

The Patterns of Oral Diseases among Type 2 Diabetes Mellitus Patients Attending at National Healthcare Network (NHN) Mirpur Centre, Dhaka, Bangladesh

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Abstract

Background: The term “diabetes mellitus” describes a group of disorders characterized by elevated levels of glucose in the blood and abnormalities of carbohydrate, fat and protein metabolism. A number of oral diseases and disorders are associated with diabetes mellitus and, gingivitis and periodontitis have been identified as possible risk factors for poor metabolic control in subjects with diabetes.

Objective: To assess oral diseases in type 2 diabetes mellitus patients and controls who attended at National Healthcare Network (NHN), Mirpur Centre, Dhaka, Bangladesh.

Materials & Methods: A total of 100 subjects - 47 diabetics and 53 non-diabetics fulfilled the eligibility criteria were selected consecutively. Pretested semi-structured interviewer administered questionnaire and check list were utilized to assess the main objective of the study. Cross tabulations and associations were found out by using Chi-square Test. Statistical Package for the Social Sciences was used for data analysis.

Results: The cases were relatively older than the controls with mean age of the subjects in case group being significantly higher than that in the control group ($p < 0.001$), but the groups were not statistically different in terms of sex ($p = 0.194$). More than two-thirds (68.1%) of the cases and 52.8% of the controls exhibited burning mouth syndrome ($p = 0.120$). Candidiasis and dental caries were associated, more in case than control group ($p = 0.020$ and $p < 0.001$ respectively). Gingivitis was found significantly higher in case group compared to control group (78.7% vs. 37.7%, $p < 0.001$). In the case group, nearly half (48.9%) had periodontitis, 29.8% alveolar bone loss and 27.7% collagen metabolism, as opposed to none in the control group ($p < 0.001$).

Conclusion: Oral diseases are multi-factorial and the factors responsible for these diseases are preventable. Dentists must be familiar with techniques to diagnose, treat and prevent oral diseases in patients with diabetes.

Key words: Candidiasis, diabetes mellitus, dental caries, oral diseases, periodontitis.

Introduction

The current global and regional patterns of oral disease largely reflect distinct risk profiles across countries, related to living conditions, lifestyles and the implementation of preventive oral health systems.

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The significant role of socio-behavioural and environmental factors in oral disease and health has been shown in numerous epidemiological surveys.¹ Diabetes is a chronic metabolic disease known to affect oral disease progression that affects more than 100 million people worldwide.² The prevalence and severity of medical and oral health complications may depend on the specific type of diabetes assessed. Approximately 10 to 20 percent of all patients with diabetes mellitus have type 1 diabetes. These patients are usually diagnosed before they are 21 years of age, have rapid onset of symptoms and are virtually unable to produce insulin. Type 2 diabetes mellitus-the most common category of diabetes-often is associated with obesity and is characterized by slow onset of symptoms, usually in patients older than 40 years of age.³

The American Diabetes Association (ADA) acknowledges the link between periodontal diseases and diabetes that periodontitis is often found in people with diabetes. Periodontal (gum) diseases, including gingivitis and periodontitis, are serious infections that, left untreated, can lead to tooth loss.⁴

It is important to note that patients with diabetes are susceptible to oral sensory, periodontal and salivary disorders, which could increase their risk of developing new and recurrent dental caries. People with diabetes have been reported to complain of dry mouth, or xerostomia, experience salivary gland dysfunction, developing certain oral mucosal disorders.⁵ Another manifestation of diabetes and an oral sign of systemic immuno-suppression is the presence of opportunistic infections, such as oral candidiasis. Fungal infections of oral mucosal surfaces and removable prostheses are more commonly found in adults with diabetes. Taste is a critical component of oral health that is affected adversely in patients with diabetes.⁶ One study reported that more than one-third of adults with diabetes had hypogeusia or diminished taste perception, which could result in hyperphagia and obesity. This sensory dysfunction can inhibit the ability to maintain a proper diet and can lead to poor glycemic regulation.⁷

Oral hygiene behavior and seeking oral health care depend on a number of factors. Patients comply better with oral health care regimens when informed and positively reinforced. Lack of information is among the reasons for non-adherence to oral hygiene practices. Furthermore, oral health attitudes and beliefs are significant predictors of oral health behavior.⁸ A higher likelihood of seeking preventive dental care is found to be associated with dental knowledge.⁹ The motives prompting people to seek preventive dental care include the belief that one is susceptible to dental disease, that dental problems are serious, and that dental treatment is beneficial. Those who believe that they are highly susceptible to dental disease make more preventive dental visits.¹⁰ This is believed to improve the oral health status of the diabetic patients, in turn controlling diabetes and, ultimately, quality of life. The strong correlation between several oral diseases and non-communicable chronic diseases is primarily a result of the common risk factors. Many general disease conditions also have oral manifestations that increase the risk of oral disease which, in turn, is a risk factor for a number of general health conditions. Severe periodontal disease, for example, is associated with diabetes mellitus and has been considered the sixth complication of diabetes.¹¹

Materials and Methods

This cross sectional case-control study was conducted to assess the patterns of oral diseases among type 2 diabetes mellitus patients in a selected area of Dhaka, Bangladesh.

The study was carried out among 100 subjects - 47 diabetics (type 2 diabetes mellitus) and 53 non-diabetics who were suffering from different oral diseases, who attended at National Healthcare Network (NHN), Mirpur Centre which is An Enterprise of Diabetic Association of Bangladesh, Dhaka for routine check up over a period of six months from April 2012 to September 2012. Diabetic patients attending at OPD were considered as 'Case' and patients without diabetes were considered as 'Control'.

Inclusion criteria for 'Case Group' were: (1) men and women who had at least one natural tooth in their oral cavity (2) aged more than 35 years diagnosed with type 2 diabetes mellitus for more than three months as well as (3) had glycosylated hemoglobin (HbA1c) levels equal to or more than 7.0%. Exclusion criteria were: (1) those who refused to provide consent after been informed about the purpose and confidentiality of the information, (2) persons with co-morbid psychiatric conditions (i.e., drug abuse, suicidal ideation, and psychosis) and (3) handicapped patients.

To reach the targeted sample quickly non-probability purposive sampling technique was followed by using a pre tested semi-structured questionnaire and a check list. Participants were asked questions to provide information on socio-demographic background; oral health related behavioral factors as well as check list (oral diseases, signs & symptoms and diagnosis). The questionnaire was filled in by the respondents themselves and each of them signed an informed consent. Data were also collected by face to face interviews and by oral and dental check up.

Data were checked, cleaned and edited properly before analysis. The data were sorted and analyzed by using the software SPSS, version 11.5. Descriptive statistics were used for interpretation of the finding. Cross tabulations and associations were found out by using the Chi-square Test where applicable. The level of significance was set at 0.05 and p-value < 0.05 was considered significant. The overall results of the study were presented in tabular form; graph form and narrative form.

Results

The patients' socio-demographic characteristics in relation to oral diseases are provided in Table I, II and Figure 1, 2. Table I demonstrates that over 42% of the case group was > 50 years old as opposed to none in the control group. The cases were relatively older than the controls with mean age of the subjects in case group being significantly higher than that in the control group (50.6 ± 11.1 vs. 43.1 ± 5.2 ; $p < 0.001$).

Table I. Comparison of patients by age between groups

| Age (yrs) | Group | | p-value [#] |
|------------------|--------------------|-------------------|----------------------|
| | Case (n = 47) | Control (n = 53) | |
| ≤40 | 11(23.4) | 22(41.5) | |
| 41 – 50 | 16(34.0) | 31(58.5) | |
| >50 | 20(42.6) | 00 | |
| Mean ± SD | 50.6 ± 11.1 | 43.1 ± 5.2 | <0.001 |

Data were analyzed using z-test.

Figure 1 compares the sex distribution between groups. About 64% of patients were male in case group, while 50.9% in the control group. The groups were not statistically different in terms of sex (p = 0.194).

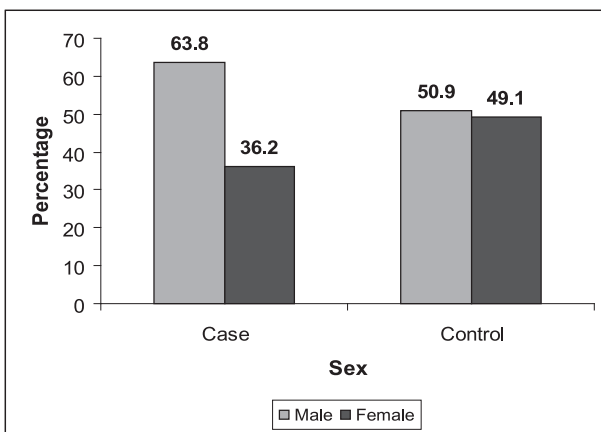


Fig.1: Comparison of patients by sex between groups

Table II shows that 78.7% of cases had monthly income of Taka 15000 or less than Taka 15000 compared to 50.9% of controls. The cases were comparatively poor than the controls (mean monthly income 13744 ± 6045 vs. 15981 ± 6523, p = 0.004).

Table II. Comparison of monthly income between groups

| Monthly income (Taka) | Group | | p-value [#] |
|-----------------------|---------------------|---------------------|----------------------|
| | Case (n = 47) | Control (n = 53) | |
| ≤15000 | 37(78.7) | 27(50.9) | |
| >15000 | 10(21.3) | 26(49.1) | |
| Mean ± SD | 13744 ± 6045 | 15981 ± 6523 | 0.004 |

Data were analyzed using z-test.

Nearly 40% of patients in case group was primary level educated, 34% secondary, 23.4% SSC & HSC level and 4.3% graduate and higher level educated. However, in control group, 37.7% was primary, 13.2% secondary, 49.1% SSC and HSC level educated. The difference was found to be significant with respect to educational status (p = 0.010) (Fig. 2).

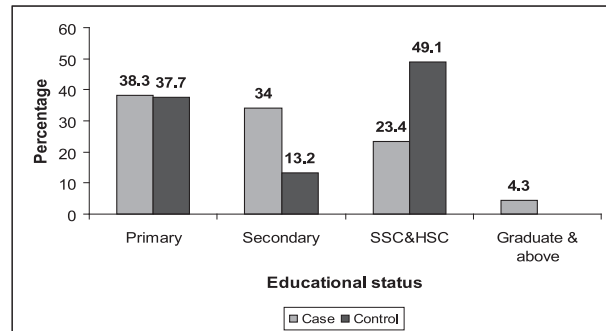


Fig.2: Comparison of patients by educational status between groups

The distribution of the patients according to oral health related behavior variables, in relation to oral diseases is shown in Table III. A significantly higher proportion of current smokers (48.8%) was observed in case group than that in the control group (27.7%) (p = 0.047). The frequency of tooth brushing was identically distributed between groups (p = 0.897). Seventeen percent of cases used fluoridated toothpastes, while none in the control used them (p = 0.002). The cases were less likely to visit a dentist within past 12 months for routine examinations (12.8% vs. 24.5%, p = 0.004). One-quarter of the cases visited the dentists for dental cleaning, 50% restoration and another 25% for other causes. The control group had a similar distribution in terms of reasons of visiting a dentist.

Table III. Comparison of oral health related behavior variables between groups

| Oral health related behavior variables | Group | | p-value [#] |
|--|---------------|------------------|----------------------|
| | Case (n = 47) | Control (n = 53) | |
| Tobacco use | | | |
| Current smoker | 21(48.8) | 13(27.7) | 0.047 |
| Smoked/chewed tobacco ever before | 7(16.3) | 6(12.8) | |
| Use smokeless tobacco | 15(34.9) | 28(59.6) | |
| Frequency of tooth brushing | | | |
| Less than once per day | 16(34.0) | 20(37.7) | 0.897 |
| Once a day | 21(44.7) | 18(34.0) | |
| Twice per day | 4(14.9) | 15(28.3) | |
| More than twice per day | 3(6.4) | 00 | 0.002 |
| Use fluoridated toothpaste | 8(17.0) | 00 | |
| Visited a dentist within past 12 months | 6(12.8) | 13(24.5) | 0.004 |
| Reason for last visit | | | |
| Cleaning | 2(25.0) | 12(48.0) | 0.030 |
| Restoration | 4(50.0) | 13(52.0) | |
| Others | 2(25.0) | 00 | |

Data were analyzed using Chi-square (χ²) Test & z-test.

The distribution of the patients according to presenting signs and symptoms related variables, in relation to oral diseases is shown in Table IV. Classic tried of polyphagia, polydipsia and polyuria were considerably higher in case group (29.8%) than that of control group (11.3%) ($p = 0.018$). Gingivitis was found significantly higher in case group compared to control group (78.7% vs. 37.7%, $p < 0.001$). In the case group, nearly half (48.9%) had periodontitis, 29.8% alveolar bone loss and 27.7% collagen metabolism, as opposed to none in the control group ($p < 0.001$, $p < 0.001$ and $p < 0.001$ respectively).

Table IV. Comparison of presenting sign & symptoms related variables between groups

| Signs & symptoms related variables | Group | | p-value [#] |
|--|---------------|------------------|----------------------|
| | Case (n = 47) | Control (n = 53) | |
| Classic tried of polyphagia, polydipsia and polyuria | 14(29.8) | 6(11.3) | 0.018 |
| Gingivitis | 37(78.7) | 20(37.7) | <0.001 |
| Periodontitis | 23(48.9) | 00 | <0.001 |
| Alveolar bone loss | 14(29.8) | 00 | <0.001 |
| Collagen metabolism | 13(27.7) | 00 | <0.001 |
| Vascularity | 7(14.9) | 6(11.3) | 0.596 |

[#] Data were analyzed using z-test.

The distribution of the patients according to diagnosis related variables, in relation to oral diseases is shown in Table V. Over two-thirds (68.1%) of the cases and 52.8% of the controls exhibited burning mouth syndrome ($p = 0.120$). Candidiasis and dental caries more in case group than control group ($p = 0.020$ and $p < 0.001$ respectively). Glossodynia, Lichen planus, salivary dysfunction, taste dysfunction and Xerostomia (66%) were observed in the case group only.

Table V. Comparison of diagnosis related variables between groups

| Diagnosis related variables | Group | | p-value [#] |
|-----------------------------|---------------|------------------|----------------------|
| | Case (n = 47) | Control (n = 53) | |
| Burning mouth syndrome | 32(68.1) | 28(52.8) | 0.120 |
| Candidiasis | 22(46.8) | 13(24.5) | 0.020 |
| Dental caries | 33(70.2) | 8(15.1) | <0.001 |
| Glossodynia | 2(4.3) | 00 | 0.218 |
| Lichen planus | 2(4.3) | 00 | 0.218 |
| Salivary dysfunction | 17(36.2) | 00 | <0.001 |
| Taste dysfunction | 16(34.0) | 00 | <0.001 |
| Xerostomia | 31(66.0) | 00 | <0.001 |

[#] Data were analyzed using z-test.

Discussion

Oral diseases are major public health problems in all regions of the world. Their impact on individuals and communities as a result of the pain and suffering, impairment of function and reduced quality of life they cause, is considerable. Globally, the greatest burden of oral diseases is on the disadvantaged and poor population groups. The current pattern of oral disease reflects distinct risk profiles across countries related to living conditions, lifestyles and environmental factors, and the implementation of preventive oral health schemes. The significant role of socio-behavioural and environmental factors in oral disease and health have been shown in numerous epidemiological surveys.^{13, 34}

Two of the population-based surveys, study in the US adult population in 2002 and Diabetes News published in 2010 showed that type 2 diabetes occurs mainly in people aged over 40, although it is affecting a growing number of young people.^{21, 22} The data of the present study showed that the cases were relatively older than the controls with mean age of the subjects in case group being significantly higher than that in the control group ($p < 0.001$), but the groups were not statistically different in terms of sex ($p = 0.194$). Nearly three-quarters (74.5%) of the cases and controls (73.3%) were urban residents ($p = 0.138$). The cases were comparatively poor than the controls ($p = 0.004$). SSC & HSC level educated were significantly less in the case group (23.4%) than that in their control counterparts (49.1%) ($p = 0.010$).

Smoking has been shown to be a major risk factor in periodontal disease, responsible for more than half of the cases of periodontitis among adults.¹⁵ Current evidence also emphasized a higher proportion of current smokers (48.8%) in case group than that in the control group (27.7%) ($p = 0.047$). This result was compatible to many other studies found in the body of literature.^{16, 17, 20}

In terms of their oral self-care, knowledge about cleaning teeth before going to bed and after breakfast protects our gum and teeth from dental caries and periodontal diseases was poor among the patients. The frequency of tooth brushing was almost similar between groups ($p = 0.897$). Seventeen percent of cases used fluoridated toothpastes as opposed to none in the control group ($p = 0.002$). The cases were less likely to visit a dentist within past 12 months for routine examinations (12.8% vs. 24.5%, $p = 0.004$). One-quarter of the cases visited the dentists for dental cleaning, 50% for restoration and another 25% for other reasons. The control group had a similar distribution in terms of reasons of visiting a dentist.

Classic triad of polyphagia, polydipsia and polyuria were considerably higher in case group (29.8%) than that in the control group (11.3%) ($p = 0.018$).

Gingivitis was found significantly higher in case group compared to control group ($p < 0.001$). In the case group, nearly half (48.9%) had periodontitis, 29.8% alveolar bone loss and 27.7% collagen metabolism, as opposed to none in the control group ($p < 0.001$). Other findings from the literature review were also in agreement with the current study^{11, 12, 18-21, 24}.

In the present study candidiasis and dental caries were more often associated with case group than those with the control group ($p = 0.020$ and $p < 0.001$ respectively). People with diabetes have a higher prevalence of dental caries^{14, 25, 26} which is consistent with findings of the present study. What's more, *Candida pseudohyphae*, a cardinal sign of oral *Candida* infection, have been associated significantly with cigarette smoking, use of dentures and poor glycemic control in adults with diabetes. Oral candidiasis is a manifestation of diabetes and systemic immuno-suppression. Fungal infections of oral mucosal surfaces are more commonly found in adults with diabetes.^{30, 31} Salivary hypo-function may further aggravate the oral candidal carriage state in adults with diabetes. The oral health care professional can readily make the diagnosis of oral candidiasis and provide therapy, but most importantly, he or she should pursue the infection's etiology, which could include a diagnosis of diabetes mellitus.³¹ It is for this reason dental professionals need to follow up all patients with diabetes on a regular basis for new and recurrent dental decay.²⁶

In this study, xerostomia (66%) were observed in the case group only. None in the control group was found to suffer from these diseases. People with diabetes have been reported to complain of dry mouth, or xerostomia, and experience salivary gland dysfunction.²⁷ A recent study detected impaired salivary uptake and excretion by salivary scintigraphy in adults with type 2 diabetes bearing consistency with findings of the present study.²⁸

Taste is a critical component of oral health that is affected adversely in patients with diabetes. One study reported that more than one-third of adults with diabetes had hypogeusia or diminished taste perception, which could result in hyperphagia and obesity. This sensory dysfunction can inhibit the ability to maintain a proper diet and can lead to poor glycemic regulation.³²

In the present study two-third of the cases had burning mouth syndrome, lichen planus, salivary dysfunction, taste dysfunction. There are reports of greater prevalences of lichen planus and recurrent aphthous stomatitis, as well as oral fungal infections. While these associations have not been consistently found in all populations with diabetes, they may be due to chronic immunosuppression and require continued follow-up by health care practitioners. These results were compatible to many other studies found in the body of literature.^{27, 29, 32, 33}

Limitations

This study needed a larger sample size in order to generalize the results in Bangladeshi population. As there was limited time frame and resources to conduct the study, we used the most convenient formula to calculate the sample size. Therefore, the sample size became smaller which may decrease statistical acceptability.

Other limitation of this study was the veracity of the data collection by purposive sampling method using a semi-structured questionnaire. In this investigation the homogeneity of the sample could not be ensured. For instance, respondents from the sex groups were not equal in number. Again, socioeconomic backgrounds of the respondents varied, as the family income depends upon the number of persons employed.

Oral health related behaviors mentioned in the questionnaire may differ from actual behavior, as the respondents have full authority to answer the questions as they like and there was no system for cross check. Further multi-centre studies are needed for reliable assessment of all patterns and predictors of oral diseases among diabetic patients.

Conclusion

Diabetes mellitus is incorporated with certain oral diseases which result from opportunistic infections, nutritional imbalance and neurosensory disorders. Among these opportunistic infections, gingivitis and candidiasis are commonly encountered. Caries is another manifestation and its percentage is no less. A substantial proportion of diabetics also present with glossodynia, salivary dysfunction, taste dysfunction and xerostomia which result from neurosensory disorders. Control of diabetes is the only way to remain free from these diseases and major efforts are required to elucidate the impact of oral diseases on diabetes mellitus.

What's more, dental surgeons should raise the suspicion whenever their patients having diabetes present with such oral diseases or disorders and must be familiar with techniques to diagnose, treat and prevent those oral diseases. At the same time, diabetic patients are needed to be made aware of regular oral hygiene maintenance and routine oral and dental check up.

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References

1. Petersen PE. Socio-behavioral risk factors in dental caries - an international perspective. *Community Dent Oral Epidemiol* 2005;33:274-9.
2. Mealey B. Diabetes mellitus. In: Glick M, Greenberg M, editors. *Burket's Oral Medicine Diagnosis & Treatment*, 10th ed. Hamilton: BC Decker; 2003.p.563-77.
3. The report of the expert committee. The diagnosis and classification of diabetes mellitus. *Diabetes Care* 1997; 20:1183-97.
4. American Diabetes Association. Expert committee on the on the diagnosis and classification of diabetes Mellitus. [Report]. *Diabetes Care* 2003;26:S5-S20.
5. Guggenheimer J, Moore PA, Rossie K. Insulin-dependent diabetes mellitus and oral soft tissue pathologies, part I: prevalence and characteristics of non-candidal lesions. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2000;89:563-9.
6. Settle RG. The chemical senses in diabetes mellitus. In: Getchell TV, editor. *Smell and taste in health and disease*. New York: Raven Press; 1991.p.829-43.
7. Stolbova K, Hahn A, Benes B, Andel M, Treslova L. Gustometry of diabetes mellitus patients and obese patients. *Int Tinnitus J* 1999;5:135-40.
8. Knecht M. Psychological features characterizing oral health behavior, diabetes self-care and health status among IDDM patients. [Dissertation]. Oulu, Finland: Institute of Dentistry, University Of Oulu; 2000.p.16-8. Available from: <http://herkules oulu.fi/isbn9514256301/isbn9514256301>. [accessed 18 June 2010].
9. Tash RH, O'Shea MM, Cohen K. Testing a preventive-symptomatic theory of dental health behavior. *Am J Public Health* 1969;59:514-21.
10. Kegeles SS. Some motives for seeking preventive dental care. *J Am Dent Assoc* 1963;67:110-18.
11. Loe H. Periodontal disease: The sixth complication of diabetes mellitus. *Diabetes Care* 1993;16:329-34.
12. Lamster IB, Lalla E, Borgnakke WS, Taylor GW. The relationship between oral health and diabetes mellitus. *J Am Dent Assoc* 2008;139:19S-24S.
13. Petersen PE. Social inequalities in dental health-towards a theoretical explanation. *Community Dent Oral Epidemiol* 1990;18:153-8.
14. Moynihan P, Petersen PE. Diet, nutrition and the prevention of dental diseases. *Public Health Nutrition* 2004; 7:1-26.
15. Tomar SL, Asma S. Smoking attributable periodontitis in the United States: findings from the NHANES III. *Journal of Periodontology* 2000;71:743-51.
16. Reibel J. Tobacco and oral diseases: an update of the evidence with recommendations. *Medical Principles and Practice* 2003;12:22-32.
17. Smokeless tobacco and some tobacco-specific nitrosamines. Lyon: IARC Press. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, 2005.
18. Haber J, Wattles J, Crowley M et al. Evidence for cigarette smoking as a major risk factor for periodontitis. *J Periodontol* 1993;64:16-23.
19. Barnett ML, Baker RL, Yancey JM, MacMillan DR, Kotoyan M. Absence of periodontitis in a population of insulin-dependent diabetes mellitus (IDDM) patients. *J Periodontol* 1984;55:402-5.
20. Cianciola LJ, Park BH, Bruck E, Mosovich L, Genco RJ. Prevalence of periodontal disease in insulin-dependent diabetes mellitus. *J Am Dent Assoc* 1982;104:653-60.
21. Tsai C, Hayes C, Taylor GW. Glycemic control of type 2 diabetes and severe periodontal disease in the US adult population. *Community Dent Oral Epidemiol* 2002;30:182-92.

22. Treatment of Gum Disease May Lower Blood Sugar Levels in Type 2 Diabetes. [News] The Peninsula College of Medicine and Dentistry. 17th May 2010. Available from:
<http://www.diabetes1.org/news/mainstory.cfm/120> [accessed 23 June 2010].
23. Wagener DK, Sacks JM, LaPorte RE, Macgregor JM. The Pittsburgh study of insulin-dependent diabetes mellitus: risk for diabetes among relatives of IDDM. *Diabetes* 1982;31:136-44.
24. Corah NL, Gale EN, Illig SJ. Assessment of a dental anxiety scale. *J Am Dent Assoc* 1978;97:816-9.
25. Mealey B. Diabetes and periodontal diseases. *J Periodontol* 1999;70:935-49.
26. Wilson TG. Not all patients are the same: systemic risk factors for adult periodontitis. *Gen Dent* 1999;47:580-8.
27. Pohjamo L, Tervonen T, Knuutila M, Nurkkala H. Adult diabetic and nondiabetic subjects as users of dental services: a longitudinal study. *Acta Odontol Scand* 1995;53:112-4.
28. Research, Science and Therapy Committee of the American Academy of Periodontology. Position paper: tobacco use and the periodontal patient. *J Periodontol* 1999;70:1419-27.
29. Christen AG, Klein JA, Christen JA, McDonald JL Jr, Guba CJ. How-to-do-it quit-smoking strategies for the dental office team: an eight-step program. *J Am Dent Assoc* 1990; Suppl:S20-S7.
30. Gerbert B, Coates T, Zahnd E, Richard RJ, Cummings SR. Dentists as smoking cessation counselors. *J Am Dent Assoc* 1989;118:29-32.
31. Curriculum guidelines for pre-doctoral preventive dentistry. *J Dent Educ* 1991;55:746-50.
32. Barker GJ, Williams KB. Tobacco use cessation activities in U.S. dental and dental hygiene student clinics. *J Dent Educ* 1999; 63:828-33.
33. Wilson DE. Excessive insulin therapy: biochemical effects and clinical repercussions-current concepts of counterregulation in type I diabetes. *Ann Intern Med* 1983;98:219-27.
34. Petersen PE, Yamamoto T. Improving the oral health of older people: the approach of the WHO Global Oral Health Programme. *Community Dent Oral Epidemiol* 2005;33:81-92.