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RESEARCH ARTICLE

Caries risk factors based on cariogram among male smokers aged 15-24 years in Temanggung, Central Java, Indonesia

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ABSTRACT

Temanggung Regency in Central Java is an area with an extensive tobacco farming, allowing its residents to have ease of access to cigarettes. In addition, it has become a tradition for locals in this area to serve any visiting guest with cigarettes. Adolescents start smoking to cope with the psychosocial crisis during their development, particularly when they try to find their identity. Smoking is, in fact, a risk factor for dental caries, so the adolescents in Temanggung have a quite high prevalence of caries. Thus, this study aimed to determine the sequence of the risk factors affecting the caries risk based on cariogram among male smokers aged 15-24 years (adolescents). This was a quantitative observational study with a cross sectional design. There were 152 subjects (n= 152) selected using a proportionate clustered random sampling out of the total population (316 adolescents). The research was carried out with a clinical examination of the oral cavity, measuring salivary secretions, examining the amount of plaque, and examining DMF-T. Scoring was done using a caliogram application. The results of this study showed that 81.3% of the adolescents had a moderate caries risk, while 18.1% of them had a high caries risk. The sequence of the risk factors affecting the caries risk based on cariogram was bacteria (22.90%), susceptibility (19.39%), dietary habits (12.09%), and other influencing conditions (7.55%).

Keywords: adolescents; caries risk; smoking frequency

INTRODUCTION

Smoking has been widely practiced since ancient times to the present day. The World Health Organization (WHO) estimated that smoking in the decade 2020-2030 will kill 10 million people annually, 70 percent of the casualties are from developing countries.[1] Therefore, it has been a challenge for developing countries, including Indonesia, to control the spread of cigarettes in public.[2] Cigarettes contain addictive substances that harm the health of individuals and society.[3] Cigarettes are fine-cut tobacco rolled in a paper for lighting up and the smoke is to be inhaled and sucked through the mouth. The main ingredients of cigarettes are from the plants *Nicotiana tabacum*, *Nicotiana rustica* and other species or synthetics. Some types of cigarettes are: *kretek* (clove cigarettes), white cigarettes, cigars, and so on.[4]

The prevalence of cigarette smoking in Indonesia is one of the highest in the world in various levels of society, particularly among males, starting from children, adolescents and adults. On average, the median range of cigarette smoked by Indonesian smokers per day was 12.8 cigarettes, which equals one pack of cigarettes.[5] The prevalence of smoking in Temanggung Regency among male adolescents aged 16-18 years was 63.8% and among those aged 19-24 years was 82.7%; in fact, this was the highest smoking prevalence in Central Java Province because smoking has become a tradition.[6]

Smoking habit brings a significantly detrimental effect on dental and oral health. A long smoking duration will affect the condition of the oral cavity in general.[7] The sticking tar and nicotine from cigarette smokes on teeth surface may roughen the tooth surface, thus accelerating the formation of plaque and bacteria.[8,9] Nicotine in cigarettes is also a chemical substance that can poison the nervous system, thus disrupting the

salivary secretion. The heat of cigarette smoke will dry out the oral cavity.[10,11] Dry mouth will lead to a decline in pH, dental and oral hygiene, a decline in the ability to remineralize enamel caries lesions, and an increase in the number of bacteria, thus increasing caries risk.[12]

The percentage of Indonesian citizens who had dental and oral health problems according to Basic Health Research in 2013 was 25.2% but it increased to 57.6% in Basic Health Research in 2018. On average, dental caries as measured by the DMF-T caries index was still relatively high. In fact, in 2018 it was 7.2, meaning that everyone had dental caries in 7-8 teeth.[5]

Dental caries is a bacterial infection which leads to demineralization of dental hard tissues (email, dentin, cementum). Caries is a multifactorial disease, since it is attributed to the interaction of four factors: teeth as the host, bacteria, substrates and time.[12] Caries risk is the possibility for a person to have several carious lesions for a certain period of time. The caries risk of a person is not always the same as the risk of other person, and it does not last a lifetime because it may change if the person takes prevention measures against caries.[13] Caries risk can be measured through various ways, one of which is by using a cariogram. Cariogram is an application to understand the relationship between caries risk factors so as to determine what preventive measures to be taken.[14,15]

This study aimed to determine the sequence of the risk factors for caries risk based on cariogram among male smokers aged 15-24 years in Mergowati Village, Kedu Subdistrict, Temanggung Regency. Researchers took samples of youth in that area as most children there were classified as cigarette addicts, and in fact, some kids were heavy addicts to cigarettes. Knowledge on the sequence of risk factors can serve as a guideline for the prevention of dental caries.

MATERIALS AND METHODS

This was a quantitative observational study with a descriptive design. The research population consisted of a total of 316 male adolescents aged 15-24 years per May 2019 in Mergowati Village which covered 11 hamlets. The research was conducted in Mergowati Village, Kedu Subdistrict, Temanggung Regency, Central Java, starting from November 24, 2019 to December 27, 2019.

The samples consisted of 152 male adolescents who met the inclusion criterion (male adolescents aged 15-24 years in Mergowati Village Kedu Subdistrict Temanggung Regency per May 2019) and exclusion criteria (not having gingival index as indicated by Loe and Silness gingival index and not suffering from psychiatric disorders). The research subjects were selected using proportional cluster random sampling, followed by a random selection of the subjects from each of the 11 hamlets. Examination of the subjects in the study was performed only once. This study obtained an ethical clearance from the Research Ethics Commission of the Faculty of Dentistry, Universitas Gadjah Mada No.00276/KKEP/FKG-UGM/EC/2019 and obtained permission from the Government of Mergowati Village.

The cariogram variables were caries risk (the possibility of not having caries), dietary habits, bacteria, susceptibility and other influencing conditions. The variables for assessment were age, smoking duration, tooth brushing frequency, smoking frequency, caries experience, influencing common diseases, eating frequency, plaque accumulation, fluoridation program, salivary secretion, and clinical assessment. The research instrument consisted of glasses for saliva collection, 3 ml syringe, oral diagnostic sets, stopwatch, kidney dish, stationery, study tables (questionnaires), cariogram software, and trash can/plastic to dispose saliva waste. The materials were paraffin wax, cotton, 70% alcohol, mask, hand Schoen, tri plaque id gel, tissues, mineral water.

The data for the independent variable were collected through an oral examination recorded in an examination sheet, followed by interview using a questionnaire. Each of the study subjects received a number of examinations, namely caries experience (DMF-T), secretion of salivary gland (stimulated saliva testing), and plaque accumulation (Loe and Silness plaque index). The

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DMF-T index was the sum of decay (D), missing (M) and filling (F). According to the data, the average DMF-T for the age group of 15 to 24 years in Mergowati Village was 9.

Meanwhile, age, smoking duration, smoking frequency, tooth brushing frequency, common influencing diseases, and eating frequency were assessed using the subjects' questionnaire sheets. The parameters assessed were scored with 0-3 in the available section; the higher the score, the worse the condition. The data obtained were then processed using a cariogram as introduced by Bratthall. The cariogram displayed a pie chart divided into five parts: dark blue for dietary habit, red for bacteria, light blue for susceptibility, and yellow for other influencing factors (Figure 1).[16] The data obtained were then presented in the form of percentages according to the sequence of risk factors for caries risk. The data were analyzed using a univariate analysis to determine the characteristics of each of the variables and to determine the sequence of risk factors for caries risk based on the cariogram among male smokers aged 15-24 years.

RESULTS

This study focused on any risk factors for dental caries carried out on youth aged 15-24 years in Mergowati Village, Kedu District, Temanggung Regency. The following table presents the frequency distribution of the respondents.

The results in Table 1 show that, in terms of age, the highest portion of the subjects (38.8%) fell in the 15-18 year age group. In terms of smoking duration, the highest percentage (44.7%) of the subjects smoked for 1-5 years and 6-10 years. In terms of tooth brushing frequency, most (75%) of the subjects brushed their teeth twice a day. In terms of smoking frequency, the highest percentage of the subjects (36.2%) fell in the low category.

In terms of the caries experience as analyzed by the cariogram, most of the subjects (51.3%) had a worse condition than the normal ones. In terms of influencing diseases, it was shown that 100% of the subjects did not have a disease affecting dental caries.

Based on the data of eating frequency, most of the subjects (73.7%) ate three times a day. In terms of fluoridation program, 100% of the subjects used fluoride toothpaste. Based on the salivary secretion data, most of the subjects (63.2%) fell in the normal category. In addition, the plaque measurement using Loe and Silness plaque index showed that most of the subjects (55.3%) had a poor plaque index. The results of the clinical assessment using the cariogram showed that most of the subjects (90.8%) had clinical conditions according to what the cariogram displayed based on the scores inputted in the program. In addition, the results of the cariogram showed that most of them (78.9%) fell in the moderate caries risk category.

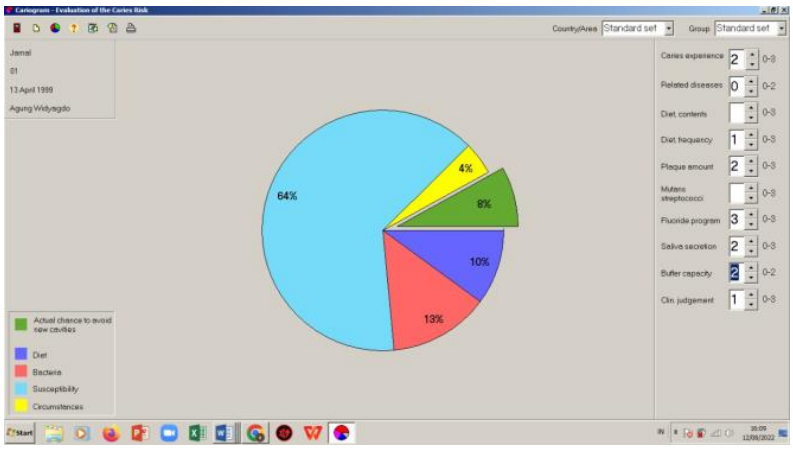

Figure 1. Cariogram – Dental Caries Evaluation[14]

Table 1. Respondent characteristics among male smokers aged 15-24 years

No	Characteristics	n (%)
1	Age	
	15-18 years	59 (38.8)
	19-21 years	48 (31.6)
	22-24 years	45 (29.6)
2	Smoking duration	
	1-5 years	68 (44.7)
	6-10 years	68 (44.7)
	11-15 years	16 (10.6)
3	Tooth brushing frequency	
	Once a day	38 (25)
	Twice a day	114 (75)
4	Smoking frequency	
	Low (1 - 10 cigarettes/day)	64 (42.1)
	Moderate (11- 20 cigarettes/day)	55 (36.2)
	High (>20 cigarettes/day)	33 (21.7)
5	Caries experience	
	Neither dental caries nor fillings	0 (0.0)
	Better than normal	55 (36.2)
	Normal	19 (12.5)
	Worse	78 (51.3)
6	Commong influencing diseases	
	No diseases	152 (100.0)
	Mild diseases	0 (0.0)
	Serious diseases	0 (0.0)
7	Eating frequency	
	3 times a day	112 (73.7)
	4-5 times a day	40 (26.3)
	6-7 times a day	0 (0.0)
	>7 times a day	0 (0.0)
8	Fluoridation program	
	Optimal fluoridation program	0 (0.0)
	Additional fluoridation program	0 (0.0)
	Only fluoride toothpaste	152 (100.0)
	No fluoridation program	0 (0.0)
9	Saliva secretion	
	Normal	96 (63.2)
	Low	32 (21.1)
	Very Low	23 (15.1)
	Xerostomia	1 (0.6)
10	Plaque accumulation	
	Very good	0 (0.0)
	Good	14 (9.2)
	Moderate	84 (55.3)
	Poor	54 (35.5)
11	Clinical assessment	
	Clinical condition is better than cariogram result	0 (0.0)
	Clinical condition is the same as cariogram result	138 (90.8)
	Clinical condition is poorer than cariogram result	14 (9.2)
	Clinical condition is very poor	0 (0.0)
12	Caries risk	
	Low (> 75%)	0(0.0)
	Moderate (25% - 75%)	120 (78.9)
	High (< 25%)	32 (21.1)
	Total	152 (100.0)

Where: n, number of subjects; %, percentage

Table 2 presents that the sequence of the effect of risk factors on caries risk based on cariogram is: bacteria (22.90%), susceptibility (19.39%), dietary habits (12.09%), and other conditions affecting caries risk (7.55%). In terms ofthe correlation of smoking duration and smoking frequency with the incidence of caries, it was revealed from the interpretation of the OR (Odds ratio) value from the results of the multivariate analysis that with increasing smoking frequency, the subject may have a risk of 0.426 times getting a low caries risk compared to getting a high caries risk and 0.587 times getting moderate caries risk compared to high caries risk. Meanwhile, for prolonged smoking, the OR (Odds ratio) value from the results of the multivariate analysis showed that with prolonged smoking, the subject may have a risk of 0.226 times to get low caries risk compared to getting high caries risk, and 1,272 times to get moderate caries risk compared to high caries risk.

Table 2. Sequence of effect of risk factors on caries risk based on cariogram among male smokers aged 15-24 years

No	Risk factors	Number of subjects	Average percentage (%)
1	Bacteria	152	22.90
2	Susceptibility	152	19.39
3	Dietary Habit	152	12.09
4	Other Influencing Conditions	152	7.55

DISCUSSION

Based on the research result, particularly in the form of the percentage of the cariogram parameters, the sequence of caries risk factors was bacteria, susceptibility, dietary habit, and other influencing conditions. Bacteria was the highest risk factor with a percentage of 22.90%. The bacteria parameter is a combination of plaque accumulation and the number of *Streptococcus muntans* bacteria. *Streptococcus muntans* and plaque are among the most significant risk factors for the occurrence of caries.[17] However, this study did not analyze the number of *Streptococcus muntans* and put more emphasis on the predetermined caries factors.

The results of the research showed that, based on the plaque measurement using Loe and Silness plaque index, most of the subjects (55.3%) in this study had a poor plaque index category. Smoking habit among adolescents in Mergowati Village reduces salivary secretion which affects the ability of saliva in maintaning dental and oral hygiene from food debris and bacteria, thus resulting in plaque accumulation. A study by Singh in India revealed that smoking reduces salivary secretion and increases plaque accumulation.[18]

Plaque is a biofilm of a colony of microorganisms that grows on a matrix that is formed and firmly attached to the uncleaned tooth surface.[19] A dirty oral cavity is a suitable place for bacteria, food debris, particularly carbohydrates and glucose; it becomes a source of substrate for bacteria to grow and multiply.[20] A study by Mubeen in 2013 showed that a decrease in salivary flow rate could reduce the ability of saliva to clean food debris and could increase the number of bacteria.[7] The most common bacteria found in dental plaque is *Streptococcus muntans*. These bacteria ferment various types of carbohydrates to become acidic, thus decreasing pH. A decline in pH will result in caries that is characterized by demineralization of tooth hard tissues and destruction of organic substances.[20] The results of this study are in line with the results of a study by Wu, indicating that there was an increase in plaque accumulation and the number of *Streptococcus muntans* in the oral cavity of adult subjects who smoked *kretek* (unfiltered) and filtered cigarettes in South China, leading to caries.[21]

Susceptibility was in the second position as a caries risk factor. Susceptibility is a combination between fluoridation program and salivary secretion. The data in this study showed that the adolescent subjects did not receive optimal fluoridation program. The research subjects brushed their teeth twice a day with fluoride toothpaste. Fluoride is widely used to prevent dental caries. The use of fluoride can inhibit demineralization and increase remineralization.[22]

Caries process is also affected by natural salivary defense. Salivary secretion plays a role in cleaning carbohydrates and microorganisms.[23] The research data showed that most of the subjects in this study fell in the low and very low categories of salivary secretion with 21.1% and 15.1%, respectively. A decrease in the salivary secretion among smokers is caused by heat from the cigarette smoke and the nicotine content which disrupts the nervous control system. This study is in line with a study by Kanwar, showing that smoking large quantities of cigarettes with a long smoking duration can decrease salivary flow rate and pH, making it susceptible to dental caries.[21]

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showed that smokers had a regular tooth brushing habit using fluoride toothpaste, but the schedule and method were improper.[5] Fluoridation program that was not optimal among the subjects of the study, exacerbated by a high smoking frequency and long smoking duration, could reduce salivary secretion. A reduced saliva in the oral cavity plays a role in caries development process.[24]

Dietary habit was in the third position as a caries risk factor. The research data showed that, in terms of eating frequency, most of the subjects ate three times a day (73.7%), while 26.3% of them mentioned 4-5 times a day. Dietary habit is one of the main factors in caries development where a poor dietary habit will affect the caries process. A person's dietary habit can be assessed in terms of two aspects, namely food ingredients and eating frequency in a day.[14] The effect of dietary habit on caries process is more commonly local than systemic, especially in relation to eating frequency.[12] Smokers usually have dry mouth, so they often drink coffee or sweet tea while smoking. In fact, higher frequency in eating and drinking anything that contains sugar for a long time will make the plaque pH to remain below the normal range, thus leading to demineralization of enamel.[20]

The last factor, other influencing factors is a combination of caries experience and common diseases related to dental health. These factors ranked in last place because the result of the research showed that none of the subjects had history of common diseases related to dental health. Common diseases or the conditions of a person affect dental health, either directly or indirectly. The examples of these conditions include: disabilities that affect a person's ability to maintain dental health, disease impacts, radiation therapy and drugs that affect salivary secretion.[16] The results of the caries measurement using DMF-T showed that 51.3% of the subjects fell in the category of worse than normal. A high smoking frequency and a long smoking duration increase the DMFT index.[23] In addition, a person's caries experience also affects the development of caries in the future.[24]

CONCLUSION

This study concludes that the sequence of risk factors affecting caries risk based on cariogram is bacteria, susceptibility, dietary habits, and other influencing conditions. The order of the influence of risk factors on caries risk based on cariogram examination of male adolescents aged 15-24 years in Mergowati Village, Kedu District, Temanggung Regency, namely: bacteria, susceptibility, diet, and other influencing conditions.

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