

CARIES RISK ASSESSMENT IN ADULTS WITH HIGHLIGHTS TO NUTRIGENOMICS AND NUTRIGENETICS

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Abstract. Caries risk assessment and caries management by risk assessment cannot be related only to children and their parents' answers. Camra and Cariogram have been working for decades in few countries. Prediction and preventive measures are especially important for young adults (16-25 years old), young professionals (25-35 years old), before pregnancy and during menopause. **Aim.** To develop a card for an easy caries risk assessment with chair-aside questions, clinical examination and salivary tests. To draw up a protocol for patient treatment and follow-up related to the caries risk. **Methodology.** It is based on the data of 1,167 participants in 6 different clinical studies conducted within various research trials, granted programmes and projects during the 30-year period from 1988 to 2018. Prediction of risk can be useful if 4 groups, i.e. low risk, moderate risk, high risk and very high risk groups are evaluated. **Results.** Packages of measures were targeted for each group. Among the important factors were the type, habits and frequency of nutrition, detected with 6 targeted questions, lifestyle hygiene with 5 questions, dental status with 6 parameters (DMFT scores, gingival status, size of teeth, etc.) and oral hygiene. Biochemical patterns of saliva, i.e. salivary flow rate and pH, with and without stimulation were included. Low risk and Moderate risk groups of different ages do not need further tests. High risk and Very high risk groups can be additionally tested with chair-aside tests for *Streptococcus mutans* and *Lactobacilli* counts and oral sucrose clearance for preventive evaluation of dental caries management. The card validation and tests last no longer than 40 minutes, 1 page for a single patient. **Conclusions.** Caries risk in adults can be measured, assessed and predicted in relation to nutrigenomics. Treatment behaviour can be managed and targeted for each patient, according to the group for long, lifetime saving of natural teeth in the mouth. In the last 100 years, concentrated and refined foods have decreased all sizes of the upper first and second incisors as a natural physiological response and a change has been observed in the anatomy of canines, making them stronger via enlargement of their MD sizes. From this current academic year, "Caries risk" is included into our new lecture programme.

Key words: caries risk, nutrigenomics, nutrigenetics, caries risk management

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INTRODUCTION

Caries risk assessment and caries management by risk assessment cannot be related only to children and their parents' answers. Camra and Cariogram have been used for decades in Australia, Sweden and the USA, without being "adopted" in other countries. Prediction and preventive measures are especially important for young adults (16-25 years old), young professionals (25-35 years old), before pregnancy and during menopause. There are no cards designed for a relatively easy caries risk assessment with a chair-aside questionnaire supported by salivary tests. Behavioural variables with age reactions and childhood habits are dominating the risk of dental caries development. For decades in Europe, caries has not been one of the top health problems, although it is still increasing in Eastern Europe. The factors related to caries risk are different in toddlers, teenagers, young and middle aged individuals and elderly patients. The real factors in the management of caries risk are the type of nutrition, DMFT scores, status of gingivae and bones, gum chewing, dental hygiene and the quality of saliva.

The epidemiology of caries and the risk factors for different age groups, young adults (16, 18-25 years old) and young professionals (25-35 years old), have been studied for decades in the Department of Conservative Dentistry at the Faculty of Dental Medicine, MU – Sofia (Table 1).

Nowadays, multifactorial assessment and numerical data are defined as caries risk [1-12]. Only in very few countries this is a part of undergraduate education courses [13-17]. Since the beginning of the 21st century, caries risk assessment has been presented in the form of questionnaires for the parents, with a few dozens of questions (30 to 40), considered by the authors as "easy for filling, accurate and a good verification method". This was accomplished

for few hundred to 1,326 children in the largest published study [18]. The data from the questionnaires for most of the participants were without any test validation. Children's saliva is well-known to be quite flexible and variable as a parameter [5] and therefore, cannot be estimated. Moreover, parents cannot give true answers for the simple reason that they are not 24 hours a day together with their children. The software algorithms Camra and Cariogram [13, 14] are from counties with totally heterogeneous populations, racial mixtures, socio-economic and ethnical differences and varieties. The specificities are related not only to the diet in the EU, the USA and Australia, but to certain major differences in the Balkans and Bulgaria in particular [19]. An example of these is the consumption of meat. In the supermarkets in Australia one can find different types of meat such as crocodile, kangaroo, water snake meat and in Scandinavia, many people have for breakfast and snacks salmon, caviar, trout at least on a weekly basis.

Following the criteria of Prof. J. Featherstone, who has published at least 8 documents about children around 6 years of age, the questions in Cariogram range from 13 to 24, with colour scale, marked salivary flow rate, buffer capacity, plaque, fluoride prevention, *Streptococcus mutans* counts and diet. This is in a contradiction with the "masterclass" of European emeritus professors in the field of biochemistry of saliva: Neil Jenkins, John Eastoe, Ann Cole, J.J. Murray, Andrew Rugg-Gunn, Denis O'Mullane, Mike Edgar.

AIM

The aim of this study was to develop a card for assessment and calculation of caries risk in 4 groups of adults. Packages of dental care measures were targeted for each group according to the data from the card.

Table 1. Papers on caries epidemiology and caries risk from the FDM in Sofia

Author	Year	N	Questionnaire	Biochemistry of saliva	Microbiology of saliva	DMF/T
Boteva Car Res	1993	228	Yes	Yes	No	Yes
Boteva, Karova, Vasileva	2003 2004	254	Yes	No	No	Yes
Karayasheva Boteva Car Res Arch Oral Biol	2005 2015	347	Yes	Yes	Yes	Yes
Boteva Karayasheva Car Res	2016 2018	98	Yes	Yes	No	Yes

MATERIAS AND METHODS

So far, caries risk has been assessed for decades on the basis of the evaluation and validation of 4 groups of individuals aged 16-35 years, with DMF/T scores as follows: Caries free, DMFT-0, Low risk DMFT 1-5, Moderate risk DMFT – 6-10, High risk 11-15, Very high risk 16 and above [2, 4, 5, 7, 8, 9]. The card is based on the data of 1,167 participants in 6 different clinical studies conducted within various research trials, granted programmes and projects during the 30-year period from 1988 to 2018 [1, 2, 4, 5, 6, 8, 9, 11, 12]. Among the major factors are the type, habits and frequency of nutrition. Only 6 targeted questions about nutrition are the most important in all studies in adults. Lifestyle and hygiene are dealt with in 5 questions, dental status data – in 6 parameters (DMFT scores, gingival status, size of teeth, etc.) and oral hygiene. The dental examination is focused on verification of the data from the questionnaire by performing an active interview. Biochemical patterns of saliva are included: salivary flow rate and pH, with and without stimulation with chewing blue articulation pa-

per – original methodology [5]. The sizes of teeth can be easily measured with K files and rulers. The Nutra genomics and the genetic aspect of the card are based on questions on the habits formed in the family: presence of breakfast, hour of evening meals, snacking between meals, hygiene, dental visits, orthodontic care controlled by parents, more than the food products which can be more flexible during lifetime consumption [3, 10]. Many properties and qualities of saliva are also genetically transmitted.

RESULTS

Low risk and Moderate risk groups do not need further tests. High risk and Very high risk groups can be additionally tested with chair-side tests for *Streptococcus mutans* and *Lactobacilli* counts and oral sucrose clearance for preventive evaluation of dental caries management. The card validation lasts no longer than 40 minutes, 1 page for a single patient. The results define 4 groups of individuals at risk:

Table 2. Card for caries risk assessment

CARIES RISK			
NAME	AGE		SEX
Questions, interview	Caries risk		
Number of sugary-starchy snacks between meals	1/24h = 3 2/24 h = 4 > 2/24 h = 5	1/ weekly = 0 2-3 /weekly = 1 5/ weekly = 2	Rarely = 0
Gum chewing	1/24 h = 2	2-3/weekly = 1	Rarely = 0
Time of evening meal	18 h = 1	19 h = 2, 20 h = 3	After 21 p.m. = 4
Morning breakfast	always = 0	weekly = 1, 2	Never = 3
Late evening snacks	always = 2	weekly = 1	Never = 0
Calories watch	Yes = 0	No = 2	
Dental visits on an annual basis	2 annually = 0	1 annually = 1	Rarely = 2, 3
ANAMNESIS AND STATUS			
Chronic diseases	Yes = 2	No = 0	
Weight	Normal weight = 0	Overweight = 1	Underweight = 2-3
Obesity	Grade I-II = 2	Grade III = 3	Grade IV = 4
Smoking	Yes = 2	No = 0	
Orthodontic treatments	Yes = 2	No = 0	
D – decayed teeth	Total: 0 = 0 1-5 = 1	6-10 = 2	11-15 = 3 16-20 = 4
M – missed teeth			
F – filled teeth			
Gingival bleeding	Yes = 1	No = 0	
Gingivitis	Yes = 2	No = 0	
Periodontitis	Yes = 2	No = 0	

Continuation of Table 2

Generalized periodontitis	Yes = 3	No = 0	
Size of teeth	Small = 2	Middle = 1	Large = 0
pH TESTS			
Salivary flow rate ml/min measured at 9-11 a.m.			
Stimulated saliva ml/min measured at 9-11 a.m.			
pH saliva			
pH stimulated saliva			
Brushing teeth/24 h: status and recall	2/24 h = 0	1/24 h = 1	Rarely = 3, 4
Total:			

Groups:

1. Low risk: 3-14
2. Moderate risk: 15-24
3. High risk: 25-45
4. Very high risk: 46+

Protocol:

1. Dental examinations: 1 annually
2. Clinical oral hygiene: 1 annually
3. Keeping regular nutrition without stress and changes
4. Without dietary or calorie monitoring

1. Dental examinations: 2 annually
2. Clinical oral hygiene: 1-2 annually
3. Personal dietary monitoring and calorie calculations
4. Monitoring of body weight
5. F varnishes if indications are present

1. Dental examinations: 3 annually
2. Vegetarians – dietary monitoring, vegan diets and/or high fish consumption
3. Diabetes – calorie count and salivary pH self-control with strips
4. F varnishes and sealants around restorations
5. Seasonal use of F mouth rinses

1. Dental examinations: 4 times a year, every 3 months
2. Vegetarians – dietary monitoring, vegan diets and/or rich in fish diets. Without wholemeal bread and seeds, white bread consumption
3. Diabetes – carbohydrate and alcohol monitoring, control of salivary pH and self-control with pH strips
4. F varnishes and sealants around restorations
5. F mouth rinses for seasonal use
6. High F dentifrices 1 in 2 to 3 years

DISCUSSION

The riskiest groups are targeted starting with the classical young age group of up to 35 and its subgroup, young adults from 16 or 18 to 25 years old, followed by the climax age (45-55) and the menopause groups. Often the measures targeted to individual risks are weak or non-existing for maximising the life of teeth and roots in the mouth for avoiding prosthetic measures as long as possible. For many decades we have been studying the relations between DMFT, nutritional dynamics, carbohydrates type and intake, oral hygiene, pH of saliva in healthy individuals but also in groups with genetically transmitted risk factors and diseases like obesity, diabetes, metabolic syndrome, patients with a dry mouth syndrome, high corrosion potential from long lasting metals in the mouth. Enzymes like alpha amylase, acid and alkaline phosphatase, catalase and peroxidase, calcium and phosphate were studied in the saliva, with the blood levels of fats, cholesterol, triglycerides, urea, calcium, phosphorus, potassium, sodium as well. All studies were targeted to caries risk prevention and risk management [1, 4, 5, 7, 9, 11].

The 6 targeted questions are based on the philosophy of more effective research after the age of 18, before the young adults become parents and focusing not only to their oral health, but on the health of their future children and grandchildren [5, 10, 14]. This addresses the modern trends of sciences like **nutrigenomics and nutrigenetics**. Nutrigenomics is linked to research focused on bonds between nutrition, food and genes in order to prevent health problems and with a personal approach to prevention and treatment of diseases, promoted in the year 2001. It is about the biological response from the body systems to nutrients, their preventive effects and the levels of absorption. Sub links of nutrigenomics are nutrigenetics and epigenetics. The genetic reactions to nutrients and phenotype expressions form the risk for disease development. Types of foods and their quantity which can prevent or treat diseases are in focus.

A classic example is the Mediterranean diet which leads to a much longer duration of life established in many EU countries like Greece, Italy, Spain and France. Protective foods and their ingredients like polyphenols against cancer, coronary heart diseases, neurovegetative and metabolic disorders are well-known and often underestimated or neglected. High levels of lipids have proved to be related to chronic periodontal diseases and multiple apical periodontal bone lesions [3, 12, 16, 19].

The classification of the size of dental crowns can be done with the easiest possible methodology based on the following data shown in Table 3.

Table 3. Sizes of upper front teeth (in mm) of the European population in the 20th and 21st centuries in comparison with measurements dated 100 years ago [5, 20, 21, 22]

TEETH L, MD /mm	WETZEL 1925		BOYANOV 1957		21 CENTURY	
	L	MD	L	MD	L	MD
11, 21	11.6	8.4	10.3	8.3	9.5-10.0	7.5-8.5
12, 22	9.0-10.2	6.5	9.4	6.5	9.0-9.5	5.0-6.0
13, 23	10.9	7.6	10.3	7.4	10.5-11.0	8.5-9.0

The data from our mean measurements during the period 2000-2023 are without significant differences from the teeth of the Frasaco preclinical models:

In clinical conditions, teeth sizes 1 mm smaller than the above presented middle (M) sizes are considered small (S), and these 1 mm bigger than the M sizes are determined as large (L). In the last 100 years concentrated and refined foods have decreased all sizes of the upper first and second incisors as a natural physiological response and a change has been observed in the anatomy of canines, making them stronger via enlargement of their MD sizes.

CONCLUSIONS

Caries risk in adults can be measured, assessed and predicted in relation to nutrigenomics. Treatment behaviour can be managed and targeted to each patient, according to the group for long, lifetime saving of natural teeth in the mouth.

In group 3 and 4 additional chair-aside tests are recommended for *Streptococcus mutans*, *Lactobacilli* in group 3 and *Streptococcus mutans*, *Lactobacilli* and 20% glucose oral clearance with a CH zone for group 4.

In the last 100 years concentrated and refined foods have decreased all sizes of the upper first and second incisors as a natural physiological response and a change has been observed in the anatomy of canines, making them stronger via enlargement of their MD sizes.

Teaching dental students in caries risk assessment can decrease the DMFT scores on a long-term basis.

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