Periodontal Diseases and Associated Factors among Type 1 Diabetes Mellitus Patients from Selected Clinics in Dhaka, Bangladesh

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ABSTRACT

Introduction: Periodontal disease and diabetes mellitus are the two most prevalent chronic diseases and global burdens in the world. Periodontal disease comprises gingivitis and periodontitis. An increasing trend of periodontal disease is reported among diabetic patients in Bangladesh. Limited studies have investigated the association between type 1 diabetes mellitus and periodontal disease in Bangladesh. This study, therefore, aims to investigate the association of demographic characteristics, lifestyle factors, diabetic-related factors, and oral hygiene practice with periodontal disease among type 1 diabetes mellitus in Dhaka, Bangladesh.

Methods: Survey and clinical examination of this cross-sectional study were conducted in three well-known clinics in Dhaka. A total of 182 participants were clinically examined based on inclusion and exclusion criteria.

Results: A higher prevalence of periodontitis was found compared to gingivitis among type 1 diabetes mellitus. About 30.2% of the respondents had moderate periodontitis, followed by mild periodontitis 28.6%. The majority of respondents (30.8%) had mild gingivitis and only 14.8% had moderate gingivitis. Furthermore, proportions of periodontitis and gingivitis were positively associated with age [(aOR1.12 (95%cis=1.07, 1.17)] and lower education. A significant association of periodontitis was found with the duration of diabetes [(aOR) 0.95 (95%cis=0.90, 0.99)] and frequency of toothbrushes (42-fold greater).

Conclusions: The findings of this study imply that dentists should emphasize on patients for well metabolic control to prevent the progression of periodontal disease.

Keywords: Periodontal disease; Diabetes mellitus; Associated factors.

Introduction

Periodontal disease is one of the most prevalent chronic non-communicable oral inflammatory diseases in the world which leads to the gradual destruction of connective tissue that supports and helps to hold the tooth in its position. If it is left in untreatable condition, the periodontal disease eventually primes to tooth loss in the severe stage. Important for a person's periodontal health is to equilibrium between bacterial plaque challenges and body immune-inflammatory response. Under the specific influence of multiple behavioural, environmental, and genetic factors of host responses can determine the general susceptibility of the host or the local susceptibility of progression of periodontal disease. In this regard, it is common in severe forms of periodontal disease in individuals with compromised immune systems, e.g., those with Diabetes Mellitus, HIV infection, leukaemia, and Down syndrome.[1]

Periodontal disease principally consists of gingivitis and periodontitis. Pocket measurement and Papillary bleeding index are conducted in the clinical site to determine the stages of gingivitis and periodontitis. Gingivitis is characterized by redness of the gum margins, swelling, and bleeding on brushing.[1] Periodontitis is a chronic low-grade infection, results in tissue destruction and alveolar bone resorption.[2]

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Periodontitis is considered as one of the main causes of tooth loss generally noticed among adult people compare to young people.

Several studies have shown that periodontal disease is highly prevalent in both developing and developed countries.[2-4] The World Health Organization (WHO) reported that the worldwide prevalence of deep periodontal pockets (≥6 mm) among adults was 10% to 15%.[5] Consequently, along with the growing ageing population, the burden of periodontitis will increase globally for tooth retention loss.[6-8] Periodontal disease progression is much faster among the poor population because of social differences.[6,9]

Periodontal diseases are more common among men than women in the world. According to Ahmed et al.[10] from Update Dental College Hospital in Bangladesh stated that about 56 % of males and 43.6 % of females are suffering from gingivitis, 48.6% males and 51.4% females were diagnosed as suffering from chronic periodontitis. Periodontal disease diagnosed was increased by age as follows; 0 to 20 years (11% gingivitis, 1.5%(periodontitis), in 21 to 40 years (64% gingivitis, 30.7% gingivitis), in (41-60) years of age (25% gingivitis, 67.8% periodontitis).[10]

On the Other hand, Diabetes Mellitus is the most common metabolic syndrome in the human body. In this metabolic disorder, the body unable to produce adequate or act in response to insulin from the pancreas causes a rise of sugar level in the bloodstream abnormally. Diabetes Mellitus is classified into three major categories: Type 1(Insulin Dependent Diabetes Mellitus), Type 2 (Non-Insulin Dependent Diabetes Mellitus), and Gestational Diabetes Mellitus (GDM). Type 1 diabetes mellitus is caused by a deficiency of insulin secretion due to autoimmune destruction of insulin-secreting beta cells of the islets of Langerhans in the pancreas,11 as well as association with periodontal diseases has been recognized.[12] Children and people who have aged below thirty years commonly suffering from type 1 diabetes mellitus.13 Older people are also affected with Insulin Dependent Diabetes Mellitus.[14] Therefore, Insulin Replacement Therapy is the main treatment for type 1 diabetes mellitus.

Diabetes mellitus is considered a major public health problem and 245 million people have this disorder. In 2030, the projected number of diabetes mellitus patients is 366 million people in the world.[15] The increasing prevalence and number of diabetes mellitus patients in Bangladesh have been reported that from 1995 to 2000 was 4% and 5% in 2001 to 2005, whereas 9% was accounted for in 2006 to 2010.[12] The International Diabetes Federation (IDF) projected the expected prevalence of diabetes mellitus in Bangladesh will be 13% by 2030.[15]

Previous studies have shown that diabetes mellitus is a risk factor for the progression of periodontal disease.[16] It is well established in theoretical and practical that diabetes mellitus and periodontal disease are linked.[17] Diabetes mellitus enhances inflammation and apoptosis specifically that mainly affects on periodontal tissues of patients with a poor periodontal health condition. Moreover, the increasing severity of periodontal disease among diabetes mellitus patients may reflect an alteration in the pathogenic process of bacteria and enhancing the breakdown of periodontal tissues, results in more frequent and severe periodontal tissue destruction.[18]

In Bangladesh, incidence rate of type 1 diabetes mellitus for <25 years was 1.24/100 000 per years (males 0.92, females 1.71) and 0.96/100 000 for <15years (males 0.63, females 1.55).19 Type 1 diabetes mellitus patients were facing many social challenges in Bangladesh. Economically, the majority of type 1 diabetic patients are in poor status in Bangladesh. Hence, low afford or little access for buying/getting insulin from public hospitals or other private institutes. In addition, lack of knowledge about good oral hygiene maintenance with poor metabolic control can assist in the development of periodontal disease among type 1 diabetes mellitus patients. Many studies have been conducted in Bangladesh to determine the relationship between type 2 diabetes mellitus and periodontal disease. According to the researcher's knowledge, there is limited, or no study had been conducted in Bangladesh to determine the association with the associated factors between type1 diabetes mellitus and periodontal disease.

More importantly, the public healthcare system in Bangladesh offers limited access to dental services, especially for individuals with diabetes mellitus who are not given treatment priority. Therefore, the findings of this study about the association between type 1 diabetic-related factors and periodontal diseases can assist to improve oral health behaviours and prevent the progression of periodontal disease.

Method and Materials

This study was a cross-sectional study that was conducted in three well-known clinics at Bhasantek Bazar in Dhaka Cantonment, Dhaka, Bangladesh. All the consecutive type 1 diabetes mellitus patients were attending these three clinics which had been selected for this study based on exclusion and inclusion criteria. 306 sample size was estimated for the finite population by using Open Epi info v.3, and the confidence level was taken as 95%. Descriptive analyses were calculated as the proportion (%), mean, SD and/or median and IQR for qualitative and quantitative variables respectively. In multivariate analysis, calculated adjusted odds ratio and 95% CI by binary logistic regression. A P-value of< 0.05 was considered statistically significant.

Inclusion criteria

- Patients with type 1 diabetes mellitus diagnosed for at least last year or more and registered by the medical practitioner.
- Willingness to participate in the study during the study period.
- 18 years and above as well as giving written consent to participate in the study.

Exclusion criteria

- Pregnancy and lactation.
- Inflammatory disease, chronic liver disease, or patients receiving any treatment that could modify the study parameters, such as, antibiotics, immune suppressants, antiepileptic treatment.

Study instruments

The study instrument consisted of two parts: A survey questionnaire and clinical parameters

Survey questionnaire

The survey questionnaire included of total 42 items including socio-demographic factors and diabetic history was adapted from Izuora et al.[20]. Management of diabetic self-compliance items was adapted from Kim et al.[21]. Oral health-related items were adapted from Quisumbing et al.[22] Kojima et al.[23] and Izuora et al.[20].

Clinical parameters

A careful oral examination was carried out with the help of a dental mirror, tweezer, surgical gauge, and caries explorer. For determined periodontal health, papillary bleeding index and Community Periodontal Index (CPI) were measured by using WHO-probe (Hu-Freidy, Chicago, IL, USA). Community periodontal index; considers the worst condition encountered in six sites evaluated and used the following four codes:0 = healthy; 1 = absence of pockets, bacterial plaque retention factors, or bleeding following probing; 2 = depth as much as 3 mm and presence of bacterial plaque retention factors; 3 = pockets with probing depth between 4 and 5 mm; 4 = probing depth ≥6 mm. Papillary bleeding index; the interdental sites were probed in order from the right maxillary second molar to the left maxillary second molar [17, 16, 11, 26 & 27] and from the left mandibular second molar to the right mandibular second molar [37, 36, 31, 46 & 47]. The stratification of the papillary bleeding index was following; Score 0-no bleeding; Score 1- A single discreet bleeding point; Score 2- Several isolated bleeding points or a single line of blood appears; Score 3- The interdental triangle fills with blood shortly after probing; Score 4- Profuse bleeding occurs after probing; blood flows immediately into the marginal sulcus.

Diabetic-related factors such as duration and compliance to self-management of diabetes were obtained by questionnaire. Each question of self-compliance management was rated on a 4-point Likert scale (1 = always and 5 = never). Respondents who were unable to answer these diabetic-related questions, the researcher helped them to get the answer to these questions. Detailed information of HbA1c was collected as the percentage of haemoglobin (glycosylated) from the medical records of participants in the particular clinic.

Result

Table 1. Factors associated with gingivitis by multivariate analysis

Factors	Adjusted odds ratio (95%CI)	P-value
Sociodemographic and lifestyle factors		
Age (18 years and above)	1.12 (1.07,1.17)	0.000
Gender		
Female	1	0.211
Male	2.204 (0.64 ,7.59)	
Income		
31000 to 40000 Taka	1	0.214
21000 to 30000 Taka	0.315 (0.07, 1.35)	0.119
Less than 20000 Taka	0.412 (0.13, 1.36)	0.146
Education		
Masters or Higher	1	0.079
Bachelor	4.118 (0.75, 22.57)	0.103
Secondary (lower & higher)	4.248 (1.2, 15.07)	0.025
Tobacco smoking		
No	1	0.804
Yes	0.871 (0.29, 2.61)	
Tobacco chewing		
No	1	0.182
Yes	0.418 (0.12, 1.51)	
Diabetes-related factors		
Duration of diabetes	0.969 (0.93, 1.01)	0.136
Hba1c	1.046 (0.88, 1.25)	0.620
Self-compliance score	1.232 (1.03, 1.47)	0.020
Oral hygiene practice		
Frequency of toothbrush		
Twice	1	0.001
Once	22.611 (3.39,151.03)	
Clean by doctor		
Yes	1	0.002
No	92.222 (5.41, 1573.13)	
Use of Mouthwash		
Yes	1	0.897
No	0.924 (0.28, 3.04)	

Results in table 1 had shown that respondents' age was positively associated with the proportion of gingivitis adjusted odds ratio [(aOR) 1.12 (95%CIs=1.07, 1.17)]. The odds of being having gingivitis were 4-fold higher among the patients who were less educated compared to patients who had higher education. Patients who had higher compliance scores had higher odds of having gingivitis [(aOR)1.232 (95%CI=1.03,1.47)]. The odds of having gingivitis were 23-fold higher among the patients who brushed their teeth once a day compared to patients who brushed their teeth two times a day. Patients who did not undergo dental cleaning had higher odds of having gingivitis 92-fold (CI=5.41, 1573.13) than patients who were cleaned by the doctor regularly.

Table 2. Factors associated with periodontitis by multivariate analysis

Factors	Adjusted odds Ratio (95%CI)	P-value
Sociodemographic and lifestyle factors		
Age	1.080 (1.02, 1.15)	0.010
Gender		
Female	1	0.178
Male	3.103 (0.6, 16.09)	
Income		
31000 to 40000 Taka	1	0.061
21000 to 30000 Taka	0.434 (0.09, 2.02)	0.287
Less than 20000 Taka	2.754 (0.57, 13.4)	0.209
Education		
Masters or Higher	1	0.120
Bachelor	8.577 (0.74, 99.66)	0.086
Secondary (lower & higher)	14.451 (1.14, 183.36)	0.039
Tobacco smoking		
No	1	
Yes	2.066 (0.41, 10.54)	0.383
Tobacco chewing		
No	1	0.003
Yes	41.46 (6.66, 258.25)	
Diabetic history		
Duration of diabetes	0.948 (0.90, 0.1)	0.044
Hba1c	1.318 (0.99, 1.76)	0.060
Self-compliance management	1.217 (0.92, 1.60)	0.162
Oral hygiene practice		
Frequency of toothbrush		
Twice	1	0.000
Once	42.713 (5.71, 319.81)	
Clean by doctor		
Yes	1	0.094
No	9.635 (0. 68, 136.52)	

Table 2 had shown that respondents' age was positively associated with the proportion of periodontitis adjusted odds ratio [(aOR)1.08 (95%CIs=1.02, 1.15)]. The odds of being having periodontitis were 14-fold higher among the patients who had less educated compared to patients who were higher education. Patients whose tobacco chewed had higher odds of having periodontitis [(aOR) 41.48 (95%CIs=6.66, 258.25)] than patients who did not take tobacco. Patients who had a longer duration of diabetes had higher odds of having periodontitis [(aOR) 0.95 (95%CIs=0.90, 0.99)]. The odds of being having periodontitis were 42-fold greater among the patients who brushed their teeth once a day compared to patients who habited to brush their teeth two times a day.

Discussion:

Age was significantly associated with both periodontitis and gingivitis suggesting greater susceptibility for periodontal disease. It has been confirmed from previous studies that increasing age was one of the predictors of the severity of periodontitis and gingivitis. In concurrence with a previous study both periodontitis and gingivitis were increasing in prevalence with age.[24]

The finding of this study was also following another study Rajhans et al.[25] which reported that the age of the diabetic patients has increased, the prevalence and severity of periodontal disease have increased. A study conducted by Ababneh[26] in Jordan found that 40 to 49 years old patients had only 21.2%, whereas, 53% reported periodontitis over 50 years. Our study has confirmed that type 1 diabetic patients' lower education level was significantly associated with periodontal disease. Patients who were less educated had a higher risk of periodontitis and gingivitis than those with higher educated. The present finding was similar to previous studies, a low level of education had an excess risk of gingivitis and periodontitis when compared with a higher level of education.[27,28] Low education level is likely to lead to low prestige and low pay occupations, and residing in a deprived area, therefore, resulting in the lack of adequate oral health knowledge, insufficient preventive behaviours, and low use of oral health services. The impact of environmental conditions on periodontal health has

been widely described such that individuals living in a neighbourhood in the most socially marginalized areas has experienced twice the risk of periodontitis relative to those in the most affluent.[28,29] Smokeless tobacco was significantly associated with periodontitis. The finding of this study was consistent with the previous finding by Kamath et al.[30] that the habit of tobacco chewing among Asians was associated with high scores and risk of periodontal disease. A similar association was also found in developed countries such as the US, Sweden.[31,32] In the current study, smokeless tobacco users were at greater risk of developing periodontal pockets than non-users of smokeless tobacco. We categorized smokeless tobacco users into four groups and concluded that previous to current users play a corresponding role in the disappearance of the periodontal disease once the smokeless tobacco use was stopped. These findings are similar to previous studies that report a significant association between periodontal disease and smokeless tobacco use.[33,34] In contrast, some studies failed to show the association between smokeless tobacco and periodontitis.[35,36] For instance, a study conducted in Saudi Arabia revealed that SLT was not a significant risk indicator in the development of periodontal disease.[37] Such contradictory observations may be attributed to several factors, such as differences in the trends of oral SLT practices and the type of SLT products and duration of diabetes used by the sample of patient's studies. On the other hand, periodontitis and gingivitis were not significant with other lifestyle factors such as smoking and betel nut in this study. When compared with the previous study, smokers were three times more likely to have a severe form of periodontal disease than non-smokers.[38] Some studies had shown that betel nut biting increases the prevalence of gingival inflammation.[39-42] Duration of diabetes and periodontitis are positively associated. This finding is similar to the previous finding, the correlation between the duration of diabetes and the severity of periodontitis has been reported.[43] The longer duration of the disease can affect the probing pocket depth, bleeding on probing, and clinical attachment level.[42] Cerda et al.[44] stated that the duration of diabetes was a significant factor in the severity of the periodontal disease. Firatli et al.[45]

observed a clear relationship between the years of evolution of diabetes mellitus and clinical attachment loss of periodontal tissue. In contrast, patients with a shorter duration of diabetes had less periodontal disease, while those with a longer duration had a higher prevalence and severity of periodontal disease.[46] Moreover, type 1 diabetes is onset at a younger age; hence the longer duration of diabetes implies that the patient is older. There was no significant association between periodontal disease and glycemic control (Hba1c) in our study. The finding of the current study was similar to a previous study.[47] In contrast, most previous studies agreed that HbA1c was associated with the severity of periodontitis.[48-49] Although Jindal et al.[50] showed that patients with poor glycemic control had more severe gingival inflammation as evident by the higher scores of Gingival Index (GI). Lalla et al.[51] found greater gingival inflammation in a large cohort of type 1 diabetics patients as compared to non-diabetic controllers. Gingivitis was significantly associated with the management of diabetic self-compliance in the present study. Knecht et al.[52] reported that participants who have good compliance to self-management of diabetes tend to have higher dental self-efficacy which is related to good periodontal health. In our study reported that patients who manage their diabetes such as regular hospital visits as per doctor's recommendation, maintain optimal blood sugar levels, taking insulin regularly had a risk of developing gingivitis.

A recent study reported a significant association between periodontal diseases and the frequency of tooth brushing. Consistent with other studies, a majority of respondents reported brushing their teeth once daily.[53-56] However, a previous study of the Chinese population showed that, in general, a high percentage of the 2105 respondents reported inadequate oral hygiene practices such as 66.7% as well as 1402 of respondents brushed their teeth once a day or less reported that 15.1% had periodontitis.[57] The current study showed, that for patients who did not undergo dental clinic, gingivitis was higher than patients who cleaned their teeth by the dentist. Good

oral hygiene and regular dental cleaning are recommended to prevent and manage oral health problems.[58] A survey conducted in Malaysia revealed that half (51%) of the people with diabetes believed teeth problems were not serious and this belief was one of the main reasons behind refusing a dental referral.[59] Unpleasant dental visits, doctor anxiety, the scare of sound and vibration from handpieces during a surgical procedure, extraction, and difficulty in scheduling appointments were found to discourage people from seeking dental care.[60,61] The results of this study have several implications for oral health professionals, policymakers, and diabetes care providers. Oral health professionals, diabetes care providers should play a more active role in promoting oral health programs among their patients. They should educate patients about their increased risk for oral health complications and advise them to have regular dental check-ups. Oral health professionals should inform diabetes mellitus patients about good oral health behaviours and emphasize the importance of good diabetes control in minimizing oral health risks. Diabetes care providers may also need to improve their knowledge in this area to incorporate oral health promotion into their practice. Besides, policymakers need to develop and implement standardized oral health care guidelines and oral health promotional resources for diabetes care settings as well as create appropriate referral pathways to increase uptake of dental services for this at-risk population. The findings of our study should be interpreted and considering the limitation described that the sample was studied from a clinic that would not be representative of type1 diabetic patients in the community, therefore, results might not apply to all type 1 diabetic patients. This study did not use a standard questionnaire to obtain information about lifestyle factors such as (smoking, tobacco, betel nut). Hence, these could be misclassification bias, leading to a lack of association of smoking with periodontitis. In our study examined the smaller sample than the minimum sample size we calculated for this study due to higher non-response. Hence, the present study did not have sufficient power for the association as indicated by wide CI for the adjusted odds ratio

Conclusion

The present study aims at signifying the relationship between type 1 diabetes mellitus and periodontal disease and to analyze how diabetes metabolic control, diabetes complications, and diabetes duration would be related to periodontal parameters. A link between diabetes and periodontitis in adults has been confirmed. Periodontitis has been considered the sixth complication of diabetes mellitus. It is well established that diabetes increases the prevalence, severity, and progression of periodontal disease. In our study periodontal disease was associated with age, education, duration of diabetes, frequency of toothbrush. These findings imply that dentists should emphasize well diabetes control for prevention and slowing the progression of periodontal disease. Furthermore, a physician treating diabetic patients should advise on the importance of oral health care and refer the opportunity to dentists for preventive oral health.

Ethical Approval:

The standard protocols, data collection tools and procedures for demographic and clinical examinations were reviewed by the Joint committee (JC) of research and ethics of the International Medical University (IMU). During the survey, interviewers informed that participation in the survey was voluntary. They were also assured about the confidentiality of the information to be provided and could opt not to answer any of the questions during the interview. Informed consent was obtained from each survey participant. The data collection was conducted from September 2017 to November 2017. The intended period for data collection was two weeks. Difficulty in getting a response from the participants conferring to exclusion or inclusion criteria, the data collection time was longer than planned.

Conflict of Interest: No conflict of interest.

References

1. https://www.dentalhealth.ie/dentalhealth/causes/ periodontaldisease.html-Google Search [Internet]. 2018 [cited 2018 Jun 6].

2. Sischo L, Broder HL. Oral health-related quality of life: what, why, how, and future implications. Journal of dental research. 2011 Nov;90(11): 1264-70.

3. Holtfreter B, Kocher T, Hoffmann T, Desvarieux M, Micheelis W. Prevalence of periodontal disease and treatment demands based on a German dental survey (DMS IV). J Clin Periodontol. 2010 Mar;37(3):211–9.

4. Eke PI, Dye BA, Wei L, Thornton-Evans GO, Genco RJ. Prevalence of periodontitis in adults in the United States: 2009 and 2010. Journal of dental research. 2012 Oct;91(10):914-20. Holtfreter B, Kocher T, Hoffmann T, Desvarieux M, Micheelis W. Prevalence of periodontal disease and treatment demands based on a German dental survey (DMS IV). J Clin Periodontol. 2010 Mar;37(3):211–9. Sischo L, Broder HL. Oral health-related quality of life: what, why, how, and future implications. Journal of dental research. 2011 Nov;90(11):1264-70.

5. How KY, Song KP, Chan KG. Porphyromonas gingivalis: an overview of periodontopathic pathogen below the gum line. Frontiers in microbiology. 2016 Feb 9;7:53.

6. Jepsen S, Blanco J, Buchalla W, Carvalho JC, Dietrich T, Dörfer C, et al. Prevention and control of dental caries and periodontal diseases at individual and population level: consensus report of group 3 of joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases. J Clin Periodontol. 2017 Mar;44 Suppl 18: S85–93.

7. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJL, Marcenes W. Global Burden of Severe Tooth Loss. J Dent Res. 2014 Jul;93(7 Suppl):20S-28S.

8. Tonetti MS, Bottenberg P, Conrads G, Eickholz P, Heasman P, Huysmans M-C, et al. Dental caries and periodontal diseases in the ageing population: call to action to protect and enhance oral health and well-being as an essential component of healthy ageing - Consensus report of group 4 of the joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases. J Clin Periodontol. 2017 Mar;44 Suppl 18: S135–44.

9. Jin LJ, Armitage GC, Klinge B, Lang NP, Tonetti M, Williams RC. Global oral health inequalities: task group--periodontal disease. Adv Dent Res. 2011 May;23(2):221–6.

10. Iqbal MA, Mohol J, Afrin F, Khaleque MA, Johra FT, Jannat N. Prevalence of periodontal diseases among the patient visiting at Periodontology OPD Update Dental College Hospital, Dhaka. Update Dent Coll J. 2016 Apr 7;5(2):23–9.

11. Atkinson MA, Eisenbarth GS. Type 1 diabetes: new perspectives on disease pathogenesis and treatment. The Lancet. 2001;358(9277):221–229.

12. Saquib N, Saquib J, Ahmed T, Khanam MA, Cullen MR. Cardiovascular diseases and type 2 diabetes in Bangladesh: a systematic review and meta-analysis of studies between 1995 and 2010. BMC Public Health. 2012 Jun 13; 12:434.

13. Jong Ha Baek1, *, Woo Je Lee2, *, Byung-Wan Lee3, Soo Kyoung Kim4, Gyuri Kim5, Sang-Man Jin5, Jae Hyeon Kim5.

14. Thunander M, Petersson C, Jonzon K, Fornander J, Ossiansson B, Torn C, Edvardsson S, Landin-Olsson M: Incidence of type 1 and type 2 diabetes in adults and children in Kronoberg, Sweden. Diabetes Res Clin Pract 82:247–255, 2008.

15. Guariguata L, Whiting D, Weil C, Unwin N. The International Diabetes Federation diabetes atlas methodology for estimating global and national prevalence of diabetes in adults. Diabetes Res Clin Pract. 2011 Dec 1;94(3):322–32.

16. Mahmud SZ, Alif SM, Tarafder MA, Hossain SM. The Correlation between Periodontal Diseases and Chronological Age among Type 2 Diabetes Mellitus Patients attending at National Healthcare Network (NHN) Mirpur Centre, Dhaka, Bangladesh. BIRDEM Med J. 2013 Dec 1;3(2):74–69.

17. Demmer RT, Trinquart L, Zuk A, Fu BC, Blomkvist J, Michalowicz BS, Ravaud P, Desvarieux M (2013) The influence of anti-infective periodontal treatment on C-reactive protein: a systematic review and meta-analysis of randomized controlled trials. PLoS One 8: e77441.

18. Kardeşler L, Buduneli N, Çetinkalp Ş, Kinane DF. Adipokines and inflammatory mediators after initial periodontal treatment in patients with type 2 diabetes and chronic periodontitis. Journal of periodontology. 2010 Jan;81(1):24-33.

19. Balsa A, Zabeen B, Ogle G, Tayyeb S, Azad K. Incidence estimate of type 1 Diabetes in Youth in Dhaka. In19th European Congress of Endocrinology 2017 May 3 (Vol. 49). BioScientifica.

20. Izuora K, Ezeanolue E, Schlauch K, Neubauer M, Gewelber C, Umpierrez G. Impact of periodontal disease on outcomes in diabetes. Contemp Clin Trials. 2015;41:93–9.

21. Kim E-K, Lee SG, Choi Y-H, Won K-C, Moon JS, Merchant AT, et al. Association between diabetes-related factors and clinical periodontal parameters in type-2 diabetes mellitus. BMC Oral Health. 2013 Nov 7;13:64.

22. Quisumbing JP, Lo TE, Lagaya-Estrada MC, Jimeno C, Jasul Jr G. Validation of the Oral Health Screening Questionnaire in Predicting Serious Periodontitis Among Adult Filipinos with Type 2 Diabetes Mellitus. J ASEAN Fed Endocr Soc. 2016;31(2):106.

23. Kojima A, Ekuni D, Mizutani S, Furuta M, Irie K, Azuma T, et al. Relationships between self-rated oral health, subjective symptoms, oral health behavior and clinical conditions in Japanese university students: a cross-sectional survey at Okayama University. BMC Oral Health. 2013;13(1):62.

24. Ghosh-Dastidar R, Gillam DG, Islam SS. Socio-Demographic and Oral Health Related Risk Factors for Periodontal Disease in Inner North-East London (INEL) Adults: A Secondary Analysis of the INEL Data. 2016 Aug 29 [cited 2018 Jun 6].

25. Rajhans NS, Kohad RM, Chaudhari VG, Mhaske NH. A clinical study of the relationship between diabetes mellitus and periodontal disease. J Indian Soc Periodontol. 2011;15(4):388–92.

26. Ababneh KT, Abu Hwaij ZMF, Khader YS. Prevalence and risk indicators of gingivitis and periodontitis in a Multi-Centre study in North Jordan: a cross sectional study. BMC Oral Health [Internet]. 2012 Dec [cited 2018 Jun 20];12(1). Available from: http://bmcoralhealth.biomedcentral.com/articles/10.1186/1472-6831-12-1.

27. Xiong X, Buekens P, Fraser WD, Beck J, Offenbacher S. Periodontal disease and adverse pregnancy outcomes: a systematic review. BJOG Int J Obstet Gynaecol. 2006;113(2):135–143.

28. Boillot A, El Halabi B, Batty GD, Rangé H, Czernichow S, Bouchard P. Education as a predictor of chronic periodontitis: a systematic review with meta-analysis population-based studies. PLoS One. 2011;6(7): e21508.

29. Borrell LN, Burt BA, Warren RC, Neighbors HW. The role of individual and neighborhood social factors on periodontitis: the third National Health and Nutrition Examination Survey. J Periodontol. 2006 Mar;77(3):444–53.

30. Kamath KP, Mishra S, Anand PS. Smokeless Tobacco Use as a Risk Factor for Periodontal Disease. Front Public Health [Internet]. 2014 Oct 20 [cited 2018 Jun 6];2. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4202691/.

31. Rolandsson M, Hellqvist L, Lindqvist L, Hugoson A. Effects of snuff on the oral health status of adolescent males: a comparative study. Oral Health Prev Dent. 2005;3(2).

32. Montén U, Wennström JL, Ramberg P. Periodontal conditions in male adolescents using smokeless tobacco (moist snuff). J Clin Periodontol. 2006;33(12):863–868.

33. Fisher MA, Taylor GW, Tilashalski KR. Smokeless Tobacco and Severe Active Periodontal Disease, NHANES III Smokeless Tobacco and Severe Active Periodontal Disease, NHANES III. J Dent Res. 2005 Aug 1;84(8):705–10.

34. Mohamed S, Janakiram C. Periodontal status among tobacco users in Karnataka, India. Indian J Public Health. 2013 Apr 1;57(2):105.

35. Bergström J, Keilani H, Lundholm C, Rådestad U. Smokeless tobacco (snuff) use and periodontal bone loss. J Clin Periodontol. 2006 Aug;33(8):549–54. 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 Sep;38(9):809–16. Al Agili DE, Park HK. Oral health status of male adolescent smokeless tobacco users in Saudi Arabia. East Mediterr Health J. 2013 Aug 1;19(08):711–9.

36. 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 Sep;38(9):809–16.

37. Al Agili DE, Park HK. Oral health status of male adolescent smokeless tobacco users in Saudi Arabia. East Mediterr Health J. 2013 Aug 1;19(08):711–9.

38. Johnson G, Hill M. Cigarette Smoking and the Periodontal Patient. Vol. 75. 2004. 196 p.

39. Chang L-Y, Wan H-C, Lai Y-L, Kuo Y-F, Liu T-Y, Chen Y-T, et al. Areca nut extracts increased expression of inflammatory cytokines, tumor necrosis factor-alpha, interleukin-1beta, interleukin-6 and interleukin-8, in peripheral blood mononuclear cells. J Periodontal Res. 2009 Apr;44(2):175–83.

40. Parmar G, Sangwan P, Vashi P, Kulkarni P, Kumar S. Effect of chewing a mixture of areca nut and tobacco on periodontal tissues and oral hygiene status. J Oral Sci. 2008 Mar;50(1):57–62

41. Akhter R, Hassan NMM, Aida J, Takinami S, Morita M. Relationship between betel quid additives and established periodontitis among Bangladeshi subjects. J Clin Periodontol. 2008;35(1):9–15.

42. Amarasena N, Ekanayaka AN, Herath L, Miyazaki H. Association between smoking, betel chewing and gingival bleeding in rural Sri Lanka. J Clin Periodontol. 2003;30(5):403–408.

43. Ajita M, Karan P, Vivek G, S MA, Anuj M. Periodontal disease and type 1 diabetes mellitus: associations with glycemic control and complications: an Indian perspective. Diabetes Metab Syndr. 2013 Jun;7(2):61–3.

44. Cerda J, Vázquez de la Torre C, Malacara J, Nava L. Periodontal disease in non-insulin dependent diabetes mellitus (NIDDM). The effect of age and time since diagnosis. J Periodontol. 1994 Dec 1;65:991–5.

45. Firatli E, Yilmaz O, Onan U. The relationship between clinical attachment loss and the duration of insulin-dependent diabetes mellitus (IDDM) in children and adolescents. J Clin Periodontol. 1996 Apr;23(4):362–6.

46. Denisse D-M, Nelly M-F, Enrique C-C, Enrique G, E R-RR, Omar T-M, et al. Relationship between Periodontal Disease and Type 1 Diabetes in Adolescents. Ann Med Health Sci Res [Internet]. 2017 [cited 2018 Jun 20].

47. Kebede TG, Pink C, Rathmann W, Kowall B, Völzke H, Petersmann A, et al. Does periodontitis affect diabetes incidence and haemoglobin A1c change? A 1;44(3):243–9.

48. Sandberg GE, Sundberg HE, Fjellstrom CA, Wikblad KF. Type 2 diabetes and oral health: A comparison between diabetic and non-diabetic subjects. Diabetes Res Clin Pract. 2000 Sep 1;50(1):27–34.

49. Almas K, Al-Qahtani M, Al-Yami M, Khan N. The relationship between periodontal disease and blood glucose level among type II diabetic patients. J Contemp Dent Pr. 2001;2(4):18–25.

50. Jindal A, Parihar AS, Sood M, Singh P, Singh N. Relationship between Severity of Periodontal Disease and Control of Diabetes (Glycated Hemoglobin) in Patients with Type 1 Diabetes Mellitus. J Int Oral Health JIOH. 2015;7(Suppl 2):17–20.

51. Lalla E, Cheng B, Lal S, Kaplan S, Softness B, Greenberg E, et al. Diabetes-related parameters and periodontal conditions in children. J Periodontal Res. 2007;42(4):345–349.

52. Kneckt MC, Syrjälä A-MH, Laukkanen P, Knuuttila MLE. Self-efficacy as a common variable in oral health behavior and diabetes adherence. Eur J Oral Sci. 107(2):89–96.

53. Sreenivasan PK, Prasad KVV, Javali SB. Oral health practices and prevalence of dental plaque and gingivitis among Indian adults. Clin Exp Dent Res. 2(1):6–17.

54. Gopinath V. Oral Hygiene practices among dental professionals in Chennai. Indian J Dent Res Off Publ Indian Soc Dent Res. 2010 Apr 1;21:195–200.

55. Mota A, Oswal KC, Sajnani DA, Sajnani AK. Oral Health Knowledge, Attitude, and Approaches of Pre-Primary and Primary School Teachers in Mumbai, India [Internet]. Scientifica. 2016 [cited 2018 Jun 20].

56. Singh MS, Tuli AK. A comparative evaluation of oral hygiene practices, oral health status, and behavior between graduate and post-graduate dentists of North India: An epidemiological survey. J Int Soc Prev Community Dent. 2013;3(1):19–24.

57. Su L, Liu W, Xie B, Dou L, Sun J, Wan W, et al. Toothbrushing, Blood Glucose and HbA1c: Findings from a Random Survey in Chinese Population. Sci Rep. 2016 Jul 7;6:28824.

58. Poudel P, Griffiths R, Wong VW, Arora A, Flack JR, Khoo CL, et al. Oral health knowledge, attitudes and care practices of people with diabetes: a systematic review. BMC Public Health [Internet]. 2018 Dec [cited 2018 Jun 20];18(1).

59. Sahril N, Aris T, Mohd Asari AS, Yaw SL, Saleh NC, Omar MA, et al. Oral health seeking behaviour among Malaysians with type II diabetes. J Public Health Asp. 2014;1(1):1.

60. Moore PA, Orchard T, Guggenheimer J, Weyant RJ. DIABETES AND ORAL HEALTH PROMOTION: A SURVEY OF DISEASE PREVENTION BEHAVIORS. J Am Dent Assoc. 2000 Sep 1;131(9):1333–41.

61. Alves C, Brandão M, Andion J, Menezes R. Oral health knowledge and habits in children with type 1 diabetes mellitus. Braz Dent J. 2009;20(1):70–3