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Caries Risk Assessment in Pregnant Women Using Cariogram

Процена ризика каријеса код трудница употребом Кариограма

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SUMMARY

Introduction/Objective The ''Cariogram'' takes into account the interactions between caries-related factors and expresses a graphic assessment of the caries risk. The aim of this study to evaluate the relationship between caries risk and different variables of Cariogram in pregnant women.

Methods This study included 96 pregnant women. At baseline, data on general health, diet, oral hygiene, and fluoride exposure were obtained. DMFT index were calculated by clinical examination. Saliva analyses included mutans streptococci and lactobacilli counts, buffer capacity, and secretion rate. Scores were entered and caries risk was assessed. The women were divided into 5 groups according to their Cariogram caries risk.

Results The results of the study showed that 29.17% (28) pregnant women had high caries risk, 21.88% (21) – medium, 17.71% (17) – low, 16.67% (16) – very high, and 14.58% (14) – very low caries risk. In an average caries risk profile of pregnant women, the dominant sector was "Bacteria" (18.85% of the risk structure profile) followed by "Diet" (17.97%), "Circumstances" (15.68%) and "Susceptibility" sector (14.65%).

Conclusion The Cariogram shows that pregnant women in Banja Luka, B&H had a 46.14 % chance of avoiding caries in the future.The Cariogram model can successfully determine caries risk profiles for pregnant women.

Keywords: Cariogram; caries risk assessment; mutans streptococci; pregnant women

САЖЕТАК

Увод/Циљ Кариограм програм процењује и графички илуструје ризик каријеса узимајући у обзир интеракцију различитих фактора његовог настанка.

Циљ рада је био да се процени однос ризика каријеса и разних параметара Кариограм програма у трудница.

Методе У студију је укључено 96 трудница. Узети су подаци о општем здрављу, исхрани, оралној хигијени и употреби флуорида. Након клиничког прегледа израчунат је КЕП индекс. Анализом пљувачке добијени су подаци о количини стимулисане пљувачке, пуферском капацитету пљувачке, степену колонизације Streptococcus mutans -а и лацтобацила. Подаци су унети у Кариограм програм и процењен је ризик каријеса. Труднице су подијељене у 5 група по Кариограму.

Резултати Са високим ризиком каријеса је 29.17% (28) трудница, 21.88% (21) – са средњим, 17.71% (17) – ниским, 16.67% (16) – врло високим, а 14.58% (14) – са врло ниским каријес ризиком. У просечном ризику каријеса доминантан сектор је „Бактерије" (18.85%), следе „Исхрана" (17.97%), „Околности" (15.68%) и „Осјетљивост" (14.65%).

Закључак Кариограм програм је показо да су труднице у Бања Луци имале 46.14% "шансе за избјегавање каријеса у будућности". Кариограм модел може успјешно одредити каријес ризик профил за труднице.

Кључне ријечи: Кариограм; процена каријес ризика; Streptococcus mutans; труднице

INTRODUCTION

Caries risk is the probability of a person to develop least certain sign of caries, reaching a given stage of the disease progression for specific period of time, conditional that the exposure to caries risks factors remains unchangeable during that period. Caries management by risk assessment is granted considerable attention [1-4].

In a view of the multifactorial nature of caries etiology and the fact that the course of the disease is determined by permutations and combinations of causal factors [1-4], the challenge is to develop a really effective model for predicting caries risk. The Cariogram®, a computer program, assesses an individual's caries risk profile and illustrates it graphically. Also, Cariogram offers recommendations for targeted preventive measures that should be implemented to avoid the formation of new caries lesions [5-9], Cariogram has been used to assess the caries risk profile of schoolchildren, teenagers [7,10-12], orthodontic [13] and elderly patients [14].

The aim of this study was to assess caries risk in pregnant women in Banja Luka, Bosnia and Herzegovina and to evaluate the contribution of various risk factors among different caries risk groups.

METHODS

The study was conducted as across sectional study on a sample of 96 pregnant women from Banja Luka, Bosnia and Herzegovina. The study sample was randomly selected and included only pregnant women a) who were in last trimester of pregnancy, b) who were without risk in pregnancy, c) who did not have any chronic disease, d) who had not taken antibiotics or other drugs during pregnancy, e) who signed an informed consent to participate in research. The average age of the pregnant women was 27.4 years, ranging between 20 and 42. Ethical approval for the study was obtained from The Research Committee of Faculty of Medicine, University of Banja Luka, Republic of Srpska, Bosnia and Herzegovina. The research has been conducted in full accordance with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This study included questionnaire, interview, clinical examination, saliva sampling, and assess of caries risk using the Cariogram. Each of the patients completed a brief questionnaire on their general health, oral hygiene, dietary behavior, frequency of tooth brushing, the use of fluoridated toothpaste, and mouthwashes.

The clinical examination comprised the DMFT index and oral hygiene status. Clinical examinations were carried out in the morning, between meals by the same examiner following WHO criteria [15]. Clearly visible lesions with cavities on tooth surfaces were classified as dental caries (i.e. d3-level cavities), whereas changes in transparency, initial enamel demineralization with intact surfaces and no cavitations were noted as intact teeth. The teeth were not professionally cleaned and no radiographs were taken. The patients did not take any food or drink (except water), did not wash their teeth, or chew gum at least one hour before the exam and saliva sampling. The plaque index was also evaluated, using Silness and Löe's scale. The plaque was assessed through collection from the vestibular surfaces.

After the clinical examinations the saliva tests (secretion rate, saliva's buffer capacity, lactobacillus and mutans streptococci counts) were performed. All saliva tests were obtained from Orion Diagnostica, Finland and handled according to the instructions of the manufacturer. The patient chewed a sterile paraffin pellet for five minutes. The stimulated saliva was collected in a test tube graduated in milliliters, then the volume of stimulated whole saliva was read off and the result was expressed in mL/min. Buffer capacity was categorized as high, medium or low using a Dentobuff®Strip (Orion Diagnostica, Finland). The salivary *Streptococcus mutans* were made with Dentocult®SM-Strip Mutans (Orion Diagnostica, Finland) placing the vial with the sample carrier in an incubator at 37ºC for 48 hours. For measuring *Lactobacillus* count was used Dentocult LB® (Orion Diagnostica, Finland) placing the vial with the sample carrier in an incubator at 37ºC for 96

hours. The density of colonies (*Streptococcus mutans* and *Lactobacillus)* was compared with a chart provided by the manufacturer.

The data from the clinical examinations and the questionnaire were entered in the Cariogram model. To create an individual risk profile nine factors/variables are required to be entered into the Cariogram (Table 1). The Cariogram calculated the data and presented the result expressed as a pie-

Table 1. Caries related factors/parameters used at baseline for the Cariogram.

Factor	Information and data collected	Cariogram scores
Caries experience	Past caries experience at baseline,including cavities, fillings and missing teeth due to caries	0: caries free 1: better than normal condition for ages 2: normal condition for ages 3: worse than normal condition for ages
Related diseases	General diseases or conditions associated to dental caries; medical history, medications; data from interviews and questionnare results	0: no disease, healthy 1: a general disease which can indirectly influence the caries process to a mild degree 2: a general disease which can indirectly influence the caries process to a high degree
Diet, contents	Lactobacillus counts were used as a measure of cariogenic diet, using Dentocult test	0: $<10^3$ CFU/mL 1: 10^4–10^5 CFU/mL 2: 10^5 CFU/mL 3: $>10^6$ CFU/mL
Diet, frequency	Estimation of number of meals and snacks per day, mean for "normal days"; data from questionnaire results	0: maximum 3 meals per day 1: 4–5 meals per day 2: 6–7 meals per day 3: >7 meals per day
Plaque amount	Estimation of hygiene according to Silness –Löe Plaque Index (PI)	0: PI<0.4 (very good oral hygiene) 1: PI=0.4–1.0 (good oral hygiene) 2: PI=1.1–2.0 (poor oral hygiene) 3: PI>2.0 (very poor oral hygiene)
Mutans streptococci	Estimation of levels of mutans streptococci in saliva, using Strip mutans test (Dentocult)	0: $<10^4$/ml 1: 10^4 – 10^5/ml 2: 10^5 – 10^6/ml 3: $>10^6$/ml
Fluoride programme	Estimation of the extent of fluoride avaible in the oral cavity	0: maximum fluoride programme 1: fluoride supplements 2. only fluoride toothpaste
Saliva secretion	Estimation of flow rate of paraffin-stimulated saliva	0: >0.7 ml/min 1: 0.3–0.7 ml/min 2: <0.3 ml/min
Saliva buffering capacity	Estimation of capacity of saliva to buffer acids, using Dentobuff test	0: pH>5.5 (blue) 1: pH=4.5–5.5 (green) 2: pH<4.5 (yellow)

diagram, illustrating the "Chance of avoiding cavities" in the future. Sectors of the diagram are: "Bacteria" (plaque amount and mutans streptococci level), "Diet" (Lactobacillus level and diet frequency), "Susceptibility" (fluoride program, saliva secretion and saliva buffer capacity) and "Circumstances" (past caries experience and medical history) [16]. The chance to avoid caries was finally grouped in five risk categories: very low risk = 81–100% chance of avoiding caries, low risk = 61–80% chance of avoiding caries, medium risk = 41–60% chance of avoiding caries, high risk = 21–40% chance of avoiding caries, very high risk = 0–20% of avoiding caries.

Statistics

All data were processed with the SPSS software (version 16.0, Chicago Ill., USA). χ^2 test of contingency was used to compare the difference between groups. Parametric ANOVA and Student's t test for independent samples (if the difference variance observed characteristics were not statistically significant) and nonparametric Mann-Whitney test (if the difference in the variance of the observed characteristics statistically significant) were used to compare the mean values of the characteristics. P-values less than 0.05 were considered as statistically significant.

RESULTS

The results of study showed that 16 (16.67%) pregnant women had very high caries risk, 28 (29.17%) - high, 21 (21.88%) – medium, 17 (17.71%) – low, and 14 (14.58%) of subjects had very low caries risk (Table 2).

Table 2. Odds ratio values for the different Cariogram groups in the logistic regression model.

Caries risk assesed by Cariogram	Pregnant women		OR	95% CI	*p*-value
	n	%			
Very high risk	16	16.67	7.7	1.16–51.17	**0.020**
High risk	28	29.17	7.0	1.45–33.70	
Medium risk	21	21.88	4.9	0.99–24.21	
Low risk	17	17.71	1.2	0.25–5.84	
Very low risk (reference value)	14	14.58	1.0		
Σ	96	100.00			

Table 2 shows the odds ratios for the different Cariogram groups. The pregnant women in the low risk group had a risk 1.2 times higher than that of the pregnant women in the very low risk group. In the groups with a medium, high and very high risk, the corresponding values were 4.9, 7.0 and 7.7 times higher, respectively. These results are statistically significant.

In an average caries risk profile of pregnant women, dominant sector was "Bacteria" (data about plaque amount and mutans streptococci level), with 18.85% of the risk structure profile. Then followed "Diet" (data about Lactobacillus level and diet frequency) with 17.97%. "Circumstances" sector (data about caries experience and medical history) was 15.68 % in Cariogram profile and "Susceptibility " sector (data about fluoride program, saliva secretion and buffering capacity) was 14.65 %. In the groups of subjects with high and medium risk, dominant sector was also "Bacteria" with 24.14% and 18.05%, followed by ''Diet'' (20.93%, 15.71%), "Circumstances" (16.79%, 15.19%) and "Susceptibility" (16.61%, 13.52%), respectively. In the group of pregnant women very high risk, dominant sector was "Diet" (31.13%), followed by "Bacteria" (26.88%), "Susceptibility" (21.63%) and "Circumstances" (20.13%). In the groups of subjects with low and very low risk, dominant sector was "Circumstances" (13.71%, 11.50%), than "Diet" (9.18%, 4.14%), "Susceptibility" (9%, 3%) and "Bacteria" (6.94%, 4.50%), respectively (Table 3).

Table 3. The average Cariograms of pregnant women.

Sectors in cariogram	Σ	Very high risk		High risk		Medium risk		Low risk		Very low risk	
		x̄	SD	x̄	SD	x̄	SD	x̄	SD	x̄	SD
Chance to avoid caries	46.14	9.88	2.36	27.86	5.95	46.43	5.13	71.06	5.84	93.43	6.42
		$p<0.05$									
Diet	17.97	31.13	1.71	20.93	5.13	15.71	3.68	9.18	1.47	4.14	1.68
		$p<0.05$ (except low and very low risk)									
Bacteria	18.85	26.88	3.4	24.14	3.01	18.05	3.57	6.94	3.07	4.5	1.29
		$p<0.05$ (except high and very high; and also low and very low risk)									
Susceptibility	14.65	21.63	3.48	16.61	4.67	13.52	2.46	9	2.06	3	0.82
		$p<0.05$ (except high and medium;and also low and very low risk)									
Circumstances	15.68	20.13	0.25	16.79	1.73	15.19	2.52	13.71	1.95	11.5	0.58
		$p<0.05$ (except high and very high; high and medium and also low and very low risk)									

Table 4. Comparison of caries-related factors between groups of pregnant women.

Factor	Score	Risk									
		Very high		High		Medium		Low		Very low	
		n	%	n	%	n	%	n	%	n	%
Caries experience	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	9	34.62	9	34.62	8	30.77
	2	0	0	3	18.75	3	18.75	4	25.00	6	37.50
	3	16	29.63	25	46.30	9	16.67	4	7.41	0	0
	p value	**<0.001**									
Diet, contents	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0	0	13	100.00
	2	0	0	26	41.27	19	30.16	17	26.98	1	1.59
	3	16	80.00	2	10.00	2	10.00	0	0	0	0
	p value	**<0.001**									
Diet, frequency	0	0	0	2	10.53	0	0	12	63.16	5	26.32
	1	0	0	18	35.29	19	37.25	5	9.80	9	17.65
	2	2	16.67	8	66.67	2	16.67	0	0	0	0
	3	14	100.0	0	0	0	0	0	0	0	0
	p value	**<0.001**									
Plaque amount	0	0	0	0	0	0	0	7	38.89	11	61.11
	1	0	0	2	11.76	4	23.53	8	47.06	3	17.65
	2	10	21.28	21	44.68	14	29.79	2	4.26	0	0
	3	6	42.86	5	35.71	3	21.43	0	0	0	0
	p value	<0.001									
Mutans streptococci	0	0	0	0	0	0	0	0	0	5	100.00
	1	0	0	0	0	5	16.13	17	54.84	9	29.03
	2	2	4.55	26	59.09	16	36.36	0	0	0	0
	3	14	87.50	2	12.50	0	0	0	0	0	0
	p value	**<0.001**									
Fluoride programme	0	0	0	0	0	0	0	0	0	0	0
	1	2	8.00	2	8.00	8	32.00	2	8.00	11	44.00
	2	14	20.59	26	38.24	13	19.12	15	22.06	0	0
	p value	**<0.001**									
Saliva secretion	0	12	14.29	25	29.76	19	22.62	14	16.67	14	16.67
	1	4	33.33	3	25.00	2	16.67	3	25.00	0	0
	2	0	0	0	0	0	0	0	0	0	0
	p value	**<0.001**									
Saliva buffering capacity	0	0	0	11	27.50	6	15.00	15	37.50	8	20.00
	1	0	0	9	39.13	7	30.43	1	4.35	6	26.09
	2	16	48.48	8	24.24	8	24.24	1	3.03	0	0
	p value	**<0.001**									

The comparative assessment of study participants based on parameters used in Cariogram model was shown in Table 4. The distribution of the patients within each Cariogram variable was significantly different ($p<0.01$) for all factors considered. Majority of the participants (56.25%) in this study had caries experience worse than normal condition for ages. All participants in group with the very high risk of caries had the highest Lactobacillus count (more than 10^6 CFU/l mL), very high Mutans streptococci count (more than 10^5 CFU/l mL) and more than 6 meals/day. The maximum number of pregnant women with very low caries risk had very good and good oral hygiene ($PI \leq 1.0$). Most of the pregnant women in all groups of risk were exposed to fluoride in the form of toothpastes only. The results show that the most pregnant women (87.5%) had normal amount of saliva secretion (>0.7 ml/min). All pregnant women in the group of very low risk showed saliva secretion less than 0.5 ml. All participants in the group of very high risk had pH salive less than 4.5.

DISCUSSION

The researchers have been looking for the factors such as: host, diet, microflora, past caries history, that would enable them to predict who would develop a carious lesion, for the past decades. The innovation in caries risk assessment has been the development of a computer program called Cariogram which compared caries experience, related general diseases, diet content, diet frequency, amount of plaque, mutans streptoccocci counts, fluoride program, saliva secretion rate, saliva buffering capacity. This program is a prediction and a risk model because it predicts who has a chance to develop the disease, identifies the risk factors and based on that determines the appropriate intervention plan [16].

In previous studies, caries risk was assessed with Cariogram for different individuals of various communities, and different results were reported [12, 13, 17, 18, 19]. There is no data about caries-risk assessments in pregnant women using Cariogram. Also, there is insufficient data about caries-risk assessment in population from Bosnia and Herzegovina. The present study is the first one where the Cariogram has been applied on pregnant women for caries risk assessment.

In the present study, the majority of participants were at high risk of caries according to Cariogram. The number of patients in the very high-caries-risk group was found to be the highest in Swedish elders (55-75 years old) who had histories of multiple drug use and had no access to effective fluoride programs before the 1960s [14]. Another study performed in adults with several dental restorations in Saudi Arabia reported that the majority of participants had a high risk of caries [19]. Gökalp et al. [20] reported that the prevalence rates of caries in children and adult populations in Turkey were high.

On the other hand, the number of patients in a low-caries-risk group was found to be the highest in Spanish dental students (18-19 years old) [17]. Celik et al. [21] reported that the number of Turkish adults (20-21 years old) had medim (33%) or low (24%) caries risk. The studies in Sardinian (7-9

years old) and Swedish (10-11 years old) schoolchildren, also reported the highest number of patients in a low-caries-risk group [12, 22].

According to the 'opinion' of the Cariogram, the Laotian children (12-13 years old) demonstrated significantly higher caries risk than Swedish children. The average „chances of avoiding caries in future" in the groups of Swedish and Laotian children were 69.2% and 37.3%, respectively [23].

The leading sector in pregnant women risk-profile in this study was "Bacteria" (18.85%), then follow the "Diet" (17.97%). The study in Sweden reported the similar results [24]. Comparison of these results with those of Hansel Petersson showed that the leading sectors in Swedish children Cariogram were also "Bacteria" (9%) and "Diet"(8%) [24]. The "Susceptibility" and "Diet" factors (23% and 20% accordingly) ranked first in the group of dental students (18-25 years old) from Minsk, Belarus [25]. The "Bacteria" factor was the most dominant sector for students in Valencia [17].

In this study for all groups of participants, statistically significant correlations were found between the „frequency of food intake" and the risk of caries. If the frequency of food intake was higher, the risk was higher. Even 100% of (pregnant women who consumed more than seven meals/day were in a group of very high risk. Petersson et al. [10] also confirmed that frequency of food intake have a very important role in the risk assessment of Swedish children, especially for a high risk group.

In present study a statistically significant correlation was found between caries risk and concentration of Streptococcus mutans in saliva. The other studies that used Cariogram for risk assessment in Swedish elderly and children aged 10-11 years reported similar results. The largest increase in caries had over 60% of elderly who had more than 10^5 CFU/ml saliva. Even 94.5% of children (aged 10-11 years) who had more than10^5 CFU/ml saliva were at high risk [7, 14]. Günay et al. [26] report that 68.5% of pregnant women and 61.5% of children aged three years in their study had more than 10^5 CFU/ml saliva. According to Kohler et al. [27] 80% of new mothers had more than 10^5 CFU/ml saliva. About 50% of tested pregnant women and young mothers had more than10^6 CFU /ml saliva in research in Finland [28, 29].

CONCLUSION

This study was performed with Cariogram in pregnant women in an effort to overcome a data insufficiency of caries risk assessments in Bosnian populations. The Cariogram shows that pregnant women in Banja Luka, B&H had a high risk of developing new caries lesions, with a 46.14 % chance of avoiding caries in the future. The main risk Cariogram sectors were "Bacteria" and "Diet". The Cariogram model can successfully determine caries risk profiles for pregnant women. Further longitudinal studies in Bosnian populations are needed to assess caries risk in various age and risk groups.

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REFERENCES

1. Brown JP. Developing clinical teaching methods for caries risk assessment: introduction to the topic and its history. J Dent Educ. 1995; 59(10): 928–31.
2. Hausen H. Caries prediction – state of the art. Community Dent Oral Epidemiol. 1997; 25: 87–96.
3. Tinanoff N. Critique of evolving methods for caries risk assessment. J Dent Educ. 1995; 59(10): 980–5.
4. Hausen H, Karkkainen S, Seppä L. Application of the high-risk strategy to control dental caries. Community Dent Oral Epidemiol. 2000; 28: 26–34.
5. Petersson GH, Carlsson P, Bratthall D. Caries risk assessment: a comparison between the computer program "Cariogram", dental students and dental instructors. Eur J Dent Educ. 1998; 2: 184–90.
6. Petersson GH, Bratthall D. Caries risk assessment: a comparison between the computer program "Cariogram", dental hygienists and dentists. Swe Dent J. 2000; 24: 129–37.
7. Petersson GH, Twetman S, Bratthall D. Evaluation of a computer program for caries risk assessment in schoolchildren. Caries Res. 2002; 36: 327–40.
8. Petersson GH. Assessing caries risk using the Cariogram model. Swe Dent J Supp. 2003; 158: 1–65.
9. Twetman S, Petersson GH, Bratthall D. Caries risk assessment as a predictor of metabolic control in young Type I diabetics. Diabet Med. 2005; 22: 312–5.
10. Petersson GH, Isberg PE, Twetman S. Caries risk profiles in schoolchildren over 2 years assessed by Cariogram. Int J Paediatr Dent. 2010; 20: 341–6.
11. Zukanovic A, Kobaslija S, Ganibegovic M. Caries risk assessment in Bosnian children using Cariogram computer model. Int Dent J. 2007; 57: 177–83.
12. Campus G, Cagetti MG, Sacco G, Benedetti G, Strohmenger L, Lingström P. Caries risk profiles in Sardinian schoolchildren using Cariogram. Acta Odontol Scand. 2009; 67: 146–152.
13. Al Mulla AH, Kharsa SA, Kjellberg H, Birkhed D. Caries risk profiles in orthodontic patients at follow-up using Cariogram. Angle Orthod. 2009; 79: 323–30.
14. Petersson GH, Fure S, Bratthall D. Evaluation of a computer-based caries risk assessment program in an elderly group of individuals. Acta Odontol Scand. 2003; 61: 165–70.
15. World Health Organization. Oral Health Surveys. Basic Methods. 4th ed. Geneva: World Health Organization; 1997.
16. Bratthall D, Petersson GH. Cariogram-a multifactorial risk assessment model for a multifactorial disease. Community Dent Oral Epidemiol. 2005; 33: 256–64.
17. Ruiz Miravet A, Montiel Company JM, Almerich Silla JM. Evaluation of caries risk in a young adult population. Med Oral Patol Oral Cir Bucal. 2007; 12: E412–8.
18. Holgerson PL, Twetman S, Steckse'n-Blicks C. Validation of an age-modified caries risk assessment program (Cariogram) in preschool children. Acta Odontol Scand. 2009; 67: 106–12.
19. Sonbul H, Al-Otaibi M, Birkhed D. Risk profile of adults with several dental restorations using the Cariogram model. Acta Odontol Scand. 2008; 66: 351–7.
20. Gökalp SG, Dogan BG, Tekçiçek MT, Berberoglu A, Unlüer S. National survey of oral health status of children and adults in Turkey. Community Dent Health. 2010; 27: 12–7.
21. Celik EU, Gokay N, Ates M. Efficiency of caries risk assessment in young adults using Cariogram. Eur J Dent. 2012; 6: 270–9.
22. Petersson GH, Isberg PE, Twetman S. Caries risk assessment in school children using a reduced Cariogram model without saliva tests. BMC Oral Health. 2010; 19: 5.
23. Tayanin L, Hansel Petersson G, Bratthall D. Caries Risk Profiles of 12-13-Year-old Children in Laos and Sweden. Oral Health Prev Dent. 2005; 3(1): 1–9.
24. Petersson GH, Fure S, Twetman D, Bratthall D. Comparing caries risk factors and caries risk profiles in children and elderly. Assessing Caries risk. Swed Dent J Suppl. 2003; 158: 1–23.
25. Leous P, Tikhonova S. Caries risk assessment in young people based on the „Cariogram". OHDMBSC. 2006; 1(V): 1–7.
26. Günay H, Dmoch-Bockhorn K,Günay Y, Geurtsen W. Effect on caries experience of a long-term preventive program for mothers and children starting during pregnancy. Clin Oral Invest. 1998; 2: 137–42.

27. Köhler B, Andreen I, Jonsson B, Hultquist E. Effect of caries preventive measures on Streptococcus mutans and lactobacilli in selected mothers. Scand J Dent Res. 1982; 90: 102–8.
28. Paunio P, Häkkinen P, Tenovuo J, Niva A, Lumikari M. Dip-slide scores of mutans streptococci and lactobacilli of Finnish mothers in the Turku area, Finland, during the first nursing year. Proc Finn Dent Soc. 1998; 84: 271–7.
29. Roeters FJM, Hoeven JS van der, Burgersdijk RCW, Schaeken MJM. Lactobacilli, mutans streptococci and dental caries: a longitudinal study in 2-year-old children up to the age of 5 years. Caries Res. 1995; 29: 272–9.

