

**Relationship of Smoking Habits to The Potential of Hydrogen (pH) of Saliva in Active Smokers****Euis Purbasari<sup>1</sup>, Oktadio Erikardo<sup>2\*</sup>, Rifa Audia Jasmine<sup>3</sup>**<sup>1,3</sup> Prodi D-III Teknologi Laboratorium Medis, STIK KESOSI, Jakarta, Indonesia<sup>2</sup> Prodi D-IV Teknologi Laboratorium Medis, STIK KESOSI, Jakarta, Indonesia

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**ABSTRACT**

Tobacco smoke when smoking contains harmful chemicals for the body, such as nicotine, tar, carbon monoxide, and others. These toxic substances enter the body and increase cancer risk, chronic obstructive pulmonary disease, cardiovascular disease, and teeth and mouth. The oral cavity is the organ first exposed to cigarette smoke. There is a liquid to maintain oral health, namely saliva, with an average Potential of Hydrogen (pH) of around 6.8-7.4. Saliva acts as a buffer to keep the salivary pH to remain neutral. The buffer capacity can decrease due to the influence of cigarette smoke, which spreads throughout the oral cavity and will be followed by a decrease in salivary pH to become more acidic. This will affect the function of saliva in maintaining the health of the oral cavity from caries, halitosis, dry mouth, and others. This study aimed to investigate the relationship between smoking habits and salivary pH in active smokers. This study used an analytic survey with a cross-sectional research design approach. The sample is 30 respondents with a purposive sampling technique. There is a significant relationship between the number of cigarettes consumed per day ( $p=0.009$ ) and the duration of smoking ( $p=0.004$ ) on salivary pH. An increase in smoking habits in terms of the number and time of tobacco has a relationship with a decrease in salivary pH.

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**1. INTRODUCTION**

Smoking is still a public habit that significantly influences health problems. The World Health Organisation (WHO) says that a smoker smokes tobacco products every day or sometimes. When tobacco is burned, unconsciously, the pollution produced is immediately inhaled and absorbed by the body. This can cause disease, decreased quality of life, and even death [1]. Based on WHO data in 2021, Indonesia is a country with the largest number of smokers in ASEAN, with a prevalence rate of 37.6%. In addition, WHO classifies data on the number of smokers by gender, namely men at 72.6% and women at 2.6% [2]. Meanwhile, according to Riset Kesehatan Dasar (RISKESDAS) data in 2018, the proportion of smokers in Indonesia is 24.3%, with a ratio of men totaling 47.3% and women 1.2% [3].

Burnt tobacco smoke contains chemicals harmful to the body, such as nicotine, tar, carbon monoxide, phenol, formaldehyde, heavy metals, and others [4]. The toxic content of cigarette smoke entering the body can increase the risk of various diseases such as cancer, diabetes mellitus, chronic obstructive pulmonary disease, and cardiovascular system disorders [5]. Smoking contributes to dental and oral diseases, where the oral cavity is the first organ exposed to cigarette smoke [6]. The oral cavity has a fluid to maintain oral health called saliva. Saliva is produced by three main salivary glands, namely parotid glands, submandibular, sublingual glands, and other minor salivary glands [7]. Saliva contains enzymes, mucin, antibacterial components, electrolytes, and others. Saliva moisturizes the oral cavity to prevent friction during the chewing process. In addition, saliva also acts as an antibacterial, tooth remineralization, tissue repair, taste sensitivity, digestion, and as a buffer to maintain the potential of hydrogen (pH) saliva to remain neutral, neither acidic nor alkaline [8], [9].

Saliva, under normal conditions, has a pH of about 6.8-7.4, which can support the work of digestive enzymes such as pipelines. The pH of normal saliva also maintains the content of Immunoglobulin A (IgA) contained in saliva to function in preventing the adhesions of bacteria and

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viruses in the oral cavity [10], [11]. A study stated that cigarette smoke that spreads throughout the oral cavity and exposes flavoring receptors continuously could cause a decrease in sensitivity and receptor changes from the sense of taste so that, in the long run, it results in a reduction of the rate of saliva flow [12]. It is known that a decrease in saliva flow rate is associated with a reduction of buffer capacity in saliva. When there is a decrease in buffer capacity, it will be followed by a reduction in saliva pH, and this is because buffer capacity is one of the critical factors in maintaining the pH balance of saliva in the oral cavity [13].

The decrease in buffer capacity can also be affected by cigarette nicotine content. Nicotine is a substance that can be absorbed through the oral cavity mucosa and will spread to the bloodstream to all organs of the body. Nicotine circulation in the bloodstream affects the function of the salivary glands, causing adverse effects on the oral cavity, such as caries, oral cavity mucositis, candidiasis, halitosis, dry mouth, and others [14], [15]. Researchers conducted by Singh et al. in 2015 suggested that long-term smoking results would decrease the flow rate of saliva and saliva pH, while other research results also showed no difference in saliva pH in smokers and non-smokers. Other studies have also shown results that prolonged smoking does not affect taste receptors and saliva flow rates [12], [16], [17].

From the background description above, it is known that there are still many smoking habits in Indonesia and the lack of public knowledge about oral cavity health, so the author is interested in conducting research on "The relationship of smoking habits with potential saliva Hydrogen (pH) in active smokers".

## 2. METHOD

The study used analytical surveys with a *cross-sectional* research design approach. The sample in this study totaled 30 respondents with purposive sampling techniques that had criteria for men (ages 15-59 years), active smokers, who were not fasting and taking drugs. Analyze data using univariate analysis and bivariate *IBM SPSS Statistics 25* computer program. The data obtained was carried out by normality tests using the *Shapiro-Wilk* test. Then, it was analyzed using the *Pearson* test to determine the relationship between smoking habits to saliva pH. The association is considered meaningful if the value of  $p < 0.05$  with a 95% CI.

## 3. RESULTS AND DISCUSSION

The research data were obtained from a direct examination of salivary pH and interviews with 30 active smokers. Researchers explain the research procedure so that respondents understand the method for sampling saliva and provide several questions in the form of questionnaires to evaluate the smoking habits of each respondent. The data that has been obtained will be processed and analyzed univariately and bivariate. Characteristics of age-related research subjects and education can be seen in Table 1.

Table 1. Characteristics of Research Subjects (n=30)

Characteristics	Frequency (n)	Percentage (%)
<b>Age (Years)</b>		
18-28	6	20,0
29-38	7	23,3
39-48	9	30,0
49-58	8	26,7
<b>Total</b>	<b>30</b>	<b>100,0</b>
<b>Mean±SD</b>	<b>39,77±11,74</b>	
<b>Education</b>		
High School	25	83,3
Bachelor	5	16,7
<b>Total</b>	<b>30</b>	<b>100,0</b>

The results of the study in Table 1 showed that the entire study subjects ranged from the ages of 18-58 years. The average age of smokers is 39.77 years. The age of 39-48 years is the age most who consume cigarettes, namely nine respondents with a percentage of 30.0%. Meanwhile, the respondents who smoked the most had an educational background of high school graduates totaling 25 respondents with a rate of 83.3% and followed by college graduates at 16.7%.

The characteristics of smokers from the 30 respondents who were the research subjects are presented in Table 2 below:

Table 2. Characteristics of Smokers

Characteristics	Frequency (n)	Percentage (%)
<b>Cigarette Type</b>		
Filter	27	90,0
Kretek	3	10,0
<b>Total</b>	<b>30</b>	<b>100,0</b>
<b>Number of Cigarettes by Sitepoe (Cigarettes/Day)</b>		
Mild (1-10)	4	13,3
Moderate (11-24)	21	70,0
Heavy (>24)	5	16,7
<b>Total</b>	<b>30</b>	<b>100</b>
<b>Smoking Time (Years)</b>		
<15	12	40,0
>15	18	60,0
<b>Total</b>	<b>30</b>	<b>100,0</b>
<b>Salivary pH</b>		
Acid	23	76,7
Neutral	7	23,3
<b>Total</b>	<b>30</b>	<b>100</b>

Table 2 shows the characteristics of the study subject smokers based on the type of cigarette, the amount of cigarette consumption per day, the length of smoking, and the pH value of saliva. From Table 2, it was found that the type of cigarette that respondents most consumed was 27 respondents' filtered cigarettes, with a percentage of 90.0%. Three respondents only consumed kretek-type cigarettes, with a rate of 10.0%. In addition, the amount of cigarette consumption per day based on the classification according to Sitepoe, the majority of study subjects had moderate smoking habits with a percentage of 70.0%, followed by heavy smoking habits totaling five people with a rate of 16.7%. Finally, four people had a ratio of 13.3%. Table 2 shows that the longest smoking of respondents was >15 years, as many as 18 people with a percentage of 60.0%, and saliva pH in the majority of smokers changed to be more acidic, which amounted to 23 respondents with a rate of 76.7%.

The relationship between smoking, from the amount of cigarette consumption per day and the length of smoking to the pH of saliva, is presented in Table 3 as follows:

Table 3. Relationship Between Smoking Habit and Salivary pH

		<b>Smoking Habit</b>	
		<b>Number of Cigarettes/Day</b>	<b>Smoking Time</b>
<b>pH saliva</b>	<b>r</b>	0,466	0,515
	<b>p</b>	0,009	0,004
	<b>n</b>	30	30

Based on the results of statistical trials using the *Pearson* test in Table 3, the results of the relationship between smoking and saliva pH were obtained. The results of a statistical test of the relationship between the amount of cigarette consumption per day and the length of smoking to the pH of saliva were obtained  $p < 0.05$  and  $r = 0.466$  (number of cigarettes/day);  $r = 0.515$  (smoking time), this showed a significant relationship between the amount of cigarette consumption per day and the length of smoking to the These results mean an increase in the amount of cigarette consumption per day and the length of smoking will increase the pH of saliva to be more acidic.

The male group had an average age of 39.77 years, with the highest number of smokers in the age group of 39-48 years (30.0%). The results are close to RISKESDAS data in 2013, which states that the age range of 39-48 years is the age of most men who consume cigarettes every day, with a prevalence of 32.2% and followed by an age range of 49-58 years with a prevalence of 31.4%. Based on educational characteristics, the largest group of smokers is high school graduates (83.3%) and followed by college graduates (16.7%). This is in accordance with the results of RISKESDAS in 2013 that the high group of smokers in Indonesia has an educational background of high school graduates [18]. It is known that education is one of the factors that can affect smoking, where the lower a person's education, the higher his habit of smoking. One of the causes is a lack of knowledge about the dangers of consuming these cigarettes [19].

In this study, filter-type cigarettes were found to be the most consumed cigarettes by respondents. This is in accordance with research conducted by Rohmawati in 2019 that respondents who smoked the filter type were 83.3% and kretek was only 16.7% [20]. Filter-type cigarettes can filter out components that endanger health in the body, such as nicotine, carbon monoxide, and tar content, so people think filter cigarettes are safer than kretek cigarettes. Filter cigarettes contain less nicotine and tar because the filter will hold some nicotine and tar in cigarette smoke. In contrast, kretek cigarettes do not have filters which result in the inability to filter harmful components in cigarettes so that the nicotine and tar content becomes higher. However, any cigarette will still harm the human body [21].

The role of cigarettes on salivary pH in this study is related to smoking in terms of the number and duration of smoking. The number of cigarettes in this study was categorized according to Sitepoe, and the results of respondents were included in the category of moderate smokers with a smoking habit of 11-24 cigarettes/day. In contrast, the length of smoking was divided into two categories, namely  $>15$  years and  $<15$  years. The results of statistical tests in Table 4 show that there is a meaningful relationship between the number of cigarettes and the duration of smoking consumed daily, and the pH of saliva in active smokers ( $p = 0.009$ ;  $p = 0.004$ ), this means that the greater the number and the longer a person smokes will affect the pH of the saliva to become more acidic. These results are thought to be that cigarettes can influence the factors that cause saliva pH to decrease. One such factor is that cigarettes can reduce the flow rate and capacity of the saliva buffer so that the concentration of bicarbonate in the saliva is significant in keeping the oral cavity unmaintained. Bicarbonate in saliva can decrease due to the chemical content in cigarettes, such as nicotine, tar, and carbon monoxide. This causes a decrease in saliva pH. The impact of other chemicals from cigarettes also irritates the oral mucosa directly and stimulates proinflammatory mediators, such as interleukin-1 and prostaglandins, that can damage salivary gland cells and tissues. The results of this study are supported by a study conducted by Lestari et al. in 2022 which states that cigarette habits can affect the pH of saliva to become more acidic, thereby increasing the incidence of caries in the teeth [10], [13], [22].

In addition, this study is in line with the results of Kayani et al. in 2020, that the pH of smokers' saliva is more acidic than non-smokers. Smoked cigarettes will cause hot smoke, which can affect the flow of blood vessels in the gums, thereby reducing saliva production in the oral cavity. The decrease in saliva production will make the mouth tend to be drier compared to non-smokers. A more parched mouth will increase the risk of developing acidogenic bacteria, such as *Streptococcus mutans* and *Lactobacillus*, resulting in an acidic atmosphere. This is due to the amount and function of saliva to protect the oral cavity decreasing. An increase in the number of acidogenic bacteria in the oral cavity will facilitate the dissolution of tooth enamel and damage surrounding tissues, triggering demineralization, which has an impact on accelerating the occurrence of dental caries [23], [24].

#### 4. CONCLUSION

Increased smoking in terms of the amount and duration of smoking has been associated with a decrease in saliva pH.

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