

Periodontal status in male smokers visiting Hue University of Medicine and Pharmacy Hospital

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Abstract

Background: Many clinical studies, which were conducted to evaluate the association between smoking and periodontal diseases, have confirmed the harmful effects of smoking on oral health. Therefore, it is essential to properly assess the periodontal status and smoking habits to improve the effectiveness of interventions and disease prevention. **Objective:** This study aims to compare the prevalence and severity of periodontal disease in male smokers and male non-smokers visiting Hue University of Medicine and Pharmacy Hospital and to investigate the relationship between smoking and periodontal disease. **Methods:** A case-control study with 220 patients divided into two groups using a questionnaire to survey men aged 18-65 who have been smoking at the Department of Odonto-Stomatology, Hue University Hospital of Medicine and Pharmacy. Factors related to smoking behavior and clinical examination of periodontal status were adopted. **Results:** In the smokers group, the mean gingival index "GI" (0.647 ± 0.316), plaque index "PII" (2.045 ± 0.447), "PPD" periodontal pocket depth ($1.955 \pm 0.470\text{mm}$), clinical adhesion loss "CAL" ($1.883 \pm 0.771\text{mm}$), "BOP" bleeding index (4.898 ± 3.117) with 95% confidence interval "CI". The percentage of patients without periodontitis accounts for the majority compared with the remaining levels of periodontitis with values of smokers 67.27% and 99.36% non-smokers. There is a significant difference in gingivitis and periodontitis in both study groups with $p < 0.05$. There is a correlation between periodontal indices and smoking indicators such as the number of cigarettes smoked per day, the number of years of smoking, and cumulative exposure $p < 0.05$. **Conclusion:** The study shows that the heavier the smoking status, the worse the periodontal condition. However, the more cigarettes smoked, the less gingivitis and bleeding gums.

Keywords: Periodontal index, smoking, periodontal disease.

1. BACKGROUND

Tobacco use is one of the major public health threats that kill more than 8 million people every year all over the world [1]. There are approximately 80% of myocardial infarctions before the age of 50 years, and 70% of chronic lung diseases and over 80% lung cancer are attributable to smoking [1],[2],[3]. In addition, about the harmful effects of smoking on overall health, there is a lot of evidence confirming the harmful effects of smoking on oral health by increasing the risk of Candida infections, tooth decay, precancerous lesions, implant failure, and periodontal diseases [4][5].

Although the association between smoking and periodontitis is supported by clinical studies, the exact biological mechanisms involved in this association have not been determined [6]. Quitting smoking has been highlighted as the best practicable way to reduce the risk of onset and progression of periodontitis and to improve treatment outcomes [4].

To better assess the periodontal status of smokers and then offer highly effective treatment options,

we carried out the topic: "Periodontal status in male smokers visiting hue university hospital of medicine and pharmacy".

Objective: 1) To compare the prevalence and severity of periodontal disease in male smokers and male non-smokers visiting Hue University of Medicine and Pharmacy Hospital; 2) To investigate the relationship between smoking and periodontal disease.

2. MATERIALS AND METHODS

2.1. Study design

This case control study was done by using a questionnaire to survey male smokers who visited the Department of Odonto-Stomatology - at Hue University of Medicine and Pharmacy during the period from August 2021 to April 2022.

The criteria for choosing cigarette smokers

- Male patients aged 18-65, who are cigarette smokers.
- Non-periodontal treatment within 6 months up to the time of the study.
- Smokers are in a normal mental state and agree

to participate in the study.

The criteria for choosing non-smokers (control group)

- Male patients aged 18-65, who do not smoke at any time in their lives.
- Non-periodontal treatment within 6 months up to the time of the study.
- Non-smokers are in a normal mental state and agree to participate in the study.

Exclusion criteria for both groups

- Patients with acute local or systemic diseases that manifest on periodontal tissue.
- Patients with aggressive periodontitis.
- Subjects who indicated the use of other forms of tobacco such as cigar, pipe.

2.2. Sample size and sampling method

Sample size

The minimum sample size for the cigarette smokers group is calculated according to the following formula:

$$N = \frac{Z^2_{(1-\alpha/2)} p (1-p)}{d^2}$$

According to the Global Adults Tobacco (2015), in Vietnam, the percentage of adult males who smoke is 45.3% [7]. Therefore, in this study, choosing $p=0.453$, $d=0.1$, $\alpha=5\%$ corresponding to $Z(1-\alpha/2)=1.96$, we get $N=96$.

The ratio of the cigarette smokers group: to the non-smokers was 1:1, so the minimum sample size is 192 patients. In this study, a total of 220 patients were examined and evaluated.

Sampling method: Non-probability sampling, intentional sampling.

Based on the selected criteria, patients were divided into two groups cigarette smokers and non-smokers until the number of patients is sufficient. List and examine all selected patients.

2.3. Study process

Step 1: Receive the patient and provide specific instructions for answering the questionnaire.

Step 2: Clinical examination, collecting information, measuring, observing, and recording periodontal indicators. Clinical examination was conducted by 02 trained people to standardize all subjects to ensure uniform data set.

Step 3: Interview the patient and fill in information about factors related to smoking such as smoking time, number of cigarettes smoked per day, and exposure level.

Step 4: Evaluate the severity of gingival inflammation, diagnose and classify periodontitis.

2.4. Variables measurement

- Characteristics of study sample:

+ Age groups were divided into 3 groups followed WHO: ≤ 24 , 25-44 and ≥ 45 [8].

+ Education levels and occupation were divided into groups followed Loc Giang Do [9].

- Periodontal indices:

+ Plaque Index (PI) of Loe and Silness (1967): Evaluation of plaque in 4 sites: disto-facial, facial, mesio-facial, and lingual. Evaluate all teeth, except wisdom teeth.

+ The gingival index (GI) of Loe and Silness (1963): The GI index was assessed on all teeth, except wisdom teeth, on 4 gingival regions of the teeth similar to the plaque index.

+ Bleeding on Probing (BOP): Probing at the site of the gingival papillae, lingual gingival margin, and the buccal gingival margin is considered positive when bleeding is observed within 20 to 30 seconds. Evaluate all teeth, except wisdom teeth. BOP of each patients was calculated in percentage of all sites which were bleeding on probing.

+ Probing Pocket Depth (PPD) was assessed according to Nield - Gehrig: Measure the distance from the gingival margin to the bottom of the gingival pocket on all teeth, except wisdom teeth, at six positions on each tooth: disto-facial, facial, mesio-facial, disto-lingual, lingual and mesio-lingual, in millimeter.

+ Clinical Attachment Loss (CAL) was assessed according to Nield - Gehrig: Measure the distance from the CEJ (Cemento - Enamel Junction) to the bottom of the gingival pocket on all teeth, at six positions on each tooth: disto-facial, facial, mesio-facial, disto-lingual, lingual and mesio-lingual. The measurement is similar to that of probing pocket depth (PPD), in millimeter.

- Smoking status

+ Tobacco use: calculated on the average number of cigarettes smoked per day, units of cigarettes/day. Divided into two levels: light (smoking < 10 cigarettes/day) and heavy (smoking ≥ 10 cigarettes/day) [10].

+ Smoking time: calculated according to the number of years smoked, in units of years. It was divided into two levels: light (smoking < 15 years) and heavy (smoking ≥ 15 years) [8].

+ Cumulative exposure: calculated by multiplying the number of packs per day by the number of years smoked package-year unit. It is divided into two levels: light (smoking < 10 pack-years) and heavy (smoking ≥ 10 pack-years) [10].

Assessment of the severity of gingivitis was based on the average GI index [11]. Periodontal disease was classified based on a combination of gingivitis and pocket probing depth (PPD) or clinical attachment loss (CAL), or radiographic bone loss, or tooth loss (caused by periodontitis). In which, PPD > 3 mm and the gums are red, inflamed, and bleeding on examination, the patient is diagnosed as periodontitis (according to the American Academy of Periodontology (AAP) and the European Federation of Periodontology (EFP) update 2018) [12].

2.5. Statistical Methods

Data were collected and cleaned by Excel software, then processed by SPSS 20 statistical software, the results are described by frequency and percentage tables, mean and standard deviation. The Fisher exact test was used to test the proportions of study parameters between nonsmokers and smokers. Students T-test (two-tailed, independent) and Mann-Whitney U test

have been used to find the significance of study parameters between nonsmokers and smokers. Analysis of variance has been used to find the correlation between periodontal status and smoking status. The significant level was set at $p < 0.05$ with a 95% confidence interval.

In this study, all content of the questionnaire and study process were accepted by participants, and all information of the study subjects is kept confidential. Ethical clearance for the study was obtained from the dean of the Odonto-Stomatology department.

3. RESULTS

3.1. General characteristics of the study sample

The study was conducted on 220 adult male patients (from 18 to 65 years old) divided into two groups of cigarette smokers and non-smokers, each group of 110 people. This is the age group with a high frequency and prevalence of smoking.

Table 1. Some characteristics of the research sample

Characteristics		Cigarette smokers N(%)	Non-smokers N(%)
Age	< 24	2 (1.82)	52 (47.27)
	24 – 44	64 (58.18)	50 (45.45)
	> 44	44 (40.00)	8 (7.27)
Education level	Primary school	1 (0.91)	0 (0)
	Junior High school	32 (29.09)	6 (5.45)
	High school	40 (36.36)	27 (24.55)
	College	10 (9.09)	13 (11.82)
	University, Graduate	27 (24.5)	64 (58.18)
Occupation	Student	2 (1.82)	47 (42.73)
	Staff	38 (34.55)	38 (34.55)
	Unskilled Labor	50 (45.45)	24 (21.82)
	Farmer	14 (12.73)	0 (0)
	Other	6 (5.45)	1 (0.91)
Assessment of smoking status in Cigarette smokers			
The number of cigarettes	< 10 cigarettes/day	49 (44.55)	x
	≥ 10 cigarettes/day	61 (55.45)	
The number of years of smoking	< 15 years	46 (41.82)	x
	≥ 15 years	64 (58.18)	
Exposure level	< 10 pack/year	67 (60.91)	x
	≥ 10 pack/year	43 (39.09)	

In the group of cigarettes smokers, the highest proportion was 24 - 44, while in the non-smokers there were 2 groups under 24 years old and 24 - 44 years old.

Education level: In the group of cigarettes smokers, the study participants were mainly at high school (36.36%). In the non-smokers, the subjects with university and graduate degrees accounted for the majority (58.18%).

Occupation: In the group of cigarette smokers, the majority of study participants were unskilled labor (45.45%). For the non-smokers group, students (42.73%) accounted for the majority.

Smoking status in the smoked group: According to the results of a study on 110 male smokers, the percentage of people who smoked cigarettes per day was at a heavy level (≥ 10 cigarettes/day) accounted for 55.45%. The proportion of people with years of smoking at a heavy level (≥ 15 years) accounted for 58.18%. Meanwhile, the cumulative exposure of the cigarette smokers group was mostly light (<10 packs/year) accounting for 60.91%.

3.2. Clinical characteristics of periodontal tissue in two groups of men.

Table 2. Average comparison of periodontal indexes of the two study groups

Periodontal index	Group	Mean \pm SD	95% C.I	p-value
GI	Smokers	0.647 \pm 0.316	0.587 - 0.706	< 0.001
	Non-smokers	1.155 \pm 0.420	1.076 - 1.234	
CAL (mm)	Smokers	1.883 \pm 0.771	1.730 - 2.036	< 0.001
	Non-smokers	0.688 \pm 0.039	0.610 - 0.766	
PPD (mm)	Smokers	1.955 \pm 0.470	1.867 - 2.044	< 0.001
	Non-smokers	1.347 \pm 0.228	1.303 - 1.390	
PI	Smokers	2.045 \pm 0.447	1.961 - 2.130	< 0.001
	Non-smokers	1.578 \pm 0.281	1.525 - 1.631	
BOP (%)	Smokers	4.898 \pm 3.117	4.310 - 5.487	< 0.001
	Non-smokers	10.10 \pm 5.308	9.097 - 11.103	

There is a statistically significant difference between the two groups of cigarettes smokers and the non-smokers group with $p < 0.05$.

3.3. Evaluation of gingivitis and periodontitis in two study groups

Table 3. Gingivitis and periodontitis in two study groups

Assessment of gingivitis and periodontitis		Smokers n - %	Non-smokers n - %	p
Assess the degree of gingivitis (By GI index)	No gingivitis	0 (0.0)	4 (3.64)	$p < 0.001$
	Mild gingivitis	99 (90.0)	41 (37.27)	
	Moderate gingivitis	11 (10.0)	61 (55.45)	
	Severe gingivitis	0 (0.0)	4 (3.64)	
Assess the degree of periodontitis (By PPD and CAL index)	No periodontitis	74 (67.27)	106 (99.36)	$p < 0.001$
	Mild periodontitis	19 (17.27)	4 (3.64)	
	Moderate periodontitis	17 (15.45)	0 (0.0)	
	Severe periodontitis	0 (0.0)	0 (0.0)	

Comparing the degree of gingivitis in both cigarette smokers and non-smokers groups, there was a statistically significant difference with $p < 0.05$.

The test results showed that there was a statistically significant difference between periodontitis extent and the two study groups $p < 0.05$.

3.4. The relationship between smoking and periodontal disease in smoked group (110 patients)**Table 4.** Correlation between the periodontal index and smoking status (N=110)

Periodontal index	Number of cigarettes smoked per day		Years of smoking		Exposure level	
	r	p	r	p	r	p
GI	-0.408	<0.001	-0.503	<0.001	-0.488	<0.001
CAL	0.563	<0.001	0.872	<0.001	0.791	<0.001
PPL	0.517	<0.001	0.792	<0.001	0.72	<0.001
PLI	0.558	<0.001	0.768	<0.001	0.75	<0.001
BOP	-0.339	<0.001	-0.488	<0.001	-0.412	<0.001

The study results show that there is a correlation between the periodontal index GI, CAL, PPD, PLI, BOP, and smoking status when considering the measures of the number of cigarettes smoked per day, and the number of years of smoking and exposure levels. The obtained correlation coefficients (r) represent moderate and close correlations with statistical significance ($p < 0.05$).

Table 5. Assess the status of periodontal indicators and years of smoking (N=110)

Periodontal index		Mean \pm SD	95% C.I	p
Years of smoking				
GI	<15 years	0.795 \pm 0.303	0.705 - 0.885	< 0.001
	\geq 15 years	0.541 \pm 0.283	0.470 - 0.661	
CAL	<15 years	1.207 \pm 0.488	1.062 - 1.352	< 0.001
	\geq 15 years	2.370 \pm 0.624	2.214 - 2.525	
PPD	<15 years	1.619 \pm 0.273	1.538 - 1.70	< 0.001
	\geq 15 years	2.197 \pm 0.432	2.09 - 2.305	
PLI	<15 years	1.735 \pm 0.257	1.659 - 1.811	< 0.001
	\geq 15 years	2.269 \pm 0.421	2.164 - 2.374	
BOP	<15 years	6.440 \pm 2.915	5.575 - 7.306	< 0.001
	\geq 15 years	3.790 \pm 2.785	3.095 - 4.486	

Results of assessing the status of periodontal indicators such as GI, CAL, PPD, PLI, BOP, and smoking years with two groups, < 15 years and \geq 15 years show that the difference. There was statistical significance between the two groups with $p < 0.05$.

Table 6. Assess the status of periodontal indicators and exposure levels (N=110)

Periodontal index	Exposure level	Mean \pm SD	95% C.I	p
GI	Light (< 10 pack/year)	0.760 \pm 0.297	0.687 - 0.832	<0.001
	Heavy (\geq 10 pack/year)	0.471 \pm 0.264	0.390 - 0.552	
CAL (mm)	Light (< 10 pack/year)	1.383 \pm 0.516	1.258 - 1.509	<0.001
	Heavy (\geq 10 pack/year)	2.662 \pm 0.512	2.505 - 2.820	
PPD (mm)	Light (< 10 pack/year)	1.678 \pm 0.295	1.606 - 1.750	<0.001
	Heavy (\geq 10 pack/year)	2.388 \pm 0.348	2.281 - 2.495	
PI	Light (< 10 pack/year)	1.779 \pm 0.247	1.718 - 1.839	<0.001
	Heavy (\geq 10 pack/year)	2.461 \pm 0.362	2.350 - 2.573	
BOP (%)	Light (< 10 pack/year)	5.782 \pm 2.868	5.575 - 7.306	<0.001
	Heavy (\geq 10 pack/year)	3.522 \pm 3.017	2.593 - 4.450	

The results of assessing the status of periodontal indicators such as GI, CAL, PPD, PLI, BOP, and tobacco exposure level with two light groups (< 10 packs/year) and heavy groups (≥ 10 packs/year) only found that the difference between the two groups was statistically significant with $p < 0.05$.

4. DISCUSSION

In this study, females were purposely excluded from this study because it would have been difficult to recruit females who admit that they smoke as well as the percentage of female smoking was less than 2% [7]. The patients were selected only on the basis of their smoking status and not depending on their periodontal status.

The study results from table 1 show that smokers are mainly at the upper secondary (high school) level (58.9%) and lower secondary (secondary school) level (22.5%). Our results are similar to the study of Nguyen Quoc Viet (2007) (High School: 66.2%, Junior high School: 10.8%), and Loc Giang Do (2001) (High School: 42.3%, Junior high School: 42.7%) [9] [10]. In addition, two groups of cigarette smokers who are unskilled workers and staff had the highest smoking prevalence that we surveyed and this result is similar to the study of Loc Giang Do (2001), the group of unskilled workers and civil servants accounted for 56.1% and 26.9%, respectively. Unlike the study of Nguyen Quoc Viet (2007), most of them are civil servants, accounting for 49.5% [9], [10]. It is clear that education is one of important factors affected oral healthcare awareness.

In addition, when surveying over 110 male smokers, the percentage of people with the number of cigarettes smoked ≥ 10 cigarettes per day accounted for 55.45%, and the percentage of people which had years of smoking ≥ 15 years was 58.18%. Meanwhile, the cumulative exposure level of the cigarette smokers group was mostly at <10 packs/year, which was 60.91%, accounting for the majority. Unlike the study of Nguyen Quoc Viet (2007), the level of severe cumulative exposure accounted for 54.7%, the majority (75.1%) smoked more than 10 cigarettes per day, and a very high prevalence (81.5%) have smoked 15 years or more [10]. This difference is similar to the results of the Vietnam Adult Tobacco Use Survey (GATS) comparing 2010 and 2015 [13].

Viet Nam is one of countries which had high prevalence of male smokers. Cigarette smoke has adverse effects on different body organ such as the cardiovascular system, respiratory system,

gastrointestinal system, oral mucosa, teeth and periodontium.

Periodontitis is a common chronic inflammatory disease with a multifactorial etiology. It is influenced by a number of factors in which there is smoking factor [4]. Cigarette smoke affects the immune response and can aggravate periodontal destruction. Therefore, this study was done to know the effects of smoking on periodontal status.

The results from table 2 show that the GI (0.647 ± 0.316) and BOP ($4.898 \pm 3.117\%$) of the patient group were lower than the non-smokers group. Other indices such as PII (2.045 ± 0.447), PPD (1.955 ± 0.470 mm) and CAL (1.883 ± 0.771 mm) of the cigarette smokers group all had values obtained higher than the non-smokers group. The results of our study are similar to the study of Nguyen Quoc Viet (2007) when surveying periodontal indicators on two groups of subjects showed statistically significant differences with $p < 0.05$ [10].

In the study group, the majority of people had gingivitis. The degree of gingivitis in the group of cigarette smokers was milder than in the non-smokers group, most of which were mild gingivitis, accounting for 90.0%, while in the non-smokers group, most of the patients had moderate gingivitis, accounting for 55.45%. Furthermore, regarding gingival index and bleeding on probing, these results showed that gingival inflammation was less in smokers. The reduced bleeding in smokers has been attributed to gingival vasoconstriction induced by the action of nicotine-stimulated adrenaline and nonadrenaline on receptors. Moreover, the increase in local temperature and by-products from tobacco oxidation induce and increase in the oral mucosa and the oral gingival epithelial thickness. The increased epithelial thickness can contribute to the reduction of inflammatory clinical signs in the gingival tissue [14]. This result is similar to the study by Preber and Bergstrom (1986) which showed a tendency for the degree of gingivitis to decrease in smokers and had a dose-response effect [15]. This finding deserves attention because of the clinical importance of probing gingival bleeding as one of the first signs of disease and thus may impede the early diagnosis of tissue destruction periodontal.

On the other hand, when comparing periodontitis between smokers and non-smokers, we found that the prevalence and severity of periodontitis were higher when smoking was present (Table 3). This is similar to the study of Bergstrom J. (1989) showing that the risk of periodontal disease of smokers is

2.5 times higher than that of non-smokers [16]. Data from the Third US Health and Nutrition Survey calculate that 41.9% of periodontitis cases in the adult population are current smokers. The relative risk for smokers is 3.97 times [17]. Thereby, it is shown that smoking is a risk factor for the development of periodontal disease.

Periodontal status and smoking duration:

The results from Tables 4 and 5 show that smoking duration also affects periodontal status. This correlation follows the trend that the longer smoking time, the lower the prevalence of gingivitis and bleeding gums ($r_{GI} = -0.503$, $r_{BOP} = -0.488$), besides plaque index, periodontal pocket depth and increased clinical adhesion loss ($r_{PII} = 0.768$, $r_{PPD} = 0.792$, $r_{CAL} = 0.872$). This result is similar to the study of Nguyen Quoc Viet (2007), Khan S. et al (2016), and Susin C. et al. (2011) [10], [18], [19]. The above studies all show that smoking affected gingival tissue blood circulation, decreased the immune system, alveolar bone and attachment loss. The harmful effects of tobacco increase with the number of years of smoking.

Periodontal status and exposure levels

The results obtained from tables 4 and 6 also show that the more severe the exposure, the lower the prevalence of gingivitis and bleeding gums ($r_{GI} = -0.488$, $r_{BOP} = -0.412$), plaque index, depth periodontal

pockets and clinical adhesion loss increased ($r_{PII} = 0.75$, $r_{PPD} = 0.72$, $r_{CAL} = 0.791$). This result is similar to the study of Nguyen Quoc Viet (2007), Khan S. et al. (2016), and Bergstrom J. et al. (2001) showed that heavy exposure was associated with more severe periodontal disease than mild exposure, that relationship between tobacco exposure and periodontal status was a dose-dependent relationship of tobacco use [10], [18], [20]. Although periodontitis damages the soft tissue and bone supporting the teeth because of many factors, quit smoking can reduce the prevalence of alveolar bone loss and attachment loss (restore periodontal status).

In this study, study results could not determine completely that smoking is the cause of periodontal disease. However, results showed the strong correlation between smoke status and periodontal status. Based on the outcomes in this study, smoking was a risk factor of periodontal disease.

5. CONCLUSION

The study shows that: there is a relationship between smoking and periodontal health. Specifically, the heavier the smoker, the worse the periodontal condition. However, the more cigarettes you smoke, the less likely you are to get gingivitis and bleeding gums.

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