

Occlusal caries risk assessment using cariogram analysis in student aged 11-12 years

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ABSTRACT

Introduction: Basic Health Research 2013 showed Dental Caries Index in school age student in West Java was lower than the expected target, with occlusal surface as most affected part. The purpose of this study was to determine the risk status of dental caries in school age student by using cariogram analysis. **Methods:** Observational research study was conducted on 30 student aged 11-12 years with caries high risk on occlusal surfaces. Purposive sampling was taken from students of SDN Cikawari and SDN Mekarjaya Bandung Regency with high DMF-S index. Inclusion criteria: male and female, aged 11-12 years, good systemic health, SDN Mekarjaya and SDN Cikawari Bandung Regency students. Exclusion criteria: suffering from systemic disorder, currently in long-term antibiotic therapy, and orthodontic appliance usage. Case history, eating habits, intake of fluoride, caries experience, salivary volume, and buffering capacity of each sample was examined using cariogram examination method. **Results:** The cariogram analysis showed 43% chance of caries avoidance. Diet control was 23.3%, includes two factors: sugary foods and eating frequency. Bacteria control was 11.9% by evaluating both bacterial factors (the amount of plaque and the bacteria *Streptococcus mutans*). Vulnerability control was 14.4%, including caries prevention by the continuation of fluorine program and other conditions control that affect salivary secretions. **Conclusion:** Based on cariogram analysis found that all samples who had occlusal surfaces caries were at a high risk category, but still having moderate potential of avoiding new caries occurrence by controlling risk factors.

Keywords: Cariogram analysis, Occlusal caries, Aged 11-12 years

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INTRODUCTION

Basic Health Research 2013 showed Dental Caries Index in school age student in West Java was lower than the expected target.¹ Information about dental caries risk status is required in the planning, implementation and evaluation of

dental caries prevention. Cariogram method was developed by Bratthall and Hansen² in order to assess the status of an individual's risk of dental caries. Cariogram method was introduced as a simple and user friendly assessment method of a person's caries risk status.² By knowing the level of each individual's risk of dental caries, prevention

program can then be designed according to each needs. In order to determine whether a person has a high or low caries risk, it is necessary to do a series of examination or evaluation in order to identify any risk factors that play a role in increasing the risk of dental caries.³

Caries risk factors can be discovered from the anamnesis results, medical record examination, clinical examination and laboratory tests. The anamnesis results and medical record examination obtain individual socioeconomic status, race and culture, bad habits, diet, case history, dental care, and treatment history. The clinical examination, and laboratory tests obtain a number of caries factors such as, the composition and morphology of the teeth, the severity of caries, the amount and quality of restorations, the use of orthodontic appliances, the level of *Streptococcus mutans* and *Lactobacilli*, and also the conditions of saliva (pH, secretion speed, and buffer capacity). From the results of risk factors evaluation, obtain two groups of caries risk, high risk, and low risk.³ By knowing the status of the risk of caries, a dental health practitioner can develop a model of health promotion and prevention of caries through caries risk factor control. Control of risk factors for dental caries is a particular part of prevention efforts in resolving dental caries as recommended by WHO.^{4,5} Environmental and socioeconomic factors influence dental health of children. Low socioeconomic milieu will resulted in low dental and oral hygiene which were predisposing factors that cause caries.

Based on the location of the occurrence, caries was divided into two types, caries on the pits and fissures, and caries on smooth surface of teeth.⁶ Occlusal surface is the most affected part by caries, while the buccal surface of upper jaw teeth and the lingual surface of lower jaw teeth are the most rare part affected by caries.⁷

Indonesia Oral Health Profile Report stated that caries in children having the highest prevalence due to children age between 6-12 years or school-age children, because of knowledge and understanding regarding the maintenance of oral hygiene. The results of the data was consistent with the results of Household Health Survey in 2001 that there were 76.2% of Indonesian student in the age group of 12 years old suffered from

dental caries, while in West Java 85% of school-age student suffered from the disease.^{8,9}

Before caries spread to all parts of the teeth, caries will occur on partial surfaces of the teeth. Surfaces that were affected by caries could be viewed by using the DMF-S index. DMF-S index was used to calculate the index of decayed, missing, and filling in permanent teeth of each tooth surface, so that we can see the most affected part.¹⁰

From the results of previous PUPT research first phase in 2015 conducted by Wardani, *et al.*¹¹ on 90 students aged 11-12 years in the same elementary schools discovered that the average number of surface cavities (decayed) was 3.83 surfaces. The most affected surface by caries was the occlusal surface with the number of 226 surfaces, while the mesial surface was rarely affected by the caries with the number of 17 surfaces. The number of *Streptococcus mutans* was as follow: in the negative category was 90% and positive category was 10%, while saliva pH was 46.7% and included in acidic category.¹¹ The purpose of this study was to determine the risk status of dental caries in school age student by using cariogram analysis.

METHODS

The study was conducted on 30 student aged 11-12 years with caries on occlusal surfaces in Bandung during period of 2015-2016. The methods used was observational research, refers to self-reliance research on the comprehensive oral diseases management. The sampling method used was purposive sampling, with sample students of SDN Cikawari and SDN Mekarjaya Bandung Regency with DMF-S index higher than the population. Inclusion criteria were male and female, aged 11-12 years, good systemic health; and exclusion criteria were suffering from systemic disorder, currently in long-term antibiotic therapy and orthodontic appliance usage. The age of 11-12 years were used as indicators in monitoring caries (global monitoring age). This was because at the age of 12 years all permanent teeth have been erupted, except for the third molar.

Caries risk assesment was conducted using cariogram analysis. A number of questions were

Indent No : 02
 Date : July 2015
 Examiner : drg. Riana Wardani, M.S

Country area : Standar set
 group : High risk

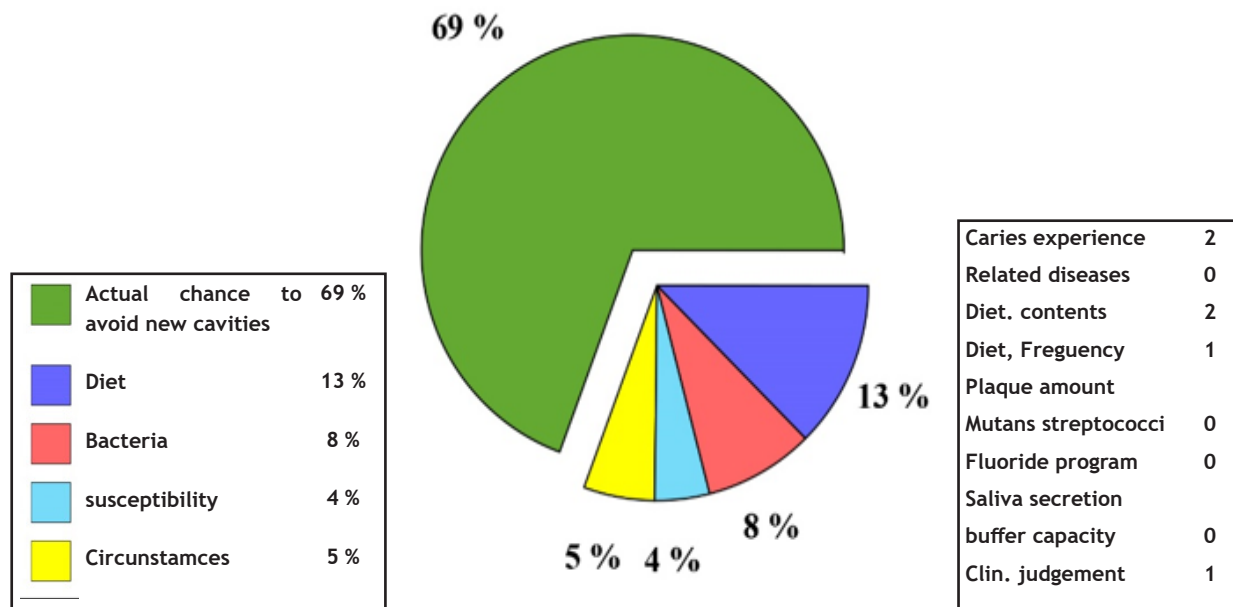


Figure 1. Example of cariogram of caries risk factor analysis

asked to a sample for case history, eating habits and intake of fluoride. Furthermore, examination to determine the caries experience, the amount of plaque, saliva volume, and buffering capacity of saliva was conducted according to cariogram examination method. Cariogram program contains 10 chargeable parameters, score 0-3 was given in the box provided by using the arrow up or down, under the circumstances that score 0 is the best score and score 3 is the worst score. The percentage of the risk factor would be shown according to the answer inputted to the box. Green sector is an opportunity to prevent new caries. When the green sector is 20% or less indicates a high caries risk. Figure 1 explain about example of cariogram of caries risk factor analysis.

RESULTS

Interview and examination conducted towards 30 male and female students of SDN Mekarjaya and SDN Cikawiri Bandung Regency. On examination of 319 decay surfaces found that 226 caries occurred on occlusal surfaces.

Based on interview and examination results also found that cariogenic food consumed was 96.3%. Student's cariogenic food eating frequency was 60% often and very often. Gum conditions 56.7%

included to good category and 93.4% students using fluoride toothpaste. Respondent's case history were healthy according to requirements of not having systemic disorder, not in the long term antibiotic therapy, and not using any orthodontic appliance.

The results of risk factors based on cariogram analysis produced two groups high risk level and low-risk level for each individual with the following criteria: The group with the status of high-very high risk having the opportunity to avoid new caries <40%, and group with the status fair-rather low risk having the opportunity to avoid new caries >40%.

The cariogram analysis also showed 43% chance of caries avoidance. Diet control was 23.3%, includes two factors: sugary foods and eating frequency. Bacteria control was 11.9% by evaluating both bacterial factors (the amount of plaque and the bacteria *Streptococcus mutans*). Vulnerability control was 14.4%, including caries prevention by the continuation of fluorine program and other conditions control that affect salivary secretions.

Cariogram data result of subject of study presented in Table 1, and the results of risk factors categorized in Table 2. Table 3 explained about mean of risk factor category after analyzed using cariogram.

Table 1. Cariogram data of 11-12 years of age student of SDN Mekarjaya dan SDN Cikawiri

Respondence	Chance to avoid new caries	Diet	Bacteria	Vulnerability	Other condition	Risk factor
1	22	38	15	15	10	High
2	69	13	8	4	5	Fair
3	9	37	15	30	10	Very high
4	19	36	14	21	9	Very high
5	47	24	10	10	9	Moderate
6	62	12	12	8	5	Fair
7	25	39	23	8	5	High
8	51	25	10	5	10	Moderate
9	7	19	8	62	5	Very high
10	23	40	16	16	5	High
11	77	7	5	7	3	Fair
12	75	15	6	3	2	Fair
13	59	9	9	14	9	Moderate
14	28	22	15	22	14	High
15	26	31	15	23	5	High
16	21	36	15	15	14	High
17	53	18	9	14	6	Moderate
18	41	9	18	27	6	Moderate
19	75	15	6	3	2	Fair
20	11	41	14	21	13	Very high
21	53	18	9	14	6	Moderate
22	40	25	17	8	11	High
23	84	7	3	5	1	Low
24	69	13	8	4	5	Fair
25	62	13	9	9	8	Fair
26	33	35	17	9	6	High
27	51	18	9	13	9	Moderate
28	30	23	15	23	10	High
29	42	22	13	13	9	Moderate
30	25	40	16	8	10	High

Table 2. Risk factors category based on individual cariogram of 11-12 years old student of SDN Mekarjaya dan SDN Cikawiri

Risk factor	Frequency	Persentation
Very High	4	13.3
High	10	33.4
Moderate	8	26.7
Fair	7	23.3
Low	1	3.3
Total	30	100

Table 3. Mean of caries risk category in 11-12 years old student of SDN Mekarjaya dan SDN Cikawiri

Risk category	Persentation (%)
Chance to avoid new caries	43
Diet	23.3
Bacteria	11.9
Vulnerability	14.4
Other conditions	7.4
Total	100

DISCUSSION

Basic Health Research 2013 showed that the Indonesian caries prevalence was 72.6%, with only 31.1% individual got oral care and treatment,

and Decay, Missing, Filled-Teeth (DMF-T) index inclination was 4.5 DMF-T index on 11-12 years old children was 1.38, whilst WHO targeting DMF-T on 11-12 years old children ≤ 1 on Global Goals for Oral Health 2020.¹² The data showed that oral

health problem in Indonesia was still on the high level. From the same research also obtained that in West Java, Dental Caries Index of school age student even lower than the expected target.¹

Dental caries is a process that involves many factors. The mechanism of dental caries involves the interaction between the four factors, microorganisms, substrate, teeth, and saliva, as well as time. Tooth morphology is also one of the host factors of dental caries.

Caries risk factors can be discovered from the anamnesis results, medical record examination, clinical examination, and laboratory tests. The anamnesis results and medical record examination obtain individual socioeconomic status, race and culture, bad habits, diet, case history, dental care, and treatment history. The clinical examination and laboratory tests obtain a number of caries factors such as, the composition and morphology of the teeth, the severity of caries, the amount and quality of restorations, the use of orthodontic appliances, the level of *Streptococcus mutans* and *Lactobacilli*, and also the conditions of saliva (pH, secretion speed, buffer capacity). From the results of risk factors evaluation, obtain two groups of caries risk, high risk and low risk.³ By knowing the status of the risk of caries, a dental health practitioner can develop a model of health promotion and prevention of caries through caries risk factor control. Control of risk factors for dental caries is a particular part of prevention efforts in resolving dental caries as recommended by WHO.^{4,5} Environmental and socioeconomic factors influenced dental health of children. Low socioeconomic milieu will resulted in low dental and oral hygiene which were predisposing factors that cause caries.

Based on the location of the occurrence, caries was divided into two types, caries on the pits and fissures and caries on smooth surface of teeth.⁶ Occlusal surface is the most affected part by caries, while the buccal surface of upper jaw teeth and the lingual surface of lower jaw teeth are the most rare part affected by caries.⁷

Before caries spread to all parts of the teeth, caries will occur on partial surfaces of the teeth. Surfaces that were affected by caries could be viewed by using the DMF-S index. DMF-S index was used to calculate the index of decayed, missing, and filling in permanent teeth of each

tooth surface, so that we can see the most affected part.¹⁰

According to research conducted in Istanbul by Demirci,¹³ 62.4% of caries distribution was in the maxillary jaw and approximal surfaces of all teeth had the highest caries rates, ranging from 58.5% to 77.5%. Occlusal surfaces of the teeth more vulnerable to caries compared with other surfaces, because of the distinctive shape makes it difficult to clean. Tooth with deep pits and fissure also more vulnerable to caries, because plaque and microorganisms will stick to tooth's pit and fissure teeth and also difficult to clean.¹⁴ Teeth composition also affects the occurrence of caries. Crowding teeth will also cause difficulties in tooth cleaning, thereby increasing the occurrence of caries and other periodontal diseases.

The function of saliva is as a lubricant, protective buffer (buffer saliva), cleansing, anti-bacterial and anti-solvent. However, saliva plays an important role in the process of plaque formation, and also as a life medium of microorganisms. There are still dissenting opinions about the relationship between caries frequency and factors inside saliva such as, saliva buffer, chemical composition, flow, viscosity, and anti-bacterial factor.

Various types of oral microorganisms that can be associated with caries including various strains of *Streptococci*, *Lactobacilli*, and others. Several research have proved that *Streptococcus* contribute to dental caries and related to carbohydrates, dental plaque, saliva, and mostly found inside oral cavity and tooth surfaces. Microorganisms attached to the teeth because the presence of plaque, that is malleable material attached tightly to the teeth and consists of microorganisms (70%) and materials between cells. Among all plaque microorganisms, *Streptococcus mutans* has the highest ability to ferment sucrose and form lactic acid.

Sucrose has the highest cariogenic potential especially for smooth surfaces and is the most widely used sugar in diet. The result of the metabolism of sucrose by cariogenic microorganisms, especially *Streptococcus mutans* is extra cellular polysaccharide which is instrumental in the formation of dental plaque. This increase the possibility of plaque adhesion on the smooth enamel surface. Glucose metabolism by *Streptococcus mutans* through glycosyl transferase

produce lactic acid and energy required by microorganisms to proliferate inside the plaque. Energy and lactic acid will continue to be formed as long as there is sucrose, so that the pH of the plaque will remain low for a long time. Bacteria is instrumental in the process of caries because of its ability to produce dental plaque from sucrose. Inside the plaque, colonies of bacteria will form acid from dietary carbohydrates, causing demineralization of tooth enamel. Therefore, dental caries activity can be assessed by counting the number of colonies of *Streptococcus mutans* inside dental plaque and also decrease of saliva pH. Germination in order to count the number of *Streptococcus mutans* colonies can be done in TYCS20B (Trypticase Yeast Cystine Sucrose 20 Bacitracin) on anaerobic conditions for 48 hours at 37°C and will be obtained colonies that formed limpid "halo".¹⁵ *Streptococcus mutans* blood must be performed beta hemolysis and reacted positively with esculin, lactose, sucrose, mannitol, sorbitol, inulin and raffinose.¹⁵

Indonesia Oral Health Profile Report stated that caries in children having the highest prevalence due to children aged between 6-12 years or school-age children lack of knowledge and understanding regarding the maintenance of oral hygiene. The results of the data were consistent with the results of Household Health Survey in 2001 that there were 76.2% of Indonesian student in the age group of 12 years old suffered from dental caries, while in West Java 85% of school-age student suffered from the disease.^{8,9}

From the results of previous PUPT research first phase in 2015 conducted by Wardani *et al.* on 90 students aged 11-12 years in the same elementary schools discovered that the average number of surface cavities (decayed) was 3.83. The most affected surface by caries was the occlusal surface with the number of 226 surfaces, while the mesial surface was rarely affected by the caries with the number of 17 surfaces. The number of *Streptococcus mutans* was as follows: in the negative category (90%) and positive category (10%), while saliva pH was 46.7% and included in acidic category.¹¹

Early detection of initial caries lesions and the preventive approach are the main aims for maintaining a good oral health status.¹⁶ Caries-risk assessment is an essential procedure for

dentists in decision-making processes concerning treatment, and recall appointments, and in determining the need for additional diagnostic procedures.¹⁷ The common practice is to assess these factors individually and also, as dental caries is a multifactorial disease, more than one factor can predict future caries. Therefore, the use of validated instruments for guiding the professional in establishing the risk profile of a patient is essential.¹⁸

Several risk prediction and risk assessment models were developed, and multifactorial modeling was used to increase the accuracy of risk assessments. The ideal risk assessment model should be easy to use, and the process should not be time-consuming in clinical practice. The outcome should be understandable, so it can be used as a didactic tool for patient education and motivation.¹⁹

Cariogram is one of the most reliable caries risk assessment models, because it is a truly comprehensive and objective method based on quantitative data of an individual.¹⁹ In addition, the model not only performs a caries risk assessment but also includes suggestions for preventive and clinical actions. Because changing patient behaviors has become the cornerstone of preventive treatment, advice about problems should be individualized, and patient awareness should be raised.²⁰ Thus, cariogram is a helpful tool for patient education and motivation, and also for dentists in clinical decision-making processes. Caries-risk assessment of communities allows high-caries-risk groups and treatment needs to be determined, so preventive applications can be carried out. In order to determine whether a person has a high or low caries risk, it is necessary to do a series of examination or evaluation in order to identify any risk factors that play a role in increasing the risk of dental caries.³

Based on interview and examination towards 30 male and female 11-12 years old students of SDN Mekarjaya and SDN Cikawiri Bandung Regency found 319 decay surfaces found that 226 caries occurred on occlusal surfaces. This is likely due to the difficulty of cleaning the teeth in such part, and also because of the lack of knowledge of children aged 11-12 years about oral hygiene. According to research conducted by Togoo *et al.*²¹ about the prevalence of the first permanent molar caries, also stated that the occlusal surface of

first permanent molars became the most location of the dental caries after eruption.

This research also found that cariogenic food consumed by students was 96.3% from all diet. Student's cariogenic food eating frequency was 60% often and very often. Gum conditions 56.7% included to good category and 93.4% students using fluorine toothpaste. It is understandable why the sample of this study classified into the high risk of dental caries category, because one of determining caries factors, cariogenic food, becoming the most consumed food in high frequency. As found in Somasundaram *et al.*²² research that children who watched television advertisements about potentially cariogenic food and used to eat them were found to have more caries index.

However, the cariogram analysis showed 43% chance of caries avoidance. With diet control was 23.3%, includes two factors: sugary foods and eating frequency. Bacteria control was 11.9% by evaluating both bacterial factors (the amount of plaque and the bacteria *Streptococcus mutans*). Vulnerability control was 14.4%, including caries prevention by the continuation of fluorine program and other conditions control that affect salivary secretions.

This means that a chance to avoid new caries still medium potential level. Because the prevention of dental caries can be done by controlling the risk factors such as diet, bacteria, vulnerability factors and other circumstances. Also in accordance with Renuka²³ research which stated that analysis about caries risk factor by using cariogram could be used as an effective health educational tool in changing the parents/caregivers attitude and behaviours in order to obtaining the good oral hygiene and dietary habit maintenance, and there was significant reduction in caries risk after six weeks of intervention in all subjects in the form of personally based caries risk factor control treatment.²³

By knowing the status of caries risk, the dental profession can develop a model of health promotion in the form of counseling about how to maintain oral health and caries prevention through the control of risk factors for caries in children such as, the application of fluorine, closing loopholes/curvatures on the surface of the teeth (fissure sealant), so the prevalence of caries

can be reduced and obtaining the improvement of oral health.²⁴

As found in research conducted by Hurlbutt²⁵ about caries management by risk assessment (CAMBRA), an evidence-based approach to preventing or treating dental caries at the earliest stages. Caries protective factors are biologic or therapeutic measures that can be used to prevent or arrest the pathologic challenges posed by the caries risk factors. Best practices dictate that once the clinician has identified the patient's caries risk (low, moderate, high or extreme), and the personal caries risk factor potential measurement by using personal measurement tool such as cariogram, a therapeutic and/or preventive plan implemented.²⁵

CONCLUSION

Based on the cariogram analysis found that 11-12 years old students of SDN Mekarjaya and SDN Cikawiri Bandung Regency who had occlusal surfaces caries were at a high risk category, but still having moderate potential of avoiding new caries occurrence by controlling risk factors.

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