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RESEARCH ARTICLES

Differences in the oral hygiene status and clinical periodontal status between conventional and electric smokers

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ABSTRACT

Conventional and electrical cigarette use could result in bad pathological conditions in the oral cavity, which may lead to periodontal diseases. This research aimed to determine the differences in the oral hygiene and clinical periodontal status between conventional and electric smokers. This research was a quantitative observational research and was designed as a cross-sectional study. The samples were selected using purposive sampling. A total of 110 respondents (n = 110) were involved, consisted of 60 conventional smokers and 50 electric smokers. Their oral hygiene status were examined using oral hygiene index simplified (OHI-S) measurement, while their periodontal tissue status were assessed using bleeding on probing (BOP) and probing pocket depth (PPD) measurements. The data were analyzed using the Mann-Whitney test with a significance level of $\alpha < 0.05$. The median and first quartile of OHI-S scores of the conventional smokers' group were 2.7 and 2.2, while the electric smokers' group was 2.2 and 1.4 respectively, with a significant value of $p < 0.001$. The median and first quartile BOP scores of the conventional smokers' group were 36% and 29%, while the electric smokers' group were 35% and 28% respectively, with a significant value of $p = 0.750$. The median and first quartile of PPD scores in the conventional smokers' group were 3.2 and 2.7, while the electric smokers' group were 3.1 and 2.6 respectively with a significant value of $p = 0.765$. Conventional smokers had worse oral hygiene status than electric smokers. Conventional and electric smokers did not have significant differences in periodontal health including gingival bleeding and poor pocket depth.

Keywords: conventional smokers; electric smokers; oral hygiene status; periodontal health

INTRODUCTION

Smoking habit is widely practice in everyday life. Data from the World Health Organization (WHO) in 2009 stated that the smoking rate in Indonesia amounted of 215 billion cigarettes per year. Based on their usages, cigarettes in Indonesia are classified into three types: shisha cigarettes (1.23%), electric cigarettes (2.15%) and conventional cigarettes (52.15%), which is further divided into kretek cigarettes (52.15%), white cigarettes (33.39%), and rolled cigarettes (11.08%). These data highlighted that most Indonesians smoke conventional cigarettes.[1]

Conventional cigarettes are made from pure tobacco, which are processed in a combustion, before they are smoked directly or indirectly using a pipe. The smoke in conventional cigarettes contains various types of harmful chemicals due to their negative impact on humans body and oral health.[2]

The epidemic due to conventional smoking is one of the biggest clinical threats in the world today. It has been estimated that there have been more than 1.3 billion smokers worldwide, about half of the current smokers die from smoking-related diseases. Governments around the world are making various efforts to suppress the epidemic caused by conventional cigarettes, one of which is by using nicotine replacement therapy (NRT). Out of the several types of NRT, electric cigarettes is the most widely recognized in recent years.[3]

Electric cigarettes are battery-based inhalers designed to provide the nicotine sensation without going through the tobacco burning process. At the early emergence of electric cigarettes, it was said

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to be safe for health because the nicotine solution contained in electric cigarettes only consisted of a mixture of water, propylene glycol, flavor enhancers, tobacco aroma and other compounds that did not contain tar, carbon monoxide or other toxic substances, which are common in tobacco cigarettes. Many researches on e-cigarettes seem to consider them as promising and safer alternative to conventional cigarettes, but in fact they are not. In 2010, WHO no longer recommended electric cigarettes as NRT because several researchers found that they contained some carcinogenic and toxic substances and thus declared that e-cigarettes did not meet safety standards.[4]

Conventional and electrical cigarettes not only have a systemic effect, but also cause bad pathological conditions in the oral cavity.[5] Oral cavity is the part of digestive system that is prone to exposure of cigarette smoke. This is the main area for the absorption of chemical substances resulted from cigarette burning. Different types of cigarettes and the intensity of smoking habits have been shown to be strongly related with the occurrence of oral and dental diseases, one of which is periodontal disease.[6]

Periodontal disease that occurs in conventional smokers is caused by the heat generated by burning cigarettes and can cause vascular disorders and salivary secretion. In addition, the chemicals contained in cigarettes may lead to the formation of brown deposits on the surface of the teeth, and thus roughens the tooth surface. The rough tooth surface causes food debris to stick easily. The sticking food debris on the tooth surface can accelerate the growth of dental plaque. Plaque accumulation that is not cleaned regularly will calcify and harden and turns into tartar. This condition may lead to the gums that is susceptible to inflammation, resulting in gingivitis. Untreated gingivitis will subsequently become periodontitis.[7]

Periodontal disease that occurs in electric smokers is caused by the presence of a chemical solution in the cigarettes. The content of electric cigarettes varies, but generally they contain nicotine, propylene glycol, glycerin and flavoring. These four chemical solutions, if heated, can produce vapor, which if exposed in the oral cavity, will especially affect gingival epithelial cells and periodontal ligament fibroblasts. As a result, it can increase expression of proinflammatory cytokines, such as cyclooxygenase-2 (COX-2) and prostaglandin E2 (PGE2) in these cells. PGE2 plays a role in inflammatory processes, such as vasodilation of blood vessels, edema, and pain.[8]

The side effects of smoking on the periodontal tissue are closely related to the length of smoking and the number of cigarettes consumed per day. This is mainly attributed to the fact that the longer and the more frequent the chemical exposure and the heated temperature from cigarettes smoking, the greater the incidence of periodontal disease in smokers.[9] The purpose of this research was to determine the differences in oral hygiene status and clinical periodontal status between conventional and electric smokers.

MATERIALS AND METHODS

A certificate of ethical approval was obtained from the Research Ethics Commission of the Faculty of Dentistry, Universitas Gadjah Mada No. 00324/KKEP/FKG-UGM/EC/2019. This research used quantitative observational method with a cross-sectional study design. The research population was the male population who live in Yogyakarta City and Sleman Regency, Yogyakarta Province. The sample of this research was 60 conventional smokers and 50 electric smokers who live in Mantrijeron Sub-District, Depok Sub-District, and Gamping Sub-District. The data were collected using purposive sampling based on the following inclusion criteria: 1) Respondents living in Yogyakarta City and Sleman Regency, Yogyakarta Province; 2) Conventional smokers: respondents who smoke filtered clove cigarettes; 3) Electric smokers: respondents without a history of conventional smoking and only use electric cigarettes; 4) Respondents with high school and university education levels; 5) Respondents who were self-employed, working in private sectors or employed as civil servants.

The respondents' conventional and electric smoking habits were measured using a particular form about smoking habits. It specified the starting time of conventional and electric smoking, the number of conventional cigarettes smoked each day, and the frequency of smoking electric cigarettes per day. The measuring tool for the assessment of oral hygiene status used an examination form that refers to OHIS Green and Vermilion. The measurement tool for periodontal health assessment used the Ainamo & Bay Bleeding on Probing (BOP) measurement and the WHO's Probing Pocket Depth (PPD) measurement. The data were analyzed statistically using the Mann-Whitney test with a significance level of 0.05. The examinations were carried out by three dentists. The kappa values for measuring agreements were between 0.697-0.844.

RESULTS

The normality test of this research used one sample Kolmogorov-Smirnov on independent variables, which included the smoking status, conventional and electric smoking durations, number of conventional cigarettes per day, length of electric smoking and frequency of smoking electric cigarettes per day. The dependent variables included OHIS, BOP and PPD. All the variables were not normally distributed.

The differences in oral hygiene status and periodontal health were tested using BOP and PPD parameters between conventional smokers and electric smokers, while the Mann-Whitney test was used because the data were not normally distributed. The results of the Mann-Whitney test were depicted in Table 1.

Based on the Mann-Whitney test on the median of OHI-S score, quartile 1 and quartile 3 were higher in the conventional smoking group, but they were lower in the electric smoker group with a significant value of $p < 0.001$, which indicated a significant difference in OHI-S scores between the two groups of smokers. Conventional and electric smokers did not show significant differences ($p > 0.05$) in the BOP and PPD scores.

DISCUSSION

The conventional smoking habit has an impact on oral hygiene, among others, in the form of tooth staining, debris, and calculus.[10] The results of the Mann-Whitney test showed a significant difference in oral hygiene status between conventional smokers and electric smokers ($p < 0.05$). This is because conventional cigarettes contain discoloring substance, especially tar. These substances can turn the color of the teeth into yellow and leave a dark brown stain that sticks firmly, which roughens the tooth surface and accelerate the accumulation of plaque on the teeth. As a result, it can worsen oral hygiene in conventional smokers.[11] Similarly, electric cigarette vapor on the oral cavity may lead to periodontal tissue damage because electric cigarette vapor does not leave stain or plaque on the tooth surface.[12]

The main causes of periodontal disease are plaque and calculus, and bacteria accumulation, while the risk factors that can affect the severity of periodontal disease are conventional and electric smoking habits. Conventional and electrical cigarette use can be an important etiological factor and can exacerbate periodontal disease. This is evidenced by an increase in periodontal

Table 1. Summary of Mann-Whitney test results

No	Dependent variable	Conventional cigarette			Electric cigarette			
		Median	Q1	Q3	Median	Q1	Q3	P
1.	OHIS	2.7	2.2	3.6	2.2	1.4	2.9	< 0.001
2.	BOP	36%	29%	46%	35%	28%	40%	0.750
3.	PPD	3.2	2.7	3.7	3.1	2.6	3.4	0.765

Notes: OHIS scores in conventional cigarette smokers were significantly worse than those of electric cigarette smokers

pockets accompanied by loss of alveolar bone in smokers, whereas in nonsmokers, the condition of the periodontium was not accompanied by a low plaque index, and evaluation of the periodontium over the last 10 years.[13] The results of this research were consistent with a research conducted by Rahayu, et al, which stated that the better a person's knowledge, attitude, and behavior towards the maintenance of oral hygiene, the better his periodontal health status.[14]

The Mann-Whitney test results showed no significant difference in gingival bleeding scores between conventional smokers and electric smokers. Conventional and electrical cigarettes can both worsen gingival bleeding scores. This is because conventional cigarette smoke contains acrolein cyanide, which can inhibit the function of PMN leukocytes, causing a decrease in lysosomes. Lysosomes play a role in the body's immune system, by decreasing lysosomes in this environment, which is beneficial for the growth of bacteria that cause periodontal disease. As a result, someone who smokes is more prone to periodontal disease than non-smokers.[15]

In electric cigarettes, gingivitis can occur because the presence of nicotine solutions in electric cigarettes can cause vasoconstriction of peripheral blood vessels, which can reduce blood flow to the gums. Decreased blood flow causes a decrease in oxygen supply to the tissues.[16] This inflammatory process is also followed by an increase in the number of inflammatory cells in the form of lymphocytes and macrophages, which can result in loss of collagen and connective tissue in the gingiva.[17]

The Mann-Whitney test results showed no significant difference in pocket depth scores between conventional smokers and electric smokers. Both conventional and electric smokers had a worsening pocket depth. Periodontitis in conventional smokers is caused by the presence of nicotine, which can damage the immune response system and narrow blood vessels, including blood vessels in the tissue around the teeth. This causes a decrease in oxygen in the tissues and destroys the immune response system, thereby creating an environment favorable for the growth of bacteria that cause periodontal diseases.[18] Periodontitis in electric cigarettes is caused by electric cigarette vapor, which can increase COX-2 and PGE2. Consequently, it has an impact on an increase on the excretion of advanced glycation end product receptors in the gingival tissue, making it easier to form inflammation. The result of untreated gingivitis can become periodontitis.[19]

CONCLUSION

Conventional smokers have worse oral hygiene status than electric smokers. Conventional and electric smokers have clinical periodontal problems, including gingival bleeding and poor pocket depth.

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