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Assessment of Caries Risk in Children with 'Cariogram'

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Abstract

In this study, the efficacy of Cariogram, to assess or predict caries risk, was evaluated.76 female, 58 male children aged between 10-11 years were included in the study. For each child, pre-examination interview questions, oral examination records and saliva tests were completed. The factors related to caries were included in the scores in the Cariogram. Scores were entered into the computer program and the percentage of each child was defined as the chance to prevent caries. All children were classified by caries risk group. 73 female and 52 male children were re-evaluated two years after the start date and DMFT index was obtained for each child. The DMFT index was compared to the percentile of caries-protection chances determined by Cariogram. Descriptive statistics were calculated. The DMFT index is used to mark the 'high risk' and 'standard set' sections in the three risk groups which are determined as 1-25%, 26-75% and 76+% by the current account and in the sub-headings of the 'Country/region' section in the Cariogram and the difference in DMFT index in the caries risk groups determined by the Cariograms was found to be different when the 'high risk' and 'standard set' sections were marked, whereas this difference was not statistically significant (p> 0.05) none of the related factors were associated with an increase in DMFT index (p> 0.05). The difference between the caries risk groups after two years reveals that the efficiency of Cariogram is controversial in term of caries risk.

1. Introduction

The global target for oral health in 1981 was determined by the World Health Organization (WHO) as not having more than 3 DMFT for 12 years and not more than 1.74 in 2001 and not more than 1.61 in 2004. Turkey has been found to be reached with World Health Organization's target of 2.7 to DMFT index for the year 2000 according to the results obtained from the first studies have been carried out in conjunction with the World Health Organization in 1988. The World Health Organization’s European Region has been determined that the form to be 2 DMFT target of 2010 for 12 years with 1.9 DMFT index in Turkey in 2004, achieving this goal. World Health Organization, World Dental Association and the International Oral and Dental Health Association, the 2020 target in the European Region is that the DMFT for 12 year olds should not be more than 1.5 and for the 2025 target, it should not be more than 1 for 12 years old (T.C. Sağlık Bakanlığı Tedavi Hizmetleri Genel Müdürlüğü. 2006; WHO: Oral health country/area profile [online], 2019).

It is stated that it is very important to determine or predict the risk of caries to be able to benefit from basic health services in terms of dental caries, but there has not been a complete success although many studies have been carried out on this subject (T.C. Sağlık Bakanlığı Tedavi Hizmetleri Genel Müdürlüğü, 2006).

The prediction of caries risk is to evaluate individual patient risk, to determine the main factors involved in caries, and to suggest specific preventive measures for individual needs (Reich, Lussi, Newbrun, 1999). Caries risk assessment (CRA) is the process of establishing the probability of an individual patient, or groups of children, developing carious lesions over a certain time period or the likelihood that there will be a change in size or activity of lesions already present (Twetman, 2016). The caries prevalence rate of children in primary and permanent teeth in Turkey is known to be between 33.94 % and 86-87 % (Eronat & Koparal 1997; Gülhan, Akıncı, Uz, 1991; Kulak-Özkan, Ozkan, Kazazoğlu, Arikan, 2001; Özer, Bilgin, Özalp, Sarı, 2003).

It has been shown that information about caries formation of individuals can be obtained with Cariogram which entered the literature recently (Kulak-Özkan et al., 2001). It is reported that the Cariogram shows the individual risk and resistance factors developed to show the interaction between caries-related factors, and different from other caries risk assessment methods from this point of view (Alian, MacNally, Fure, Birkhed, 2006; Bratthall & Petersson, 2005; Bratthall, Petersson, Sternsward, 2019; Petersson, Twetman, Bratthall, 2002; Petersson & Bratthall, 2000; Petersson, 2003; Petersson, Fure, Bratthall, 2003; Petersson, 2004).

The aim of this study is to determine the risk of caries risk in a group of 10-11 years old children using Cariogram, and to evaluate the effectiveness of Cariogram in this subject by comparing the information obtained with the same children after two years.

2. Materials and Methods

1.Determination of caries risk

A total of 134 children, 76 female, 58 male, were enrolled in the study. The children were randomly selected from 4th and 5th grade students in a primary

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school in Ankara. The criteria for inclusion of children in the study were determined as the lack of antibiotics in the last two weeks and the absence of antibacterial mouthwashes in the last 12 hours, the absence of any acute intraoral infection or systemic disease (Bratthall et al.,, 2019). The study was approved by the Ethics Committee of Gazi University Medical Faculty. After the necessary information was given to the children and their families, an informed consent was signed.

a.Collection of data

The questionnaire forms used in the studies conducted on similar subjects were evaluated and a questionnaire including pre-interview interview questions, examination records and saliva tests sections were prepared (Form 1)(Petersson, 2003).

For 3 weeks, children were taken to the interview room one hour after the start of the school at 2-day intervals and the questionnaire was completed for each child. In accordance with Form 1, pre-interview interview questions were recorded. The initial current caries status in the examination records were recorded using visual inspection method in accordance with World Health Organization criteria (WHO: Oral health country/area profile [online], 2019). In order to determine the current caries status at baseline, the standard chart, which is routinely used at the Gazi University Faculty of Dentistry Pediatric Clinic, was prepared according to the recommendations of the World Health Organization for epidemiological field studies.

In accordance with Bratthal et al. recommendations, oral hygiene was evaluated by using visual examination (Bratthall & Petersson, 2005). Saliva tests were evaluated according to Form 1. Children were chewed with paraffin for 30 seconds followed by spitting, chewing for 5 minutes, and then spitting them into a sterile plastic cup when saliva was deposited. Thus, salivary flow rate, buffering capacity and bacterial count were determined according to the following criteria.

Saliva Flow Rate:

After 5 minutes, the amount of saliva was measured and divided into 5 and the stimulated saliva flow rate was determined by calculating how many milliliters of saliva flow rate per minute.

Saliva Buffering Capacity:

A portion of the saliva sample obtained to determine saliva buffering capacity was tested with the 'Caries Risk Test (CRT) buffer' kit (Ivoclar Vivadent AG, FL-9494 Schaan / Liechtenstein) (Figure 1).

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Form 1. Qestionnaire form.

Interview Questions			
Name: Surname: Date: Age: Telephone Number: Gender:	Frequency of dietary intake: 0: up to 3 meals a day 1: 4-5 meals a day 2: 6-7 meals a day 3: > 7 meals a day	Are additional fluoride treatments performed? 0:maximum flourid program 1: flouride products 2: only flourid toothpaste 3: no intake of flouride	Related diseases: 0: healthy 1: disease have less effect on caries 2: disease have more effect on caries
Is sugar consumed?	How many times a day are brushed teeth?	Which toothpaste is used (in terms of fluoride content)?	
Examination Records			
Current caries status:			

STATUS(S)		TREATMENT(T)
Permanent tooth	Primary tooth	
0=healthy	A	0=no
1=caries	B	1=fissure sealant
2=filling and no caries	C	2= single faced amalgam filling
3= filling and caries	D	3= Two / three faced amalgam filling
4=missing due to caries	E	4=crown
5= missig due to any other reason		5=bridge
6=fissure sealant	F	6=pulp treatment
7=crown/bridge	G	7=extraction
8=untreated tooth		8=other treatment
9=elongated tooth		

T														
S														
			55	54	53	52	51	61	62	63	64	65		
	17	16	15	14	13	12	11	21	22	23	24	25	26	27
	47	46	45	44	43	42	41	31	32	33	34	35	36	37
			85	84	83	82	81	71	72	73	74	75		
T														
S														

Amount of plaque: 0: very good oral hygiene, 1: good oral hygiene, 2: poor oral hygiene, 3: oral hygiene is very poor			
Saliva Tests			
Saliva flow rate: 0:>0.7 ml / min 1:0.3-0.7 ml / min 2:<0.3 ml / min	Saliva buffering capacity: 0:pH>6.0 ‘high’(blue) 1:pH=4.5-5.5 ‘moderate’ (green) 2:pH <4.0 ‘low’ (yellow)	Number of S. mutans in saliva: 0:<105 CFU/ml 1:<105 CFU/ml 2:≥105 CFU/ml 3:≥10 5 CFU/ml	Number of Lactobacillus in saliva: 0:<105 CFU/ml 1:<105 CFU/ml 2:≥105 CFU/ml 3:≥105 CFU/ml

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Figure 1. ‘CRT buffer’ kit (Ivoclar Vivadent AG, FL-9494 Schaan/Liechtenstein)

The saliva samples obtained were placed on the test strip via sterile pipettes. The saliva buffering capacity for each child was determined by comparing with the sample color scale (Figure 2) contained in the 'CRT buffer' kit observed in the test strip.

Figure 2. 'CRT buffer' included in the kit (Ivoclar Vivadent AG, FL-9494 Schaan/Liechtenstein)

Saliva Bacteria Tests:

The remaining saliva sample was sown in the 'CRT bacteria' kit (Ivoclar Vivadent AG, FL-9494 Schaan / Liechtenstein) (Figure 3) to detect the number of the saliva *S. mutans* and *Lactobacillus*.

Figure 3. 'CRT bacteria' kit (Ivoclar Vivadent AG, FL-9494 Schaan/Liechtenstein), agar surface, carrier and test tube

The agar was placed in the carrier test tube and the name of the child on each tube and the date of preparation of the tube for testing were written. The test tube was placed in a CRT incubator (Ivoclar Vivadent AG, FL-9494 Schaan / Liechtenstein) (Figure 4) within 1 hour and incubated at 37°C for 48 hours.

Figure 4. CRT Incubator (Ivoclar Vivadent AG, FL-9494 Schaan/Liechtenstein)

Following the incubation, according to the manufacturer's recommendations, the density of *S. mutans* and *Lactobacillus* was maintained by sloping agar carriers under appropriate light conditions and the agar surfaces were compared with the images in the model table and the

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results were recorded in the questionnaire forms (Figure 5).

Figure 5. Model comparing the density of *S. mutans* and *Lactobacilli*

Use of Cariogram

The use of the Cariogram was performed in accordance with the recommendations of Bratthall et [10], the factors associated with caries were scored between 0-2 and 0-3 in accordance with the criteria given in Table 1, and the factors related to caries in the Cariogram were recorded in the score. In the 'Group' section of Cariogram, the 'clinical decision' was marked for all children. In the ‘Country / Region’ section, ‘standard set 'marking and ‘high risk' marking were performed.After all the data was entered in the computer program, the results of the calculations of the computer program were obtained by pressing the enter key. Thus, by the program, the percentage of chances of caries prevention for each child was determined and all children were classified according to the caries risk groups, which were 1-25%, 26-75% and 76+%, which were determined by Cariogram.

b. Evaluation of the current situation

The children to evaluate the current situation were re-called 2 years after and DMFT index was obtained for each child. 5 of the children were moved from the region and 4 of them changed their schools. A total of 9 children were excluded from the study, and the remaining 73 girls and 52 boys were evaluated with DMFT index and a group was formed to compare them with the caries risk groups that were determined by Cariogram.

c. Evaluation and analysis of Cariogram

Descriptive statistics were calculated after the data were transferred to the computer. For qualitative data, percentage and mean and standard deviation values for numerical data were calculated. Chi-square test was used to examine the relationship between two qualitative variables. In the case of multi-eyed tables, Fisher's exact chi-square test was generalized to multi-eyed tables when the expected frequency less than 5 eyes had more than 20% of the total number of eyes. According to the risk grouping, the difference between the DMFT averages was examined by one way variance analysis. Bilateral comparisons were performed by Duncan test when the difference between the groups was significant. $p < 0.05$ was considered statistically significant.

Results

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The percentage distribution of the factors related to the caries obtained from the surveys according to Cariogram is given in Table I.

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Table I. Percentage distribution of caries related factors according to Cariogram scores (n=134)

Caries related factors	Cariogram Scors			
	0	1	2	3
Current caries status	29.1	6.7	19.4	44.8
Related diseases	100			
Diet content	23.9	21.6	28.4	26.1
Frequency of dietary intake	29.1	60.4	9.0	1.5
Amount of plaque	26.9	38.1	22.4	12.7
Mutans Streptococci	11.2	26.9	29.9	32.1
Fluoride Programme			83.6	16.4
Salivary flow rate	55.2	30.6	14.2	
Salivary buffering capacity	73.9	17.9	8.2	
Clinical decision			100	

For each child, when the 'high risk' and 'standard set' sections are marked, the initial DMFT index of the percentage of the percentages of the caries to be in the range of 1-25%, 26-75%, and 76 +%, according to the three risk groups; a comparative evaluation of the DMFT index and the increase in DMFT index within two years are presented in Tables II, III.

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Tables II. Evaluation of DMFT index according to caries risk groups determined by Cariogram when 'High risk' section is checked.

		Average	Standard deviation		P value
First DMFT	**1-25**	3.38	1.753		0.000
	26-75	1.79	1.974		
	76+	0.00	0.000		
	Total	2.41	2.064		
Two years later DMFT	**1-25**	4.49	2.248		0.000
	26-75	3.02	2.685		
	76+	1.91	2.256		
	Total	3.64	2.582		
DMFT increase	**1-25**	1.11	1.517		0.352
	26-75	1.22	1.705		
	76+	1.90	2.256		
	Total	1.23	1.671		

Table III. Evaluation of DMFT index according to caries risk groups determined by Cariogram when 'Standard set' section is checked.

		Average	Standard deviation	P value
First DMFT	**1-25**	3.40	1.790	0.000
	26-75	2.09	1.976	
	76+	0.00	0.000	
	Total	2.41	2.064	
Two years later DMFT	**1-25**	4.60	2.273	0.000
	26-75	3.22	2.609	
	76+	1.71	2.128	
	Total	3.64	2.582	
DMFT increase	**1-25**	1.21	1.585	0.510
	26-75	1.13	1.638	
	76+	1.71	2.128	
	Total	1.23	1.671	

In order to determine the efficacy of each of the factors associated with caries in determining the risk of caries, different from Cariogram weighted calculations, the evaluation of the relationship of these factors with the increase in DMFT indices after two years is presented in Table IV.

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Table IV. Effect of caries related factors on DMFT index.

Caries related factors	X^2*	P
Current caries status		0.984
Related diseases		
Diet content	1.744	0.627
Frequency of dietary intake		0.311
Amount of plaque	1.348	0.718
Mutans Streptococci	1.044	0.791
Fluoride programme	0.194	0.660
Salivary flow rate	0.901	0.637
Salivary buffering capacity	2.996	0.224
Clinical decision		

When the data obtained were evaluated, it was determined that DMFT indexes increased at the end of two years in the three high risk groups and the "high risk" and "standard set" sections in Cariogram and the differences in the results were not statistically significant in any group (p>0,05). None of the factors associated with caries were associated with an increase in DMFT index after two years (p>0,05).

In the light of all this information, it was found that the values of caries risk group determined by Cariogram for the children included in the study and the values of the current situation after two years differed.

Discussion

Despite the fact that the etiological factors involved in decay formation during the last century and the beginning of the 21st century have been established, it is stated that the success in predicting the risk of caries is not 100% (Bratthall & Petersson, 2005; Bratthall et al., 2019; Petersson et al., 2002; Petersson et al., 2003; Andersson, 2002; Anusavice, 2001; Axelsson, 2000; Haussen, 1997; Powell, 1998; Mueller, 2003). The determination of the individual caries risk is predicted to be very important for the selection of the most suitable treatment cure to be used in the diagnosis, prevention and treatment of caries (Mueller, 2003; Ratio, Pienihakkinen, Scheinin, 1996; Masser, 2000). It is stated that the development of strategies for the determination of individuals with high caries risk in children and adolescents and the development of strategies for the transition of these individuals to low risk group can be realized (Reich et al., 1999; Masser, 2000; Rethman, 2000). Fluoride applications, anti-bacterial treatment agents, pit and fissure sealant applications and nutritional recommendations have been shown to be highly effective in preventing caries, but controversy continues on the benefit of applying these methods to each patient (Anusavice, 2001; Ratio et al., 1996; Haussen, Karkkainen, Seppa, 2000; Tinanof, 1995). It is stated that the contents of the protective applications and the frequency of application should be made according to the

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needs of the individual (Anusavice, 2001; Tinanof, 1995; Disney, Bohannan, Klein, Bell, 1990). The basis of this approach is the evidence-based practice that has emerged in all medical fields in recent years and emphasizes the understanding that patients should receive the best treatment in the most economical way (American Dental Council on Scientific Affairs, 2006; Atabek, Sillelioğlu, Çinar, Ölmez, 2015).

Caries is a chronic and multifactorial disease caused by a series of events over a long period of time, which is not a result of a single factor like a classic infectious disease, but four main factors, host, plaque, diet and time, play a role (Bratthall & Petersson, 2005; Haussen, 2004; Atabek et al. 2015; Powell, 1998; Twetman & Garcia-Godoy, 2004). Traditionally, studies on multifactorial caries risk identification have focused on the evaluation of biological factors, socio-demographic factors, and clinical factors, and have considered the presence of cavitation in caries lesion as a result variable (Petersson, 2003; Haussen, 1997; Disney et al., 1992; Pitts & Stamm, 2004). In this regard, Bratthall and Petersson suggested that the factors used in the prediction of caries risk could be classified as current caries status, socio-economic factors and biological factors (Bratthall & Petersson, 2005; Petersson & Bratthall, 2000; Petersson et al., 2003). Several scientific studies have investigated various predominant factors in terms of caries risk, and these factors are thought to be clinical signs of caries risk. Studies have not fully agreed on which factors are effective in determining the risk of caries. Therefore, a universal model could not be reached and it was stated that more studies were needed for the models to be used for routine use (Brunton, 2002; Stamm et al., 1991; Steward & Stamm, 1991; Wandera, Bhakta, Barker, 2000).

Cariogram, which was developed in order to understand the interaction of various factors, is considered as a prediction model in terms of predicting which individuals will be in the risk group and a risk model in terms of making treatment plan (Almosa, Lundgren, Al-Mulla, Birkhed, Kjellberg, 2018; Çelik, Gokay, Ates, 2012; Di Pierro, Zanvit, Nobili, Risso, Fornaini, 2015; Dou, Luo, Fu, Tang, Gao, Yang, 2018; Garg et al., 2018; Hayes, Da Mata, McKenna, Burke, Allen, 2017; Karabekiroğlu & Ünlü, 2017; Kim, Choi, Choi, Kim, 2018; Naik et al., 2018; Öter, Ulukapı, Topçuoğlu, Çıldır, 2011; Petersson et al. 2017; Sen et al. 2019; Sen et al., 2019; Sudhir, Kanupuru, Nusrath, Embeti, Chaitra, 2017). It is stated that each factor in the Cariogram is based on the data of many studies and it is important to determine whether the program is suitable for real life. Although it is accepted that multi-factor models are beneficial for a country or society, it is reported that the same models may be less useful for other countries and societies (Petersson, 2003). As well some studies state that there are limitations in this respect (Birpou, Agouropoulos, Twetman,

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Kavvadia, 2019; Cagetti et al., 2018; Christian et al., 2018; Leal, 2018). In a 3-year study by Petersson and Twetman, in a group of young adults living in Sweden in 2015, Cariogram did not perform well from the caries risk assessment plan based on past caries experience and progression in young adults (Petersson & Twetman, 2015). In parallel with the studies in which there are limitations in the assessment and prediction of caries risk, Cariogram was not effective in predicting caries in Turkish children.

The Cariogram was first introduced in the Swedish version, then translated into several languages for use in different countries and the model is reported to be universal. It is stated that the important point here is to assess whether it is suitable for other societies (Bratthall & Petersson; 2005; Bratthall et al., 2019). It has been reported that the weighted assessment used in assessing individual factors may be different in different countries. It is stated that this means that the user of the program should be prepared for unexpected results. At this point, the clinical judgement of the physician turns out to be a very important factor. The clinical judgement score is automatically set to 1 in the Carogram. If the clinical decision is to be given a score other than 1, it is recommended that all other scores be entered into the program and the result of the Cariogram is shown. In the presence of a positive score of 0 than a normal score of 1, a score of 2 may be given in the presence of a negative score of more than a normal score of 1, it is not appropriate to give a score of 3, and should not use the Cariogram if it is considered to be given. It is stated that score 3 means rejecting the decision of Cariogram (Bratthall et al., 2019). It is stated that this approach, which is called clinical decision, is not an exact science with formulas, but rather a clinical situation based on inferential reasons (Andersson, 2002; American Dental Council on Scientific Affairs, 2006). In their study, Petersson et al. asked patients about the clinical decision (Petersson et al., 2002). Based on this question, it was taken into consideration in the questionnaire fom that the sugar in the pre-examination interview questions section of our study was consumed, how many times a day was brushed and which dentist was used in terms of fluoride content could be important for the clinical decision. In the light of the information obtained from the questionnaire and Cariogram's information on clinical decision scoring, the clinical decision score was entered as 2 for all patients.

It is stated that diet is one of the key factors that play a role in caries formation and affects caries lesion in different ways (Reich et al., 1999; Andersson, 2002; Malmö University, Faculty of Odontology, Department Cariology [online], 2019). The frequency of dietary intake was analyzed by interview method. The reason why this method is preferred is that it can be obtained more reliable results according to the survey method and it is simpler and more

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ergonomic than the 3-day diet registration method.

The use of microbial tests in prediction of caries risk has been known since the 1940s (Alaluusua, Sovalainen, Tuompo, Grönroos, 1984; Gabris et al., 1999). It has been stated that saliva tests have become increasingly popular in recent years in relation to determining the present caries status and caries risk (Gabris et al., 1999). In many studies evaluating the effectiveness of the Cariogram, it is stated that Strip Mutans test is used for S. mutans count and Dentocult LB test is used for Lactobacilli count, but microbial saliva tests that are equivalent to these tests can be used (Alian et al., 2006; Petersson, 2003; Petersson et al., 2003). It has been reported that other microbiological tests are not as sensitive as bacteria tests in determining the risk of caries (Haussen, 2004; Alaluusua, Kleemola-Kajula, Grönroos, Evalahti, 1990; Bowden, 1997). In the study, one of the clinical caries tests, the selected culture medium and the number of S. mutans and Lactobacilli in the saliva to detect the number of simultaneous test 'CRT bacteria' kit was used.

It is known that salivary flow rate varies considerably among individuals and is a factor that must be repeated and tested in the same individual in order to make accurate detection and that the stimulated salivary flow rate is generally evaluated in terms of caries risk (American Dental Council on Scientific Affairs, 2006). As conventional information, the stimulated saliva flow rate is 1-3 mL / min. reported (Axelsson, 2000; Haussen, 2004; Powell, 1998). In their study, Bratthal et al. evaluated the efficacy of Cariogram in children and classified the salivary flow rate as <0.3 mL / min., 0.3-0.7 mL / min., and> 0.7 mL / min. and performed the scoring according to these values. In the study, these values were taken as a basis for compliance with children (Bratthall et al., 2019).

It is known that salivary buffering capacity is one of the best indicators of caries risk indicating host response and pH at low buffering capacity is 3 and 0.6 at high buffering capacity. Bratthal et al. stated that they measured salivary buffering capacity with Dentobuff test, but caries tests could be used for the same purpose in the clinic (Bratthall et al., 2019). Based on this, one of the clinical caries tests, ‘CRT buffer’, was used in the study.

Bacterial plaque is known to be an important factor in caries formation (Haussen, 2004; Kidd, 1999; Saemundsson, 1997). Therefore, it is stated that it is among the factors related to caries in the Cariogram (Petersson & Bratthall, 2000). In this study, the amount of plaque was determined by visual inspection method.

The importance of fluoride applications to prevent caries is a known fact (Haussen, 2004, Axelsson, 1999; Graves et al., 1991;

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Karjalainen, Eriksson, Ruokola, 1994). Among the factors related to caries of the Cariogram, in the fluoride program section; The maximum fluoride program, although not frequent, includes additional fluoride applications, only fluoride toothpaste, and no fluoride intake (Petersson et al., 2003). It was observed that none of the children included in the study were included in the maximum fluoride program and, although not frequent, additional fluoride applications scoring.

Since it is designed for universal use, it is known that all factors other than general health and caries experience, which do not include social factors in the Cariogram, are universally acceptable biological factors due to their direct possible relationship with the tooth surface (Bratthall & Petersson, 2005; Petersson et al., 2002). Although Cariogram use is thought to have been designed in accordance with universal validity, though not being in Turkey in the light of the findings obtained in this study may be due to regional and national factors. Therefore, it should be considered that it would be beneficial to develop a new caries risk prediction model that will be created by adding risk factors including the regional conditions.

It is known that in the epidemiological field studies, the index of decayed / missing / filling DMF teeth and surfaces has traditionally been used to determine the caries status, it is not this ratio or percentage, it does not indicate caries occurrence in a population and it shows the total caries experience in the person (Bratthall et al., 2019; Alanen, 1991). It is stated that DMFT index shows decayed / missing / filling teeth and it is a practical method for calculating caries, especially when going to a large number of samples to collect comparative data (T.C. Sağlık Bakanlığı Tedavi Hizmetleri Genel Müdürlüğü, 2006). In this study, the visual inspection method was used to determine DMFT index in accordance with World Health Organization criteria (WHO: Oral health country/area profile [online], 2019). In this study, which was planned as a field study, DMFT index was used to determine the present caries status of children at the beginning and two years. The scores of the initial DMFT index were calculated based on the 2 scores determined for our country in the 12-year age group (T.C. Sağlık Bakanlığı Tedavi Hizmetleri Genel Müdürlüğü, 2006). Since the study was a field study, no treatment was given to the children for two years.

What are universally accepted standards for caries diagnosis and which is the best method for caries diagnosis is still a matter of debate (Reich et al., 1999). Although the general view is to accept histological evaluation as the gold standard, it is known that this method cannot be used in epidemiological studies because this method needs to be extracted (Bloemendal & de Vet , Bouter, 2004; Hintze & Wanzel, 2003). It is accepted that it should be used as an adjunct to

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the visual examination method because of the difficulty in using advanced caries diagnosis methods and taking time, as well as only the amount of mineral loss in the tooth can be determined (Haussen, 2004; Twetman & Garcia-Godoy, 2004). Epidemiological studies have traditionally used the clinical examination method reported by the World Health Organization in 1997 (WHO: Oral health country/area profile [online], 2019).

Bratthall et al. set the marking of the 'Country / region' section of the Cariogram's recommendations for use as the 'standard set' for developed countries where drinking water is fluoridated (Bratthall et al., 2019). Considering that Turkey is a developing country and that drinking water is not fluoridized, it is planned to mark this section as 'high risk'. In order to evaluate the effect of this marking on the results, a standard set marking was also performed and the results were compared. There was no statistically significant difference between the two markings in terms of results.

It is stated that the targeted age group is very important in developing and using caries risk determination models (Powell, 1998). The age groups 12, 15, 35-44, 65-74 recommended by the World Health Organization for the determination of the research sample are listed (WHO: Oral health country/area profile [online], 2019). In this study, children between 10-11 years of age were included in the study due to their close proximity to 12 age groups.

In the general medical literature, when the risk models are considered, it is known that the number is quite high, and very few studies have been carried out to develop a complex and practical risk model for caries. According to Bratthall et al., this is because it is difficult to calculate specificity and sensitivity values in multifactorial diseases such as caries (Bratthall et al., 2019). Kingman recommends the sum of specificity and sensitivity to be 160% for a caries risk model to be accepted correctly (Kingman, 1990). It has been reported that none of the risk factors and models used in the determination of caries risk has a recommended specificity and sensitivity of 160%. In studies performed to determine caries risk, specificity and sensitivity values are not calculated in the Cariogram because the cut-off point for specificity and sensitivity is to determine the number of cavitations that will occur within a certain period of time and no model can give this number (Bratthall et al., 2019).

Conclusion

When the results of this study are evaluated, the difference between the caries risk group determined by Cariogram and the children's current status after two years shows that it is possible to discuss the effectiveness of Cariogram in assasing or predicting caries risk. Caries risk assessment in determining the

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weighted results of the study suggest that it may be different for Turkey. It is seen that there is a need for studies on multi-factor models that make weighted assessments where country specific caries risk assessment can be done.

As a result of classification of all children included in the study according to caries risk groups by using Cariogram, DMFT index increased in all risk groups after two years.

When both risk sections were marked as 'high risk' and 'standard set' from the sub-headings of the 'country / region' section, it was determined that the DMFT index increased two years later in children.

It was determined that the increase in DMFT index after two years in children was not statistically significant in terms of marking all risk groups and both risk section (p>0,05).

It was determined that none of the caries-related factors determined by the Cariogram were related to the increase in DMFT index after two years in children (p>0,05).

No statistically significant difference was found when the current risk of caries risk groups determined by Cariogram and all children after two years were compared.

Conflicts of interest

The author declares no conflicts of interest related to this study

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