

Tabacco use in smokeless and smoking forms and its effect on periodontal health in India

Research article

Vimal Jacob^{1*}, Sajith Vellappally¹, Jindra Smejkalova¹, Krishnan Rajkumar²,
Eva Cermakova³, Zdenek Fiala¹, Rakesh V. Somanathan⁴, Pilathadka Shriharsha⁴

¹ Charles University in Prague, Faculty of Medicine in Hradec Králové,
Department of Hygiene and Preventive Medicine, Czech Republic

² SRM Dental College and Hospital, Department of Oral Medicine,
Radiology and Diagnosis, Chennai, India

³ Computer Technology Centre, Department of Biophysics,
Faculty of Medicine in Hradec Králové, Czech Republic

⁴ Department of Dentistry, Charles University in Prague, Czech Republic

Received 13 July 2007; Accepted 28 September 2007

Abstract: The aim of the present study was to establish the relationship between tobacco use and periodontal health in an adult sample in India. A cross-sectional population-based study was conducted in a province of southern India. A total of 805 subjects between the ages of 30 and 69 years were interviewed, and clinical examinations were made by three cooperating dentists. The examiners recorded oral mucosal findings, gingivitis, and the Community Periodontal Index of Treatment Needs index using a WHO-621 Trinity probe. Among the 805 participants, 72% were males and 28% were females. Among regular smokers, 98% were males and 2% were females. In the studied population, 64.6% visited the dentist only when they had some dental problems. Oral mucosal findings were present more in of the regular smokers and chewing tobacco users than in the non-consumers. The maximum findings from six sextants indicate that non-consumers exhibited higher rates of healthy periodontium and bleeding on probing but lower rates of pockets than tobacco consumers. The present analysis shows that tobacco use exerts a strong and chronic effect on periodontium and oral mucosa and reduces bleeding on probing.

Keywords: Cigarette smoking • Periodontitis • CPITN index • Oral mucosal lesions • Gingivitis

© Versita Warsaw and Springer-Verlag Berlin Heidelberg.

1. Introduction

In studies performed in developed countries, tobacco smoking was found to be a significant risk factor for adult periodontitis [1-3], as indicated by an increased loss of attachment [4-6], development and progression of periodontal inflammation [7,8], and increased gingival recession [9]. Longitudinal studies indicate that periodontal disease may progress faster in smokers than in nonsmokers [10,11]. These studies have demonstrated not only the detrimental effects of smoking on the pathogenesis of periodontitis but also the distribution of periodontal destruction among studied populations. Although there is very little scientific data on the effects of smokeless tobacco either used alone or in combination with smoking, on

periodontium, it is reasonable to hypothesize that it could lead to impaired periodontal health [12].

Few of these studies have been carried out in developing countries [13,14], where tobacco consumption in various forms, is highly prevalent and the development and progression of periodontitis is not confounded by preventive measures or treatment modalities. Studying risk factors for periodontal disease among these populations can be advantageous as it offers an opportunity to contribute to the understanding of possible risk factors for periodontal disease. The aim of the present cross-sectional population-based study was to investigate the possible association of tobacco use and periodontitis and to describe the oral health status of a sample of adults aged 30 to 69 years living in Chennai, India.

* E-mail: vimaljacob77@yahoo.com

Table 1. Classification according to tobacco use and gender.

	Males		Females		Total		Age	
	n	%	n	%	n	%	(mean)	(SD)
Consumers	542	81.8	121	18.2	663	100.0	47.29	11.26
Non-consumers	38	26.8	104	73.2	142	100.0	40.31	10.43

n-number; SD-Standard Deviation

2. Material and Methods

Epidemiological studies on periodontal status have employed a variety of indicators and indices. The most commonly used indices are the Periodontal Index from Russel, the Periodontal Disease Index of Ramfjord and the Community Periodontal Index of Treatment Needs (CPITN). Investigators have recognized that mean values of any index alone is not adequate enough to describe the nature of periodontal disease in populations because of the marked variation between and within subjects. Despite the fact that most clinical indicators used in the CPITN are either not sufficiently sensitive or specific as predictors of groups or individuals at risk for periodontal disease and that this index does not adequately reflect the distribution of periodontal disease in a population [15], its use provides information about the high prevalence and low severity of periodontal disease among populations [16]. For these reasons along with the simplicity of its recording and its world-wide use, we used the CPITN Index for this study. The study was approved by the Ethics Committees of Charles University in Prague and SRM University. The study was conducted at SRM Dental College and Hospital in Chennai, India with the cooperation of three dentists.

2.1. Study population

Although several studies have used representative samples to collect data [17,18], most studies have used a convenience sample such as volunteers or patients attending dental clinics [1,2]. The participants of this study were the patients of the three cooperating dentists. The inclusion criterion was age between 30 to 69 years. We fixed the minimum age as 30 years for participating, under the assumption that the majority of tobacco users start the habit in their teenage or early adult years and taking into consideration the fact that it takes some time for the destructive effect or clinical manifestation of tobacco use to be obvious. Participants with the following medical conditions were excluded: 1) those at risk for bacterial endocarditis; 2) those undergoing

hemodialysis; 3) completely edentulous patients. The participants were informed about the purpose of the study, and informed consent was obtained in all cases. At the end of clinical examination, each participant was given instructions regarding dental treatment needs.

2.2. Questionnaires

All participants were requested to answer a questionnaire that included questions concerning their personal history, economic status, educational qualifications, profession, general health status, food habits, frequency of dental visits, brushing habits, dental aids used, and a detailed history of tobacco consumption. Information collected on tobacco use included current tobacco consumption status, duration, amount of tobacco use, and form of tobacco use. Possible forms of tobacco consumption included the following: 1) tobacco with betel nuts and leaves, 2) tobacco alone, 3) beedi/chutta, 4) cigarettes without filters, 5) cigarettes with filters, and 6) pipes and other forms of tobacco. Cigarette or beedi/chutta smokers were classified into the following: 1) regular smokers, 2) occasional smokers, and 3) ex-smokers. Regular smokers were defined as individuals who, at the time of examination, smoked at least one cigarette daily. Occasional smokers were individuals who smoked less than one cigarette per day. Former or ex-smokers were defined as individuals who smoked at least 1 cigarette per day for 6 consecutive months and did not smoke for at least the past 6 months from the time of the study. Because the use of smokeless tobacco, mostly in the form of chewing tobacco, is prevalent in India, we further classified our study population into 'consumers but nonsmokers' and 'non-consumers'. Consumers but nonsmokers consisted of subjects who use tobacco in forms other than smoking and non-consumers consisted of subjects who never used tobacco (at the time of study or in the past) in any form.

2.3. Clinical examination

Three dentists performed clinical examination. The examiners used a standard examination environment, standard equipment, and followed detailed written

Table 2. Detailed tobacco consumption history of respondents.

	Males		Females		Total	
	n	%	n	%	n	%
Regular smokers	433	98.0	9	2.0	442	100.0
Occasional smokers	33	94.3	2	5.7	35	100.0
Ex-smokers	35	89.7	4	10.3	39	100.0
Consumers but nonsmokers	35	24.8	106	75.2	141	100.0
Non-consumers	38	26.8	104	73.2	142	100.0

instructions. The following clinical evaluations were performed: 1) oral mucosal findings, 2) presence or absence of gingivitis, 3) recording CPITN index. CPITN was recorded according to the codes and its respective inferences as follows: Code 0, healthy periodontal tissues; Code 1, bleeding on gentle probing; Code 2, supragingival and/or subgingival calculus; Code 3, shallow pockets up to 4–5mm; Code 4, deep pockets 6 mm or more. A mouth mirror and a WHO-621 Trinity probe set to give a constant probing force of 20–25 g as recommended were used. The probe has a 0.5-mm diameter ball tip, which enhances detection of subgingival calculus or overhanging restorative margins and limits false readings from over-measurement of probing depths. It also has a color-coded band extending 3.5 to 5.5mm from the tip, which facilitates rapid interpretation of probing depths. The CPITN probe was gently inserted into the gingival pocket, and the depth of penetration read against the color-coded band. The dentition is divided into six parts (sextants) for assessment of periodontal conditions. The sextants begin from the maxillary right sextant, proceeding in a clockwise manner and finishing in the mandibular right sextant. At least six points on each tooth (mesiobuccal, midbuccal, distobuccal, distooral, midoral, and mesiooral) were examined by gently “walking the probe” around the tooth, and for each sextant, only the highest score was recorded. All fully erupted teeth, except third molars and retained roots, were examined. The CPITN does not include measures of gingival recession, tooth mobility, intensity of inflammation, precise identification of pocket depths, or differentiation between supragingival and subgingival calculus [19].

2.4. Data analysis

The statistical analysis of the data included the classification of data and calculation of frequencies and was carried out using the NCSS 2004 program. The Mann-Whitney test or the Kolmogorov-Smirnov test was used for comparing two groups of quantitative data (age), and Kruskal-Wallis analysis of variance

with multiple comparison tests was used for the five groups according to tobacco use. The Chi-square test of independence in contingency tables or Fisher's exact test was used for qualitative data (CPITN, education) and the level of significance was set at $\alpha = 0.05$.

3. Results

The study population was classified into consumers who used tobacco in different forms (including smoking, chewing, snuff, and other forms) and non-consumers who never used tobacco (at the time of study or in the past) in any form. Consumers were further sub-classified into regular smokers, occasional smokers, ex-smokers and consumers but nonsmokers. The population under study consisted of 580 males (72%) and 225 females (28%). A detailed classification of the subjects according to tobacco use and gender is given in Table 1.

The majority of respondents were male consumers of tobacco, and taking both the genders into consideration, the mean age of consumers was 47.3, whereas the mean age of non-consumers was 40.3. Table 2 shows the detailed tobacco consumption history of the subjects. Among regular smokers, 98% were males, and among non-consumers, 73.2% were females. We also found that the percentage of consumers but nonsmokers was higher among women (75.2%) than among men (24.8%). We next compared educational qualifications and form of tobacco consumption. We found that among subjects without any education, having only a basic education, or having a high school education, a higher percentage used tobacco with betel nut and leaves and smoked beedi or chutta. But in case of graduates, 58.6% were abstinent from using tobacco with betel nuts and leaves and 56.2% were abstinent from using beedi or chutta compared to 30% and 7.8% using these forms of tobacco consumption respectively ($p < 0.001$).

Table 3 shows the distribution of subjects according to tobacco consumption compared to participation in

Table 3. Percentage of respondents participating in preventive dental check-ups ($P<0.001$).

	Twice a year	Once a year	Visits only when having problem(s)	Never before
Regular smokers	15.2	15.8	65.8	3.2
Occasional smokers	2.9	25.7	60.0	11.4
Ex-smokers	12.8	23.1	59.0	5.1
Consumers but nonsmokers	7.1	23.4	62.4	7.1
Non-consumers	20.4	12.0	65.5	2.1
Total	14.0	17.3	64.6	4.1

preventive dental check-ups. Irrespective of tobacco consumption, 64.6% of respondents visited the dentist only when they had some dental problems. 20.4% of non-consumers visited dentists twice a year and was highest among the groups.

Table 4 shows the distribution of respondents according to tobacco consumption compared to oral mucosal findings and gingivitis. We found that 22.7% of respondents in the group of consumers but nonsmokers, which mainly consisted of chewing tobacco users (tobacco with betel nuts and leaves), and 12.9% of regular smokers had some oral mucosal changes or lesions.

We found that 23.6% of respondents using tobacco with betel nuts and leaves, 21.1% of those smoking beedi/chutta ($P<0.001$) and 10.9% smoking cigarettes with/without filters ($P<0.01$) had some oral mucosal changes or lesions, but only 2.8% of non-consumers had oral mucosal changes or lesions. We also found that 28.6% of respondents using tobacco with betel nuts and leaves and 23.6% of those smoking cigarettes with/without filters had gingivitis, but gingivitis was present in 46.5% of non-consumers ($p<0.001$).

The CPITN scores (%) in consumers and non-consumers (the maximum findings from six sextants) are shown in Table 5. Non-consumers had a higher percentage of CPITN score 0 than consumers, indicating a higher percentage of healthy periodontium in non-consumers. Consumers had a higher percentage of CPITN scores 2, 3, or 4 than non-consumers. Non-consumers also had a higher percentage of CPITN score 1 than consumers.

We found that the percentage of CPITN score 0, indicating healthy periodontium, in subjects using tobacco with betel nuts and leaves (5.9%), smoking beedi/chutta (1.1%), and smoking cigarettes (5.6%) with/without filters was lower than in non-consumers (19%). We also noticed that the percentage of CPITN score 1, indicating bleeding on probing, was lower in subjects smoking cigarettes with/without filters

(35.6%) and those using tobacco with betel nuts and leaves (39.5%) and slightly higher in respondents smoking beedi/chutta (48.9%) than in non-consumers (47.2%). Considering the pattern of smoking, we noticed that percentages of CPITN score of 0 and 1 in regular smokers (smoking beedi/chutta and/or cigarette) were 3.8% and 35.3%, respectively, compared to 19% and 47.2%, respectively, in non-consumers ($P<0.001$). Finally, the percentage of CPITN score 0 in all sextants was higher in non-consumers than consumers (Table 6).

4. Discussion

Along with the use of common tobacco forms consumed worldwide, such as cigarettes and pipes, the Indian population uses other forms, the most common of which are Beedi, Chutta, and chewing tobacco. A Beedi is a thin, often flavored, Indian cigarette, handmade by rolling a dried rectangular piece of Temburni leaf (*Diospyros melanoxylon*) with 0.15–0.25 g of sun-dried tobacco and secured with a colored thread at one end. They are smaller than regular cigarettes but more potent. Because they do not have filter and are wrapped in nonporous leaves, a smoker needs to inhale more often and more deeply to keep them lit. One Beedi produces three times more carbon monoxide and nicotine and five times more tar than a regular cigarette [20].

A chutta is a type of small hand-made cigar, without a wrapper and a single tobacco leaf as a binder. It consists of air-cured and fermented tobacco folded into a dried tobacco leaf. Chuttas vary greatly in form, length, diameter, and weight. Chuttas usually lack a filter, are characterized by being open-ended, and often have tapered mouthpieces. They are frequently associated with the remarkable habit of “reverse” smoking, during which the burning end is held inside the mouth [21]. Some other forms of tobacco consumption in India include Pan (piper betel leaf filled with sliced areca nut, lime, catechu, and

Table 4. Percentage of respondents with oral mucosal findings and gingivitis.

	Oral mucosal findings(P<0.001); χ^2 test	Gingivitis (P<0.001); χ^2 test
Regular smokers	12.9	23.1
Occasional smokers	8.6	51.4
Ex-smokers	5.1	25.6
Consumers but nonsmokers	22.7	29.1
Non-consumers	2.8	46.5

Table 5. CPITN scores (%) in consumers and non-consumers (P<0.001; χ^2 test)

	CPITN 0	CPITN 1	CPITN 2	CPITN 3	CPITN 4
Consumers	6.2	39.3	38.4	12.7	3.5
Non-consumers	19.0	47.2	23.9	7.0	2.8

other spices, chewed with or without tobacco), Pan-masala or Gutkha (a chewable tobacco containing areca nut), and Mishri (a powdered tobacco rubbed on the gums as toothpaste) [22]. In contrast, the tobacco consumption habits of the Western countries are mostly confined to cigarettes, pipes, and snuff, although other forms are also available.

The criteria for recognizing periodontal disease severity differ among various studies, with some using mean clinical attachment level (CAL), some using radiographic assessments of bone level, and others using a combination of CAL and probing depth measurements [23]. In our study, we used the CPITN index to assess periodontal conditions, and a CPITN score of 3 and 4 was considered as indicating the presence of periodontitis. The index parameters for evaluation of periodontal conditions were bleeding, calculus, and pockets. Gingivitis and oral mucosal lesions were assessed by clinical examination without measuring the extent or severity of the disease. The mere presence or absence of the disease was recorded.

Our study showed that rate of smoking was high among the males of the sample, whereas the rate among females was low, as social and cultural norms in India may preclude women from smoking. This social and cultural pressure might prevent some female smokers from reporting their true smoking status, which might have affected the study results. A similar trend of smoking status was reported in a study conducted in India [22] and in Vietnam [24]. However, the percentage of females in the group of consumers but nonsmokers was higher than that of males. This may be explained by the fact that tobacco chewing is a common practice among females of lower economic strata in India. We also found that a higher percentage of respondents with better education, that is, graduates, abstained from

using chewing tobacco or beedi/chutta smoking. This may be because these forms of tobacco, being much cheaper compared to cigarettes, are commonly used by people belonging to lower economic classes and therefore an issue of status for the educated people. These results are in agreement with results of studies conducted in India by Subramanian *et al.* [25] and Sorensen *et al.* [26].

That the majority of respondents visited the dentist only when having some dental problems can be explained by multiple factors, such as high cost of dental treatment, lesser accessibility to dentists, lack of dental health awareness amongst the the poor, or the fact that yearly regular dental checkups are not required for medical health insurance in India.

The finding that respondents using tobacco with betel nut and leaves, smoking beedi/chutta, and smoking cigarettes with/without filters had a higher percentage of oral mucosal lesions or changes than non-consumers may be due to the local irritation of oral mucosa caused by using these forms of tobacco. These results are in agreement with the results of previous studies conducted in this regard [27].

The finding that non-consumers exhibited a higher percentage of healthy periodontium than consumers corroborates the results of several previous studies [3,10,11,23]. Our study also reconfirmed the relationship between smoking and a reduced gingival bleeding on probing, which has been well documented in previous studies [28,29]. This may be due to the vasoconstrictive action of nicotine and its profound influence on vascular dynamics and cellular metabolism [30].

Calculus is an indicator of oral hygiene. It has been documented that smoking is a strong and consistent risk indicator for periodontitis with the presence of calculus [24]. Smokers have also been reported to exhibit a low awareness of their health [31]. In our

Table 6. CPITN score (%) of consumers and non-consumers in each sextant.

	CPI 0	CPI 1	CPI 2	CPI 3	CPI 4
	1. sextant ($p < 0.001$; χ^2 test)				
Consumers	20.4	50.4	23.6	5.1	0.5
Non-consumers	45.8	30.3	20.4	2.8	0.7
	2. sextant ($p < 0.001$; χ^2 test)				
Consumers	29.4	54.0	13.3	2.8	0.5
Non-consumers	58.5	30.3	8.5	2.8	0.0
	3. sextant ($p < 0.001$; χ^2 test)				
Consumers	21.3	48.3	24.9	4.4	1.1
Non-consumers	47.5	30.2	16.5	4.3	1.4
	4. sextant ($p < 0.001$; χ^2 test)				
Consumers	18.7	42.0	29.2	8.2	1.9
Non-consumers	49.3	32.4	11.3	6.3	0.7
	5. sextant ($p < 0.001$; χ^2 test)				
Consumers	25.3	49.8	18.7	5.4	0.8
Non-consumers	54.3	33.6	9.3	2.9	0.0
	6. sextant ($p < 0.001$; χ^2 test)				
Consumers	19.7	41.9	28.4	8.2	1.7
Non-consumers	50.4	28.1	14.4	5.8	1.4

study, we found that smokers or consumers of tobacco had a higher percentage of supragingival and/or subgingival calculus than non-consumers.

Certain limitations should be taken into consideration when interpreting the results of this study. The cumulative effect of periodontal destruction over time, such as attachment loss, recession, and loss of alveolar bone, were not recorded by the CPITN index because it was originally constructed for the assessment of treatment needs [32]. Thus, the index scores may not fully reflect the true periodontal condition. Another limitation was that the plaque levels were not recorded during the dental examination. Consequently, adjustments for plaque could not be made in the present analysis. However, most studies reported similar plaque levels for smokers and nonsmokers [30,33], and no difference between smokers and nonsmokers with regard to plaque accumulation could be observed in experimental gingival studies [34,35]. Another limitation was the inability to generalize our findings to the Indian population. Our study group was a convenient sample and was not randomized. A comparison of our data with recent studies was therefore not always possible because of differences in methodology.

In conclusion, the present study shows that tobacco use exerts a strong and chronic effect on periodontium and oral mucosa and reduces bleeding on probing. This was a cross-sectional study, in

which only an association between smoking and periodontitis can be shown. A longitudinal study will be required to determine whether tobacco use is a true risk factor for the development of periodontal disease in this study group.

Acknowledgements

This study was supported by the department of Hygiene and Preventive Medicine, Faculty of Medicine, Hradec Králové, Charles University in Prague, Czech Republic (Grant IGA MZ CR NR 8781-3/2006). The authors wish to thank Dr. K. Balachandar of the SRM Dental College and Hospital, Ramapuram, Chennai, India and Dr. Vinod Kumar, Kochi, India for supervising the fieldwork and collecting data.

References

- [1] Gelskey S.C., Young T.K., Singer D.L., Factors associated with adult periodontitis in a dental teaching clinic population, *Community Dent. Oral Epidemiol.*, 1998, 26, 226-232
- [2] Paidi S., Pack A.R., Thomson W.M., An example of measurement and reporting of periodontal loss of attachment (LOA) in epidemiological studies: smoking and periodontal tissue destruction, *N. Z. Dent. J.*, 1999, 95, 118-123
- [3] Tanner A.C.R., Kent R.Jr., Van Dyke T., Sonis S.T., Murray L.A., Clinical and other risk indicators for early periodontitis in adults, *J. Periodontol.*, 2005, 76, 573-581
- [4] Amarasena N., Ekanayaka A.N.I., Herath L., Miyazaki H., Tobacco use and oral hygiene as risk indicators for periodontitis, *Community Dent. Oral Epidemiol.*, 2003, 31, 158-160
- [5] Hyman J.J., Reid B.C., Epidemiological risk factors for periodontal loss among adults in the United States, *J. Clin. Periodontol.*, 2003, 30, 230-237
- [6] Razali M., Palmer R.M., Coward P., Wilson R.F., A retrospective study of periodontal disease severity in smokers and nonsmokers, *British Dent. Journal*, 2005, 198, 495-498
- [7] Genco R.J., Current view of risk factors for periodontal diseases, *J. Periodontol.*, 1996, 67, 1041-1049
- [8] James J.A., Sayers N.M., Drucker D.B., Hull P.S., Effect of tobacco products on the attachment and growth of periodontal ligament fibroblasts, *J. Periodontol.*, 1999, 70, 518-525
- [9] Müller H-P., Stadermann S., Heinecke A., Gingival recession in smokers and nonsmokers with minimal periodontal disease, *J. Clin. Periodontol.*, 2002, 29, 129-136
- [10] Beck J.D., Cusmano L., Green-Helms W., Koch G.G., Offenbacher S., A 5 year study of attachment loss in community-dwelling older adults: incidence dentistry, *J. Periodontol. Res.*, 1997, 32, 506-515
- [11] Winn D.M., Tobacco use and oral diseases, *J. Dent. Edu.*, 2001, 65/4, 306-310
- [12] Seppo W., Söder P.-Ö., Maria R.G., Birgitta S., Björn K., Periodontal disease in a group of Swedish adult snuff and cigarette users, *Acta Odontol. Scand.*, 2004, 62, 333-338
- [13] Awartani F., al-Jasser N., The effect of smoking on periodontal conditions assessed by CPITN, *Odontostomatol. Trop.*, 1999, 22, 38-40
- [14] Taani Q., The periodontal status of Jordanian adolescents measured by CPITN, *Int. Dent. J.*, 1995, 45, 382-385
- [15] Mack F., Mojon P., Budtz-Jorgensen E., Kocher T., Splieth C., Schwahn C., et al., Caries and periodontal disease of the elderly in Pomerania, Germany: results of the study of Health in Pomerania, *Gerodontology.*, 2004, 21, 27-36
- [16] Rapp G.E., Bardosa Junior Ade A., Mendes A.J., Motta A.C., Biao M.A., Garcia R.V., Technical assessment of WHO-621 periodontal probe made in Brazil, *Braz. Dent. J.*, 2002, 13(1), 61-65
- [17] Grossi S.G., Zambon J.J., Ho A.W., Koch G., Dunford R.G., Machtei E.E., et al., Assessment of risk for periodontal disease. 1. Risk indicators for attachment loss, *J. Periodontol.*, 1994, 65, 260-267
- [18] Hashim R., Thomson W.M., Pack A.R.C., Smoking in adolescence as a predictor of early loss of periodontal attachment, *Community Dent. Oral Epidemiol.*, 2001, 29, 130-135
- [19] Cutress T.W., Ainamo J., Sardo-Infirri J., The community periodontal index of treatment needs (CPITN) procedure for population groups and individuals, *Int. Dent. J.*, 1987, 37(4), 222-233
- [20] Rahman M., Sakamoto J., Fukui T., Bidi smoking and oral cancer: A meta-analysis, *Int J Cancer.*, 2003, 106, 600-604
- [21] Pakhale S.S., Maru G.B., Distribution of major and minor alkaloids in tobacco, mainstream and sidestream smoke of popular Indian smoking products, *Food Chem. Tox.*, 1998, 36, 1131-1138
- [22] Rani M., Bonu S., Jha P., Nguyen S.N., Jamjoum L., Tobacco use in India: prevalence and predictors of smoking and chewing in a national cross-sectional household survey, *Tobacco Control.*, 2003, 12:e4
- [23] Torrungruang K., Nisapakultorn K., Sutdhibhisal S., Tamsailom S., Rojanasomsith K., Vanichjakvong O., et al., The effect of cigarette smoking on the severity of periodontal disease among older Thai adults, *J. Periodontol.*, 2005, 76, 566-572
- [24] Do G.L., Spencer A.J., Roberts-Thomson K., Ha H.D., Smoking as a risk indicator for periodontal disease in the middle-aged Vietnamese population, *Community Dent. Oral Epidemiol.*, 2003, 31, 437-446
- [25] Sorensen G., Gupta P.C., Pednekar M.S., Social disparities in tobacco use in Mumbai, India: The roles of occupation, education, and gender, *Am*

- J Public Health., 2005, 95, 1003-1008
- [26] Subramanian S.V., Nandy S., Kelly M., Gordon D., Smith G.D., Patterns and distribution of tobacco consumption in India: cross-sectional multilevel evidence from the 1998-99 national family health survey, *British Medical Journal.*, 2004, 328, 801-806
- [27] Taybos G., Oral changes associated with tobacco use, *Am. J. Med. Sci.*, 2003, 326, 179-182
- [28] Dietrich T., Bernimoulin J-P., Glynn J.R., The effect of cigarette smoking on gingival bleeding, *J. Periodontol.*, 2004, 75, 16-22
- [29] Tomar S.L., Asma S., Smoking-attributable periodontitis in the United States: Findings from NHANES III, *J. Periodontol.*, 2000, 71, 743-751
- [30] Bergström J., Boström L., Tobacco smoking and periodontal hemorrhagic responsiveness, *J. Clin. Periodontol.*, 2001, 28, 680-685
- [31] Tada A., Hanada N., Sexual differences in smoking behaviour and dental caries experience in young adults, *Public health.*, 2002, 116, 341-346
- [32] Page R.C., Morrison E.C., Summary of outcomes and recommendations of the workshop on CPITN, *Int. Dent. J.*, 1994, 44(suppl 1), 589-594
- [33] Haffajee A.D., Socransky S.S., Relationship of cigarette smoking to attachment level profiles, *J. Clin. Periodontol.*, 2001, 28, 283-295
- [34] Danielsen B., Manji F., Nagelkerke N., Fejerskov O., Baelum V., Effect of cigarette smoking on the transition dynamics in experimental gingivitis, *J. Clin. Periodontol.*, 1990, 17, 159-164
- [35] Lie M.A., Timmerman M.F., van der Velden U., van der Weijden G.A., Evaluation of 2 methods to assess gingival bleeding in smokers and nonsmokers in natural and experimental gingivitis, *J. Clin. Periodontol.*, 1998, 25, 695-700