



The Relationship of Caries with the Risk of Calculus Occurrence in Adolescents (Calrisk Approach)

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Abstract

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Adolescents are a vulnerable age group prone to smoking behavior, which negatively affects oral health, particularly increasing the risk of caries and calculus. To determine the relationship between caries and calculus risk among adolescent smokers using a technological approach the Calrisk Dentistry application. This was a descriptive-analytic study with a cross-sectional approach, conducted at SMK Swakarya Palembang in April 2025. The sample consisted of 49 students selected through total sampling. Data were obtained through clinical examinations and input into the Calrisk application. Data analysis using Pearson correlation test. A total of 69,4% of respondents smoked "occasionally", with 73,5% categorized as light smokers (1 – 5 cigarettes/day). Caries were found to be low (51%), moderate (34,7%), and high (12,2%). Based on depth, 75.5% had dentin-level caries (DCC) and 67.3% had pulp-level caries (PCC). Calculus was most frequently found on the same side as the caries, especially in cases of pulp caries. All respondents who smoked "frequently" or "very frequently" had a moderate calculus risk, while those who smoked "occasionally" had a mild (55,9%) or moderate (44,1%) risk. There were significant correlations between smoking frequency and caries ($P=0,002$), smoking frequency and calculus risk ($p=0,004$), as well caries and calculus risk ($p=0,042$). There is a relationship between adolescent smoking, caries occurrence, and calculus risk.

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INTRODUCTION

Adolescence is often considered a period of identity crisis, a time when individuals search for their true selves and are easily influenced by their environment, such as peers who shape their decisions and behaviors. Teenagers tend to reject norms and act boldly without considering the risks, making them more vulnerable to engaging in negative behaviors. One of the common negative behaviors among adolescents is smoking. Many adolescents perceive smoking as a symbol of maturity and a way to gain acceptance within their social groups. Unknowingly, smoking has harmful effects on health, especially oral health, which plays an important role in maintaining overall well-being.

Dental caries is one of the oral diseases caused by smoking habits. Research by Yulianita et al. showed a significant association between smoking habits and the incidence of dental caries in adolescents. Nicotine and other chemicals in cigarettes can disrupt the balance of microorganisms in the oral cavity, increase plaque formation, and ultimately cause caries. Based on the Indonesian Health Survey (SKI) 2023,

the prevalence of caries among the Indonesian population aged ≥ 3 years is 56.9%. Meanwhile, the incidence of dental caries among children aged 15–17 years is relatively high, reaching 75.3%.

If left untreated, dental caries can reduce a person's quality of life. One of the most common impacts is physical discomfort, such as pain when chewing food due to cavities. Research by Susilawati et al. indicated that individuals with a high caries experience are more likely to suffer from eating and speaking difficulties due to the pain caused. Furthermore, Mahendra found that individuals with severe caries often chew only on one side of the mouth as a way to avoid pain. This habit can contribute to a decline in oral hygiene.

Sudarso et al. explained that the chewing process has a self-cleansing effect, as saliva produced during mastication helps clean the oral cavity and maintain the balance of normal flora. As a result, the side of the mouth not used for chewing tends to become dirtier and more prone to plaque accumulation. Uncontrolled plaque buildup over time may undergo mineralization due to the mineral content in saliva. This process causes soft plaque to harden into calculus, which firmly attaches to the tooth surface. The formation of calculus may increase the risk of various other dental health problems.

This study is important to further understand the relationship between the occurrence of caries and the risk of calculus formation, particularly among adolescents with smoking habits or suboptimal oral hygiene. Thus, this research can provide insights into prevention and dental care efforts for adolescents, ultimately improving their quality of life.

METHOD

The type of research used is descriptive analytic with a cross-sectional approach. The study was conducted at SMK Swakarya Palembang in April 2025. The sample consisted of 49 students who had smoking habits, selected using a total sampling technique. The research was carried out after obtaining respondents' approval in the form of informed consent and was declared ethically feasible by the Health Research Ethics Committee of Poltekkes Kemenkes Palembang through an approval letter No.0091/KEPK/Adm2/II/2025. Data were obtained from clinical examinations and outputs from Calrisk Dentistry.

Data analysis was performed using univariate analysis to describe the characteristics of each research variable, resulting in frequency distributions, and bivariate analysis with Pearson correlation.

RESULT AND DISCUSSION

This study was conducted at SMK Swakarya Palembang in April 2025. The sample consisted of 49 participants. The collected data were presented in frequency distribution tables, followed by data processing and analysis, with the results as follows.

Table 1. Frequency Distribution of Smoking and Number of Cigarettes Smoked per Day among Vocational High School Students

Smoking Frequency/Day	N 49	Number of Cigarettes/Day		
		Light (1-5 sticks)	Frequently (6-10 sticks)	Weight (>10 Bars)
Sometimes	34	29	3	2
Often	11	7	2	2

Very Often	4	0	0	4
Total	49	36	5	8

Source: Primary Data, 2025

Table 1. shows that most vocational high school students fall into the “occasionally” category for smoking frequency, with the number of cigarettes smoked per day classified as light (1–5 cigarettes/day). In addition, a pattern can be observed that the more frequent the smoking, the greater the number of cigarettes consumed per day. This is evident from students who smoke very frequently, as they tend to fall into the heavy smoking category.

Table 2. Frequency Distribution of the Number of Dental Caries Based on Smoking Frequency among Vocational High School Student Smokers

Cigarette Frequency	N	Caries		
		Low	Moderate	High
Sometimes	34	21	9	3
Often	11	4	6	1
Very Often	4	0	2	2
Total	49	25	17	6

Source: Primary Data, 2025

Table 2. shows that the higher the smoking frequency, the greater the severity of dental caries, providing an initial indication of a possible relationship between the two.

Table 3. Frequency Distribution of Caries Severity (Depth) Based on Smoking Frequency among Vocational High School Student Smokers

Cigarette Frequency	N	Caries		
		Low	Moderate	High
Sometimes	34	8	25	22
Often	11	7	10	8
Very Often	4	2	2	3
Total	49	17	37	33

Source: Primary Data, 2025

Table 3. shows that most respondents experienced caries with a depth reaching the dentin (KMD). The total number of caries depths exceeded the number of respondents because one individual could have more than one carious lesion with different depths.

Table 4. Frequency Distribution of Caries and Calculus Locations Based on Caries Depth among Vocational High School Student Smokers

Caries Depth	N	Caries Location	Location of Calculus		
			Right	Left	Right Left

KME	17	Right	6	1	1	4
		Left	7	1	3	3
		Both	4	0	0	4
KMD	36	Right	10	3	2	5
		Left	9	1	4	4
		Both	17	1	0	16
KMP	33	Right	7	7	0	0
		Left	4	0	4	0
		Both	22	0	1	21

Source: Primary Data, 2025

Table 4. shows that in cases of pulpal caries (KMP), most students had calculus on both sides of the oral cavity, with the calculus location tending to be on the same side as the caries. In contrast, in enamel caries (KME), the distribution of calculus was more varied.

Table 5. Frequency Distribution of Calculus Risk Based on Smoking Frequency among Vocational High School Students with Caries

Cigarette Frequency	N Caries	Caries		
		Low	Moderate	High
Sometimes	34	19	15	0
Often	11	1	10	0
Very Often	4	0	4	0
Total	49	20	29	0

Source: Primary Data, 2025

Table 5. shows that the more frequent the smoking among students with caries, the higher their risk of developing calculus. All students in the “frequent” and “very frequent” categories were found to be at a moderate risk of calculus.

Table 6. Results of Pearson Correlation Test between Smoking Frequency, Dental Caries, and Calculus Risk among Student Smokers

Correlation	R	P-Value
Smoking Frequency - Caries	0.045	0.002
Smoking Frequency - Calculus Risk	0.379	0.004
Caries - Calculus Risk	0.250	0.042

Table 6. shows that there is a significant relationship among all variables, namely smoking frequency with caries ($p = 0.002$) and calculus risk ($p = 0.004$). The relationship between caries and calculus risk was also significant ($p = 0.042$), with $p < 0.05$.

Discussion

The results of this study indicate that most respondents were categorized as occasional smokers, with the number of cigarettes smoked per day classified as light (1–5 cigarettes/day). Nevertheless, there was a tendency for increased smoking frequency to be directly proportional to the number of cigarettes consumed. This is consistent with the opinion of Ranti, who stated that individuals with higher smoking frequency tend to consume more cigarettes per day compared to those who smoke less frequently.

Furthermore, the severity of caries found in this study showed that students with higher smoking frequency were more likely to experience more severe caries. In the category of very frequent smokers, all respondents experienced caries of moderate to severe levels. These findings provide an initial indication that smoking habits may contribute to an increased incidence of dental caries. This statement is supported by research conducted by Yulianita et al., which reported that most individuals with smoking habits experienced dental caries.

Cigarettes can affect the condition of the oral cavity, one of which is by creating a more acidic environment that accelerates the demineralization process and increases the risk of caries. The nicotine content in cigarettes can reduce salivary flow rate and buffering capacity, thereby lowering the oral pH. This acidic environment enhances the activity of acidogenic bacteria such as *Streptococcus mutans*, which ferment carbohydrates into organic acids. The acidogenic theory proposed by W.D. Miller, as cited in Shifana et al., explains that the drop in pH due to acid production by bacteria leads to enamel demineralization. This process is supported by a study by Jasim, which showed that smokers have lower salivary pH and a higher risk of caries.

Based on caries depth, most respondents experienced caries that had reached the dentin layer (KMD), with some cases also extending to the pulp (KMP). The total number of caries depths exceeded the number of respondents, indicating that an individual may present with more than one type of caries depth and multiple carious lesions across different teeth. This finding shows that caries lesions are not always singular but may spread and develop in several teeth simultaneously. In line with the study by Nobre et al., individuals with smoking habits are at higher risk of developing multiple caries.

The distribution of calculus location revealed certain patterns. In cases of pulpal caries (KMP), calculus was commonly found on both sides of the oral cavity and often located on the same side as the affected tooth. Conversely, in enamel caries (KME), the distribution of calculus appeared more varied and did not show a specific pattern. Moreover, in cases where caries was found only on one side, for instance on the right side, calculus distribution also tended to occur on the same side. These results suggest the possibility of a unilateral chewing habit, which aggravates calculus formation in the affected area. This habit, combined with pulpal caries (KMP), contributes to greater calculus accumulation on the problematic side. These findings are consistent with Mahendra et al., who demonstrated that in severe caries cases, a one-sided chewing habit increases calculus distribution on that side.

The calculus risk assessment, calculated using the Calrisk application, showed that most respondents with caries had a calculus risk level within the mild to moderate category. However, in the group with higher smoking frequency, the majority of respondents were classified in the moderate risk category. Although the severity of caries and calculus does not always correspond, both conditions can occur simultaneously and worsen the condition of the dental hard tissues. Their interrelation is likely due to plaque accumulation and oral conditions favorable for bacterial growth, where the presence of one condition can contribute to the progression of the other. Research conducted by Marsh Pd, as cited in Wang et al., also revealed that accumulated dental plaque not only facilitates the development of cariogenic microorganisms that cause caries but also plays a role in calculus formation, ultimately worsening overall dental health.

After gaining an overview of the data, statistical tests were carried out to examine the deeper relationships between variables using Pearson correlation analysis. The results showed significant

relationships between smoking frequency and caries ($p = 0.002$), smoking frequency and calculus risk ($p = 0.004$), as well as between caries and calculus risk ($p = 0.042$). All three correlations had positive coefficients, indicating that an increase in one variable tends to be followed by an increase in the others. Based on these results, the alternative hypothesis (H_a) was accepted, namely that there is a relationship between caries and calculus risk among adolescent smokers.

This study shows that caries and calculus are two conditions affecting the dental hard tissues that may be interrelated, where an increase in caries severity tends to be followed by an increase in calculus risk. Therefore, the presence of caries should be considered not only as a localized dental disorder but also as an early indicator of the potential development of other problems, such as calculus formation.

CONCLUSION

Based on the findings of this study on the relationship between dental caries and the risk of calculus among students at SMK Swakarya Palembang, it can be concluded that most respondents were occasional smokers, while smaller proportions reported frequent or very frequent smoking. The majority of students consumed cigarettes at a light level of 1–5 sticks per day, with fewer students classified in the moderate and heavy categories. In terms of caries, most respondents were in the low to moderate categories, although some presented with a high number of affected teeth. All respondents experienced caries that had reached the dentin, with several cases extending to the pulp, and individuals could present with more than one lesion of varying depths. Every adolescent smoker in this study was found to have both caries and calculus, with calculus commonly detected on both sides of the oral cavity, often in the same location as the affected teeth.

In terms of risk, most students with caries were categorized as having a low to moderate risk of calculus. Statistical analysis using Pearson's correlation demonstrated significant associations between smoking frequency and caries, smoking frequency and calculus risk, as well as between caries and calculus risk, with all correlations being positive. These results confirm the alternative hypothesis (H_a), namely that there is a significant relationship between caries and calculus risk among adolescent smokers.

Suggestions

Based on the above conclusions, several suggestions can be made. Smoking has a detrimental impact on oral health; therefore, proper education is needed to raise public awareness about the dangers of smoking. In addition, Calrisk can be used as an alternative tool for measuring calculus risk as an early detection method to help prevent gingivitis and periodontitis.

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