

# Current status of periodontitis and its association with tobacco use among adult population of Sunsari district, Nepal

Khushboo Goel (✉ [khushboo.goel@bпкиhѕ.edu](mailto:khushboo.goel@bпкиhѕ.edu))

BP Koirala Institute of Health Sciences <https://orcid.org/0000-0002-4395-3536>

Shivalal Sharma

BP Koirala Institute of Health Sciences

Dhamidhar Baral

BP Koirala Institute of Health Sciences

Santosh Agrawal

BP Koirala Institute of Health Sciences

---

## Research article

**Keywords:** Periodontitis, prevalence, smoking, smokeless tobacco

**Posted Date:** May 11th, 2020

**DOI:** <https://doi.org/10.21203/rs.3.rs-19612/v1>

**License:**  This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

---

**Version of Record:** A version of this preprint was published on February 12th, 2021. See the published version at <https://doi.org/10.1186/s12903-021-01416-3>.

# Abstract

**Background:** Tobacco products are considered significant but preventable factors related to initiation and progression of periodontal diseases. We assessed the prevalence of periodontitis and evaluated its association with tobacco use and other factors among the adult population of eastern Nepal.

**Methods:** A community-based cross-sectional study was conducted in the rural municipalities in the province one of eastern Nepal. A total of 440 individuals were interviewed with a set of a standardized pre-tested semi-structured questionnaire. Data on social demographics, adverse oral habits followed by periodontal clinical examination were recorded. Prevalence of periodontitis was assessed by a case definition given by CDC-AAP. Univariate and multivariate logistic regression analysis was used to measure the association between tobacco use and other factors with periodontitis.

**Results:** The overall prevalence of periodontitis was found to be 71.6%. Majority (85.4%) of tobacco users had periodontitis and they were significantly associated with the disease and its severity. The study identified age groups, 45-65 years (AOR=7.585, 95% CI, 3.938-14.610), plaque index (AOR=1.017, 95% CI, 1.005- 1.029), smoking (AOR=3.149, 95% CI, 1.364- 7.270), khaini users (smokeless tobacco, AOR=2.275, 95% CI, 1.122-4.613) and teeth loss (AOR=2.025, 95% CI, 1.211-3.387) as the significant factors associated with periodontitis.

**Conclusion:** Almost three-quarters of the adult population had some form of periodontitis. Oral hygiene awareness programs, educational efforts and tobacco cessation policies targeted to limit the modifiable factors should be considered immediately at the community level.

## Background

Periodontal disease result from disruption in the host microbial interaction and is one of major causes of tooth loss [1]. Overall, this disease affects about 20-50% of the global population [2] and its severe form ranks sixth among the most prevalent disorders [3]. Although dental plaque-associated microorganism is the primary etiologic agent, several other associated factors determine the susceptibility of individuals to periodontal diseases such as genetic, systemic, immunological, environmental and behavioral factors [4,5].

Among the environmental factors, tobacco smoking is considered one of the true risk factors and is independently related to periodontal destruction [6]. The common forms of tobacco smoking are cigarette, beedi, chutta and hooka, with cigarettes being the main product smoked [7]. More than seven thousand toxins are present in tobacco smoke which includes carcinogens and addictive psycho-active substances like nicotine which are detrimental to general health and is a major public health concern [8]. In addition, the use of smokeless tobacco (SLT) as an alternative tobacco product for cigarette smoking is gradually becoming popular. An estimated 346 million people in the world use SLT products and the prevalence of use is relatively high in Southeast Asian region accounting for nearly 86 per cent of the global users [9].

SLT is consumed un-burnt and exists in numerous forms across the globe with various applications. The most common products available in the US are the form of chewing and snuff (moist and dry) and in Sweden its snus [10]. In South East Asian countries, most commonly available and used SLT products is “khaini” (powdered tobacco/leaves and slaked lime paste) that is placed in mouth for use or held between the gum and cheeks for variable time intervals. Other products that are ingested through the oral tissues, chewed or swallowed [11] are betel quid with or without tobacco, zarda (boiled tobacco leaves with water and slaked lime) and gutkha (areca nut with added tobacco, slaked lime and catechu) [10,12]. Unlike tobacco smoke that is a risk for overall periodontitis, reports suggest greater clinical attachment loss only near the area where the smokeless tobacco products are placed in the mouth [13]. However, conclusion vary when the loss of interproximal bone is discussed. Few studies corroborate the association between SLT use and bone loss [14] but it is not in agreement with others [13,15]. SLT use and generalized periodontitis is also, a debatable issue as the use is not necessarily associated with overall periodontitis.

Early evidence has given an indication that the Nepalese population is highly susceptible to periodontitis and other oral health related problems [16]. Subsequently, the rising burden of the cost of dental services and lack of proper oral hygiene practices contributes to the poor oral health status in Nepal. In addition, habits of smoke as well as smokeless tobacco use are common and prevalent in Nepal [17]. Hence, identification of socio-demographic factors, habits and disease prevalence becomes crucial to take action and implement oral health promotion interventions in rural and urban areas. The aims of this study are therefore, to assess the prevalence of periodontitis and to evaluate its association with tobacco use and other factors among the adult population of eastern Nepal.

## Methods

**Study design and study setting:** A cross-sectional study was carried from duration from April 2018 to July 2019. Study population were inhabitants from the rural area of Sunsari district in the eastern region of Nepal. Sunsari district includes a total of twelve both rural and urban municipalities. Dental health camps were organized by department of public health dentistry in different wards of six rural municipalities (Koshi, Gadhi, Barju, Bhokraha, Harinagara, Dewanganj). One ward of every six rural municipality was selected via lottery method. The total eligible population of these wards was approximately 16120 (percentage of the population above 20 years old and below 65 years old). We randomly examined approximately 1578 inhabitants from these wards who attended the health camp. Among them a total of 440 individuals who met the inclusion criteria were interviewed and enrolled in the study. This study was approved by the institutional review committee of BPKIHS, Dharan (IRC/0959/017). Written consent was obtained from each individual after explaining the objectives of the study and names mentioned in the datasets are pseudonyms.

**Criteria for selection: Inclusion Criteria:** Patients between 20 and 65 years old, tobacco users as an individual who was currently consuming tobacco in the form of smoke or smokeless tobacco, non-tobacco users as an individual who had never used tobacco in the form of smoke or smokeless tobacco,

patient who consented for clinical examination and answered the comprehensive questionnaire.

**Exclusion Criteria:** Former smokers, patients consuming both forms of tobacco, patients who consumes alcohol, patients suffering from known systemic illness, pregnant and lactating females.

**Method of data collection:** A set of standardized pre-tested semi- structured questionnaire were applied to all the selected individuals. Face-to-face interviews on basic information and social demographics were recorded. Age was categorized as “20-34”, “35-44”, “45-65” years. Body mass index (BMI) was calculated as body weight (kg) divided by height (m<sup>2</sup>). Socio-economic status (SES) was assessed and categorized into upper, lower middle and lower class [18]. Direct questions were asked to the individuals regarding the use of tobacco. Current smokers were defined as subjects smoking more than five cigarettes per day for the past 2 years or more, SLT users as subjects consuming SLT on a daily basis for the past 2 years or more [19]. The SLT users were dichotomized as individuals who consumed khaini and those who chewed SLT (gutkha, betel quid with tobacco, zarda). Intraorally, plaque index (PLI) was recorded as the presence or absence of visible plaque [20]. Bleeding point index (BPI) was used to examine for the presence and absence of bleeding on probing [21]. Simplified Oral Hygiene Index (OHI-S) was recorded according to Greene and Vermillion, 1964 [22]. A periodontal probe, UNC-15 (University of North Carolina-15, Hu-Friedy, Chicago, IL) was used for all periodontal recordings. To avoid inter-observer variation, a single experienced periodontist (K.G) examined all subjects and a dental hygienist was trained by the researcher to fill the questionnaire form. The kappa statistics was used to assess the intra-examiner reliability among the forty-four individuals who were not enrolled in the study. The kappa value for single examiner was 0.8 for that showed good agreement between two examinations. The estimation of periodontal disease in this study was based on the case- definition given by CDC- AAP and updated by Eke, Page [23]. Probing depth was measured to the nearest millimeter the distance from the gingival margin to the bottom of the periodontal sulcus/pocket (cut-offs at  $\geq 4$  mm and  $\geq 5$ mm). Clinical attachment level (CAL) was computed from the cemento-enamel junction (CEJ) to the base of pocket/sulcus (cut-offs at  $\geq 3$ mm,  $\geq 5$  and  $\geq 6$ mm). Severity of periodontitis was calculated as sum of attachment loss of all diseased sites divided by the number of diseased sites. Therefore, all the teeth were examined in the study. Presence of caries, teeth loss and the reason for each tooth loss as self-reported by the individuals were recorded.

**Statistical Analysis:** Descriptive statistics, mean, standard deviation, percentage and frequency were calculated for all the variables along with tabular presentation were made. Univariate and forward conditional method for multivariate logistic regression analysis was done to find out the crude and adjusted odds ratio at 95% CI for the association between tobacco use and other factors with periodontitis. Level of significance was set at  $p < 0.05$ . Collected data were entered into Microsoft Excel 2007 and converted into the statistical software package SPSS 11.5 (SPSS, Chicago, IL, USA) for further analysis.

## Results

A total of 440 individuals with the mean (SD) age of 43.80 (13.17) with 42.3% males and 57.7% females were analyzed in the study. Periodontitis was found to be present in 71.6% (n=315) of the attended

population, 31.7% with severe periodontitis, 35.6% with moderate periodontitis and 32.7% as mild periodontitis. The mean BMI of individuals was  $24.18 \pm 2.74$  with the mean PLI score as  $67.82 \pm 21.836$  and BPI score of  $45.77 \pm 25.13$ . Dental caries was present in 63% of the individuals. Nearly one in every two individual aged 21–65 years (46.6%) were found to be using some form of tobacco. The characteristics of study population are mentioned in table 1.

Table 2 illustrates the factors such as gender, BMI, BPI and OHI-S that were significant at univariate analysis lost significance at multivariate analysis. Significant factors associated with periodontitis in the study population were age, PLI, missing teeth, smokers and khaini users. Periodontitis increased with increasing age. Older age groups had an odd of 7.58 times increased risk of having the disease when compared with the young group. Diseased individuals with plaque score percentage of 72% had an odd of 1.01 times for periodontitis. Individuals consuming tobacco showed a significant strength of association with periodontitis with tobacco smoke and khaini users showing odds of 3.149 and 2.275 times respectively. The prevalence data should also correlate with tooth mortality and patients who had teeth loss had an odd of 2.02 for periodontitis and showed significant strength of association with the disease. Males had higher form of periodontitis than females despite being less in frequency, however no gender differences were observed for periodontitis at multivariable analysis. Similarly, individuals with poor oral hygiene had 6.246 times odds of developing periodontitis but it failed to show significant effect at the multivariable level. The socio-economic status and brushing frequency showed no significant association with the disease. Individuals who chewed SLT has higher chance of occurrence of periodontitis than non-chewer. However, the difference was not significant.

The overall consumption of tobacco products in our study reported was 46.6%. A total of 85.4% (n=175) of tobacco users had periodontitis, whereas 14.6% (n=30) did not have the disease. Individuals who never used tobacco and neither did they develop the disease were 40.4% (n=95) whereas 59.6% (n=140) of the individuals had the disease. Tobacco users were significantly associated with periodontitis and its severity ( $p < 0.001$ ). CAL of  $\geq 6$ mm,  $\geq 5$  and  $\geq 3$ mm was found in 45.2%, 32.4% and 22.3% in old age group, compared to the middle age group in 15%, 56.3% and 28.8% and young age group in 6.4%, 12.8% and 80.9% respectively. The probing depths  $\geq 4$  mm were present in 181 (57.5%) sites and  $\geq 5$  mm in 111 (35.2%) sites amongst the periodontitis patients. A total of 26.3% of the population were affected with deep probing depths in 35-44 years age group that increased to 43.6% in 45-65 years age group. The 57 individuals who had lost their teeth due to periodontal disease (TLPD), all had some form of periodontitis in their remaining teeth with 57.9% having severe, 33.3% moderate and 8.8% having a mild form of periodontitis.

## Discussion

Periodontal diseases are one of the two most prevalent dental disease worldwide. It has been concluded that subjects with Asian ethnicity have the third-highest prevalence of periodontitis [24]. The overall prevalence of periodontitis based on attachment level in this study was found to be 71.6%. The general trend observed was for a higher loss of attachment than probing pocket depths. Tobacco habits, brushing

frequency and technique could have contributed to an increase in attachment loss. In countries like the United States and Europe, the prevalence rates reported were 47% to 76% in an age range of 30-74 years [25,26]. Shaju J et al in 2011 in an Indian population reported a prevalence of 89.6% to 79.9% in the age group of 12-74 years [27]. In the middle age population of south-east Asian countries such as India, Nepal, and Vietnam, reported nearly one-third to half the population were affected with periodontitis [28]. A direct comparison of prevalence rates may not be made as the case definition used differs in most studies and therefore, heterogeneity in the results are observed. Despite this, periodontitis is still prevalent with no gender differentials observed in the studied population. Important factors responsible could be poor oral hygiene with high plaque score along with tobacco consumption rather than gender, geography or economic status.

Periodontitis is a multifactorial disease with various factors affecting it that may be modifiable or non-modifiable [29]. Factors associated with periodontitis do not necessarily imply the cause and effect relation, but identifying them may have a significant impact on prevention, treatment, and progression of the disease [30]. This study showed a significant strength of association between periodontitis and tobacco users (smokers, khaini users), along with age, high plaque score and teeth loss as significant factors associated to periodontitis in this specific population. The results of our study are in agreement to study done by Bhat et al in 2018 that concluded a high prevalence of periodontitis, with sociodemographic factors, plaque, and tobacco as the main risk indicators to periodontitis [31]. Age has been described as a non-modifiable predisposing factor, and there is ample epidemiological evidence suggesting progressive worsening of periodontal status with increasing age [32,33]. In this study an increasing age was a significant risk to periodontitis and the study adds to evidence that the disease tends to cumulate for life [34]. Both factors, high plaque score levels and tobacco consumption are preventable and can be modified. Corbet et al in 1993 [35] mentioned that supragingival plaque is related to progressive periodontal disease and the association between them are available from studies conducted on Sri Lankans and South Pacific island populations [36]. Plaque is considered the primary etiological factor for periodontitis, and it's also noted that controlling it may form the basis for management of periodontitis. In this study, over 90% of the population answered that they use toothbrushes for cleaning their teeth at least one time in frequency. However, the population assessed had a significantly high plaque score percentage. This signifies the need for proper brushing techniques and oral hygiene awareness programmes to be reinforced at community level.

In the present study, an association between tobacco consumption and periodontitis was established, supporting previous research data [37,38]. The prevalence of tobacco smoking was 20.7% in our study and the results are in accordance with the STEPS survey done in 2012-13 in the Nepalese population [39]. Effect of tobacco smoking has been implicated as one of the important risk factors for periodontitis and this study also showed that smokers to have a significant impact and had an odd of 3.149 for periodontitis. Comparing the results with the global population, studies have shown an overall increased risk with odds ratio of 2.82 [40] in Swedish population, 1.18 [41] in Portuguese population and 1.6 [42] in an Indian population. A research done in other South-East Asian population reported a higher odd of 3.5 for chronic periodontitis among smokers [43]. The ill effect of tobacco smoke on periodontal status is

seen principally by the nicotine, that exerts its harmful effects on the tissues and its healing. The impact results in reduced migration of neutrophils into the oral tissues [44] with inhibition of phagocytosis and oxidative killing [45]. There are increased levels of pro-inflammatory cytokines such as TNF- $\alpha$  [46] and a decrease in levels of antibodies to putative periodontal pathogens [47].

However, tobacco smoking has been on the decline [48] and the rate of SLT users has surpassed that of tobacco smoke. The reason may be an increase in cigarette taxation and smoke-free policies implemented at a vast scale. Another strong reason may be the perception that SLT use is relatively safer than cigarette smoking and may be an alternate to tobacco consumption [49]. This is a question to be raised as a staggering 83.8% of population using SLT in both the forms had periodontitis and were almost two times more likely to have the disease than non-users. The results are in agreement with the studies that have reported an odds ratio of 2.1 in a US study [14] and 1.7 in an Indian population [42]. In the current study, 66.4% of individuals consumed khaini, also known as surti in the local language followed by 33.6 % individuals who were SLT chewers. Nepal STEPS survey reveals khaini (77.6%) to be the most common SLT product used followed by chewing tobacco [50]. The results of this study are in agreement to a hospital-based study done in India by Katuri et al in 2016 [51] showed the most commonly used SLT product was khaini (51.3%) and concluded SLT users to have greater attachment loss. Study done by Kulkarni et al in 2016 [19] reported gutkha (69.47%) to be the most commonly used, and concluded SLT use to have similar impact on periodontium as tobacco smoke. Research in other South-East Asian populations reports a strong association between chewing quid with tobacco and periodontal diseases [52], however, the current study fails to show a significant association of periodontitis with SLT chewers. The reason may be SLT chewers either spitted the products after chewing or swallowed them. In many countries in South East Asia, including India and Nepal, over 90% of SLT users use tobacco as the main constituent or often betel quid, slaked lime, catechu is added to tobacco [53]. Therefore, nicotine exposure may be supposed to exert its wide range of effects on the periodontal tissues. Traditional khaini and zarda available in south east Asian countries are supposed to contain the highest levels of carcinogenic substances. In addition, the product available also have high pH and nicotine content that may facilitate rapid absorption of chemicals through oral mucosa making the population more susceptible to periodontitis [10]. Therefore, differences in the effects of SLT products in relation to periodontium exists across the globe and, the results should be interpreted based in population studied. However, it would be fair to predict that due to pervasive use of SLT, periodontitis will be higher than projected and this study indicates that SLT users have similar impact as smokers on the periodontium. Based on these evidences and result of the current study, policy makers in the developing countries should address strongly the differential harms of SLT use on the oral health and encourage its cessation.

Teeth loss can be a consequence of caries, periodontitis, trauma, accidents, and previous root canal treatments. In this study, individuals who lost their teeth, 52.7% was due to caries and 26.1% due to periodontitis. The results are in accordance to study done by Papapanou PN in 1996 [54], who reported 50% of teeth lost due to caries and 30-35% due to periodontitis. This study showed that patient's with teeth loss had an odd of 2.02 for periodontitis. The reasons for tooth loss may be high plaque score, loss

of attachment, dental caries and widespread tobacco use in the population. The results are in agreement with the studies that refer to the combination of age, modifiable factors such as smoking, smokeless tobacco as the strongest predictor of tooth loss [55,56,57]. The number of lost teeth in adults has also been used as a marker of periodontitis in epidemiologic literature. The dentists should counsel their patients about the impact of modified factors on tooth loss.

## **Conclusion**

Almost three-quarters of the adult rural population had some form of periodontitis. The reason can be attributed to factors such as high plaque scores and socially ingrained tobacco consuming habit. Tobacco cessation should be given a high priority during planning and management of comprehensive tobacco control programmes.

## **List Of Abbreviations**

AOR: Adjusted odds ratio

BMI: Body mass index

BPI: Bleeding point index

COR: Crudes odds ratio

CAL: Clinical attachment level

CDC-AAP: Center for disease control-American academy of periodontology

CEJ: Cemento-enamel junction

OHI-S: Simplified oral hygiene index

PLI: Plaque index

SES: Socio-economic status

SD: Standard deviation

SLT: Smokeless tobacco

TLPD: Tooth loss due to periodontal disease

UNC-15: University of North Carolina-15

## **Declarations**

**Ethics approval and consent to participate:** This study was approved by the institutional review committee of BPKIHS, Dharan (IRC/0959/017). Written consent was obtained from each participant after explaining the objectives of the study.

**Consent for publication:** Not applicable

**Availability of data and materials:** The datasets supporting the findings of this article are available from the corresponding author

**Competing interest:** The authors declare that they have no competing interests.

**Funding:** No funding.

**Author's contribution**

**Affiliations**

1. Department of periodontology and Oral Implantology, College of Dental Surgery, B.P Koirala Institute of Health & Sciences, Dharan, Nepal. Khushboo Goel
2. Department of periodontology and Oral Implantology, College of Dental Surgery, B.P Koirala Institute of Health & Sciences, Dharan, Nepal. Shivalal Sharma
3. School of Public Health and Community Medicine, B.P Koirala Institute of Health & Sciences, Dharan, Nepal. Dharnidhar Baral
4. Department of Public Health Dentistry, College of Dental Surgery, B.P Koirala Institute of Health & Sciences, Dharan, Nepal. Santosh Kumari Agrawal

**Contributions:** The principal author designed the study, collected the data, and drafted the manuscript. The second author critically revised the data and approved the final manuscript. The third author interpreted the intellectual input and approved the statistical analysis. The fourth author gave the statistical input and organized the dental health camps.

**Corresponding author:** Correspondence to Khushboo Goel.

**Acknowledgements:** Not applicable

## References

1. Anand PS, Kamath KP, Nair B. Trends in extraction of permanent teeth in private dental practices in Kerala State, India. *J Contemp Dent Pract.* 2010;11(3): 041-8.
2. Sanz M, D'aiuto F, Deanfield J, et al. European workshop in periodontal health and cardiovascular disease - Scientific evidence on the association between periodontal and cardiovascular diseases: A review of the literature. In: *European Heart Journal Supplement.* 2010; 12 (suppl\_B): B3–B12.

3. Kassebaum NJ, Bernabe E, Dahiya M, et al. Global burden of severe periodontitis in 1990-2010: A systematic review and meta-regression. *Journal of Dental Research*. 2014; 93(11):1045-53.
4. Genco RJ, Borgnakke WS. Risk factors for periodontal disease. *Periodontol 2000*. 2013; 62(1):59-94.
5. Holtfreter B, Albandar JM, Dietrich T, et al. Standards for reporting chronic periodontitis prevalence and severity in epidemiologic studies: Proposed standards from the Joint EU/USA Periodontal Epidemiology Working Group. *J Clin Periodontol*. 2015; 42(5): 407-12.
6. Bergstrom J, Eliasson S. Cigarette smoking and alveolar bone height in subjects with a high standard of oral hygiene. *J Clin Periodontol*. 1987;14(8): 466-9.
7. Rosa GM, Lucas GQ, Lucas ON. Cigarette smoking and alveolar bone in young adults: A study using digitized radiographs. *J Periodontol*. 2008; 79(2): 232-44.
8. Chu YH, Tatakis DN, Wee AG. Smokeless Tobacco Use and Periodontal Health in a Rural Male Population. *J Periodontol*. 2010; 81(6):848-54.
9. Gupta B, Johnson NW. Systematic review and meta-analysis of association of smokeless tobacco and of betel quid without tobacco with incidence of oral cancer in south asia and the pacific. *PLoS ONE*. 2014; 9(11): e113385
10. Stanfill SB, Connolly GN, Zhang L, et al. Global surveillance of oral tobacco products: Total nicotine, unionised nicotine and tobacco-specific N-nitrosamines. *Tob Control*. 2011;20(3): e2.
11. Mukherjea A, Morgan PA, Snowden LR, et al. Social and cultural influences on tobacco-related health disparities among South Asians in the USA. *Tob Control*. 2012; 21(4): 422-8.
12. Giovino GA, Mirza SA, Samet JM, et al. Tobacco use in 3 billion individuals from 16 countries: An analysis of nationally representative cross-sectional household surveys. *Lancet*. 2012; 380(9842): 668-79.
13. Robertson PB, Walsh M, Greene J, et al. Periodontal Effects Associated With the Use of Smokeless Tobacco. *J Periodontol*. 1990; 61(7): 438-43.
14. Fisher MA, Taylor GW, Tilashalski KR. Smokeless tobacco and severe active periodontal disease, NHANES III. *J Dent Res*. 2005; 84(8): 705-10.
15. Montén U, Wennström JL, Ramberg P. Periodontal conditions in male adolescents using smokeless tobacco (moist snuff). *J Clin Periodontol*. 2006;33(12): 863-8.
16. Department of Health Services: National Oral Health Policy 2014. Kathmandu: Oral Health Focal Point, Management Division, Department of Health Services; 2014.
17. Gupta PC, Ray CS. Smokeless tobacco and health in India and South Asia. *Respirology*. 2003; 8(4): 419-31.
18. A.Ghosh, T. Ghosh. Modification of Kuppuswamy's Socioeconomic Status Scale in context to Nepal. *Indian Pediatr*. 2009;46: 1104–5.
19. Kulkarni V, Uttamani JR, Bhatavadekar NB. Comparison of clinical periodontal status among habitual smokeless-tobacco users and cigarette smokers. *Int Dent J*. 2016; 66(1): 29-35
20. O'Leary TJ. The periodontal screening examination. *J Periodontol*. 1967;38:617–24.

21. Lennox JA, Kopczyk RA. A clinical system for scoring a patient's oral hygiene performance. *J Am Dent Assoc.* 1973;86:849–52
22. Greene JC, Vermillion JR. The simplified oral hygiene index. *J Am Dent Assoc.* 1964; 68: 7–13.
23. Paul I. Eke, Roy C. Page, Liang Wei, et al. Background: Update of the Case Definitions for Population-Based Surveillance of Periodontitis. *J Periodontol.* 2012; 83(12): 1449-54.
24. Albandar JM, Rams TE. Global epidemiology of periodontal diseases: An overview. *Periodontol 2000.* 2002;29:7–10.
25. Eke PI, Dye BA, Wei L, et al. Update on Prevalence of Periodontitis in Adults in the United States: NHANES 2009 to 2012. *J Periodontol.* 2015; 86(5): 611-22.
26. Holtfreter B, Kocher T, Hoffmann T, et al. Prevalence of periodontal disease and treatment demands based on a German dental survey (DMS IV). *J Clin Periodontol.* 2010; 37(3): 211-9
27. Shaju J, Zade R, Das M. Prevalence of periodontitis in the Indian population: A literature review. *J Indian Soc Periodontol.* 2011;15(1): 29–34.
28. Helderman W, Groeneveld A, Truin GJ, et al. Analysis of epidemiological data on oral diseases in Nepal and the need for a national oral health survey. *Int Dent J.* 1998; 48(1): 56-61.
29. Page RC, Krall EA, Martin J, et al. Validity and accuracy of a risk calculator in predicting periodontal disease. *J Am Dent Assoc.* 2002; 133(5):569-76.
30. Koshi E, Rajesh S, Koshi P. Risk assessment for periodontal disease. *J Indian Soc Periodontol.* 2012;16:324–8.
31. Bhat M, Do L, Roberts-Thomson K. Risk indicators for prevalence, extent and severity of periodontitis among rural Indian population aged 35-54 years. *Int J Dent Hyg.* 2018;16(4):492–502.
32. Abdellatif HM, Burt BA. An Epidemiological Investigation into the Relative Importance of Age and Oral Hygiene Status as Determinants of Periodontitis. *J Dent Res.* 1987; 66(1):13-8.
33. Grossi SG, Zambon JJ, Ho AW, et al. Assessment of Risk for Periodontal Disease. I. Risk Indicators for Attachment Loss. *J Periodontol.* 1994; 65(3):260-7.
34. Machtei EE, Dunford R, Grossi SG. Cumulative nature of periodontal attachment loss. *J Periodont Res.* 1994;29(5):361–4.
35. Corbet E, Davies W. The role of supragingival plaque in the control of progressive periodontal disease: A review. *J Clin Periodontol.* 1993; 20(5):307-13.
36. Löe H, Anerud A, Boysen H, et al. Natural history of periodontal disease in man: Rapid, moderate and no loss of attachment in Sri Lankan laborers 14 to 46 years of age. *J Clin Periodontol.* 1986; 13(5):431-45.
37. Krall EA. Smoking, smoking cessation, and tooth loss. *J Dent Res.* 1997; 76(10):1653-9.
38. Haber J, Wattles J, Crowley M, et al. Evidence for Cigarette Smoking as a Major Risk Factor for Periodontitis. *J Periodontol.* 2010; 64(1):16-23.
39. WHO report on the global tobacco epidemic, 2017, Nepal, conducted by WHO report on the global tobacco epidemic 2017 [internet]. Geneva: WHO; 2017. Available from: <http://www.who.int/tobacco/>

global\_report/en/. [Full Text]

40. Hugoson A, Rolandsson M. Periodontal disease in relation to smoking and the use of Swedish snus: Epidemiological studies covering 20 years (1983-2003). *J Clin Periodontol.* 2011; 38(9):809-16.
41. de Araújo Nobre M, Malo P. Prevalence of periodontitis, dental caries, and peri-implant pathology and their relation with systemic status and smoking habits: Results of an open-cohort study with 22009 patients in a private rehabilitation center. *J Dent.* 2017; 67:36-42.
42. Mohamed S, Janakiram C. Periodontal status among tobacco users in Karnataka, India. *Indian J Public Health.* 2013; 57(2):105-8
43. Khan S, Khalid T, Awan KH. Chronic periodontitis and smoking: Prevalence and dose-response relationship. *Saudi Med J.* 2016; 37(8): 889–894
44. Pauletto NC, Liede K, Nieminen A, et al. Effect of Cigarette Smoking on Oral Elastase Activity in Adult Periodontitis Patients. *J Periodontol.* 2000;71(1):58-62
45. Xu M, Scott JE, Liu KZ, et al. The influence of nicotine on granulocytic differentiation - Inhibition of the oxidative burst and bacterial killing and increased matrix metalloproteinase-9 release. *BMC Cell Biol.* 2008; 15;9:19.
46. Bostrom L, Linder LE, Bergström J. Clinical expression of TNF- $\alpha$  in smoking-associated periodontal disease. *J Clin Periodontol.* 1998; 25(10):767-73.
47. Tangada SD, Califano JV, Nakashima K, et al. The Effect of Smoking on Serum IgG2 Reactive With *Actinobacillus actinomycetemcomitans* in Early-Onset Periodontitis Patients . *J Periodontol.* 2012; 68(9):842-50.
48. Warnakulasuriya K. Smoking and chewing habits in Sri Lanka. In *Control of Tobacco-related Cancers and Other Diseases. Proceedings of an International Symposium*, eds. Gupta, P. C., Hamner, J. E. and Murti, P. R. Bombay Oxford Univ Press. 1992;113–8.
49. Liu ST, Nemeth JM, Klein EG, et al. Risk perceptions of smokeless tobacco among adolescent and adult users and nonusers. *J Health Commun.* 2015; 20(5):599-606.
50. Aryal KK, Neupane S, Mehata S, et al. *Non Communicable Diseases Risk Factors: STEPS Survey Nepal 2013.* Kathmandu: Nepal Health Research Council. 2014.
51. Katuri KK, Alluri JK, Chintagunta C, et al. Assessment of periodontal health status in smokers and smokeless tobacco users: A cross-sectional study. *J Clin Diagnostic Res.* 2016; 10(10):ZC143-ZC146.
52. Sumanth SS, Bhat KM, Bhat GS. Periodontal health status in pan chewers with or without the use of tobacco. *Oral Heal Prev Dent.* 2008;6(3):223-9.
53. EU Working Group on Tobacco and Oral Health. Meeting Report. *Oral Dis.* 1998;4:464–7.
54. Papapanou PN. Periodontal diseases: epidemiology. *Ann Periodontol.* 1996;1:1–36.
55. Holm G. Smoking as an Additional Risk for Tooth Loss. *J Periodontol.* 1994; 65(11):996-1001
56. Dietrich T, Walter C, Oluwagbemigun K, et al. Smoking, smoking cessation, and risk of tooth loss: The EPIC-Potsdam study. *J Dent Res.* 2015; 94(10):1369-75.

57. Begum S, Reddy V, Kumar R, et al. Tooth loss prevalence and risk indicators among adult people visiting community health centers in Nellore district, Andhra Pradesh: A cross-sectional study. J Indian Assoc Public Heal Dent. 2016; 14:413-8

## Tables

**Table 1: Characteristics of study population (n=440). \*Column percentage**

Variables	Subcategory	Frequency (%)*
Age in years	20- 34	110 (25.0)
	35 - 44	124 (28.2)
	45 - 65	206 (46.8)
Gender	Females	254 (57.7)
	Males	186 (42.3)
SES	Upper class	16 (3.6)
	Lower middle	166 (37.7)
	Lower	258 (58.6)
Brushing frequency	≤ once/day	312 (70.9)
	≥ twice/day	128 (29.1)
Tobacco users	Yes	205 (46.6)
	No	234 (53.2)
Smoking Status	Current Smokers/Bidi smokers	91 (20.7)
	Non smokers	349 (79.3)
Smokeless tobacco (SLT)	Users	152 (34.5)
	Non users	288 (65.5)
	Khaini users	101 (66.4)
	SLT chewers	51 (33.6)
OHI-S	Good	67 (15.2)
	fair	202 (45.9)
	Poor	171 (38.9)
Teeth loss	Present	218 (49.5)
Reason for teeth loss	Caries	115 (52.7)
	Periodontitis	57 (26.1)
	Others	46 (21.1)

**Table 2: Univariate and multivariate logistic regression analysis between tobacco use and other factors with periodontitis**

	Disease Present	COR <sup>#</sup>	p value	AOR <sup>□</sup>	95%CI(L-U)	p value
<b>Age</b>						
20-35	47 (42.7%)	Constant	<0.001	Constant		
35-44	80 (64.5%)	2.437		1.983	1.127-3.490	<0.018
45-65	188 (91.3%)	14.000		7.585	3.938-14.610	<0.001
<b>Gender</b>						
Female	163 (64.2%)	Constant	<0.001			
Male	152 (81.7%)	2.496		NS		
<b>Socio-economic status (SES)</b>						
Upper	14 (87.5%)	3.089	0.363	NS		
Lower middle	122 (73.5%)	1.224				
Lower	179 (69.4%)	Constant				
<b>Brushing frequency</b>						
≤once/day	229 (73.4%)	Constant	0.190	NS		
≥ twice/day	86 (67.2%)	1.347				
<b>OHI-S</b>						
Good	34 (50.7%)	Constant	<0.001	NS		
Fair	133 (65.8%)	1.871				
Poor	148 (86.5%)	6.246				
<b>Missing teeth</b>						
Absent	134 (60.4%)	Constant	<0.000	Constant		
Present	181 (83.0%)	3.213		2.025	1.211-3.387	0.007
<b>Smoking Status</b>						
Absent	232 (66.5%)	Constant	<0.001	Constant		
Present	83 (91.2%)	5.232		3.149	1.364- 7.270	0.007
<b>Khaini</b>						
Absent	226 (66.7%)	Constant	<0.001	Constant		
Present	89 (88.1%)	3.708		2.275	1.122-4.613	0.023
<b>SLT chewers</b>						
Absent	277 (71.2%)	Constant	0.623	NS		
Present	38 (74.5%)	1.182				
<b>BMI</b>						
BMI	24.6 + 2.6	1.232	<0.001	NS		
<b>PI</b>						
PI	71.9+ 20.2	1.032	<0.001	1.017	1.005- 1.029	0.004
<b>BPI</b>						
BPI	49.7 + 24.4	1.025	<0.001	NS		

<sup>#</sup>Crude odds ratio

<sup>□</sup>Adjusted odds ratio

## Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [BMCexcel.xml](#)