key factors, which support the development of caries, or resist caries, have a stronger impact than the less important factors when the program calculates the "Chance to avoid new cavities". The factors are also weighted in relation to each other. Thus, different factors have different "weights" in different situations and the number of combinations of factors is enormous.

Conclusions

Past caries experience, *Streptococcus mutans* counts, fluoridation programme and buffer capacity of the saliva are the main factors included in the Cariogram that showed significant correlation with the caries risk determined by this software.

Other variables that the Cariogram does not include directly, such as DMFT, DMFS and the

plaque index, also showed high correlation with caries risk.

The Cariogram shows if the patient over all is at high, intermediate or at low risk for caries. It also shows for every individual examined, which etiological factors are considered responsible for the caries risk. The results also indicate where targeted actions to improve the situation will have the best effect.

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