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**ORIGINAL ARTICLE**

# Effect of diabetes on periodontal status of a population with poor oral health

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**Abstract**

***Objective.*** Diabetes is a global health problem and its prevalence is increasing worldwide. The objective of the study was to investigate the effect of diabetes on the periodontal status of a Pakistani population with poor oral hygiene. ***Material and methods.*** Eighty-eight individuals with diabetes and 80 non-diabetic individuals were recruited from a disadvantaged district in Karachi, Pakistan. The group with diabetes comprised 50 males and 38 females, and the non-diabetic group 43 males and 37 females. All underwent clinical and radiographic examination. ***Results.*** The average numbers of teeth in the diabetes and non-diabetes groups were 24 and 26, respectively. The odds ratio (OR) for missing or fewer teeth was 2.3 times higher for diabetics than for non-diabetics (CI 1.32–4.14; $p < 0.001$). Diabetic patients had more sites with plaque than did non-diabetics (OR 1.96, CI 0.99–3.88; $p < 0.056$). Moderate to severe periodontitis was significantly more prevalent among diabetic patients ($p < 0.01$). ***Conclusion.*** In this disadvantaged population with poor oral hygiene, diabetes has had a strongly negative influence on oral health: diabetic patients have fewer teeth, more plaque, and a higher prevalence of moderate to severe periodontal disease than non-diabetics.

**Key Words:** *Bone loss, caries, calculus, oral hygiene, plaque*

## Introduction

Diabetes mellitus is an increasing global health problem and is highly prevalent in Asian communities. Worldwide adult diabetes prevalence was 4.0% in 1995 and is expected to increase to 5.4% by the year 2025 [1]. According to projections by the World Health Organization, 366 million people will have diabetes by the year 2030. In the year 2000, 5.2 million people in Pakistan had diabetes, and it is estimated that this number will increase to 13.9 million by the year 2030 [2]. In a recent questionnaire study, 17% of a population in Karachi reported that they were diabetics [3]. A similar prevalence has been reported in earlier studies [4,5].

An association between periodontitis and diabetes has been proved in many studies [6]. A meta analysis has shown that patients with diabetes have more severe periodontitis in terms of average plaque index (PI), average gingival index (GI), and clinical attachment loss, but exhibit the same extent of periodontal disease [6]. It has been suggested that poorly controlled type 2 diabetes is associated with greater prevalence of severe periodontitis. In a United States adult population, individuals with poorly controlled diabetes mellitus had a significantly higher prevalence of severe periodontitis than non-diabetics. The association was less pronounced for those with well-controlled diabetes [7]. Studies conducted on populations with good oral hygiene have not shown dramatic differences in clinical attachment level and alveolar bone height [8–10]. On the other hand, studies on populations with poor oral hygiene have shown a highly negative effect of diabetes on periodontal status [11–13]. There are conflicting results about the effect of diabetes on dental caries, with some studies showing an increased prevalence of caries, others showing no association [11,14].

The aim of the present study was to test the hypothesis that diabetes has a highly negative influence on oral health in a population with poor oral hygiene. The oral health of the diabetic patients was

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compared with that of non-diabetic individuals in the same population.

## Material and methods

The study population was selected from the P&T (Post and Telegraph) colony of Karachi, Pakistan. This colony has a population of 6,000–10,000 people of all age groups, but, as for Pakistan in general, children and young adults predominate. The socio-economic status is poor, with an annual household income of less than 50,000 rupees (USD 800). The educational level is mostly intermediate, with men better educated than women.

In an earlier study, 1000 individuals were asked to answer a questionnaire [3], and, among those who responded (994), every tenth person was given an invitation to receive a clinical and radiological examination. In order to meet the criteria of random selection, if the tenth person declined to participate then the offer was extended to the eleventh, twelfth, and so on. In total, 110 subjects (57 M and 53 F) underwent examination. Among the 994 who responded, 17% reported having diabetes. All the diabetic patients were offered a clinical dental examination. In total, 48 accepted and underwent clinical and radiographic examination. In order to increase the test group, an additional 40 diabetic patients of similar age were recruited from the same colony through an open invitation to join the study. The 88 diabetic patients comprised 50 males and 38 females. The diagnosis of type 2 diabetes was confirmed by a recent blood glucose analysis from a recognized laboratory, or by the medications stated in the questionnaire and confirmed at the time of clinical examination. The control group comprised 80 non-diabetic individuals (43 M and 37 F) from the random selection group. Diabetic status was based on the anamnesis. The answers in the earlier questionnaire [3] were confirmed at the time of the clinical examination. The demographic data are presented in Table I.

Clinical assessment of caries and periodontal disease was undertaken by the principal investigator (F.T.) and the radiographic examination by a trained radiologist at the dental hospital. The radiographic examination comprised panoramic radiographs and four bitewings and, where indicated, periapical radiographs using the standardized, long cone parallel technique. Alveolar bone loss was measured with digital calipers, i.e. from the cemento-enamel junction to the crest of alveolar bone on the approximal surfaces of premolars and molars, using bitewings, or with a panoramic radiograph in the case of participants who refused to undergo bitewing examination. Caries of enamel and dentine was registered by visual and tactile (mirror and probe) examination and radiographically (bitewings). All 28 teeth, excluding 3rd molars, were examined in normal, direct operational light. Carious lesions found on the radiograph were also added to the findings. The DMF scores of each individual were recorded in DMFT Index and DMFS Index [15].

Periodontal health was assessed from the following observations at six sites on each tooth, except for 3rd molars, with a Williams Periodontal probe.

- Visible plaque index (PI%) – Presence or absence of visible plaque was recorded [16].
- Bleeding on probing (BOP%) – Presence or absence of bleeding on probing was recorded (modified from [16]).
- Pocket depth – the distance between the gingival margin and the apical limit of probing. Pockets $\geq 4$ mm were registered.
- Furcations were recorded as grade I, II, or III [17].
- Mobility was also recorded as grade 1, 2, or 3 [17].
- Supragingival calculus was recorded when clearly visible and subgingival calculus when clearly felt with the probe.

On the basis of the clinical and radiographic evidence, periodontal condition was diagnosed as gingivitis, chronic periodontitis, or aggressive periodontitis, in accordance with the 1999 International Workshop [18]. The oral mucosa was examined and any changes were registered. The use of betel nut and betel quid was also registered. Betel quid (Pan) is composed of betel leaf, betel nut, and slaked lime (often tobacco is added), whereas betel nut (Chalia) is the seed of betel palm.

The study was approved by the local ethics committee at Karolinska University Hospital, Huddinge, Sweden and at the Altamash Institute of Dental Medicine in Karachi, Pakistan. Written informed consent was obtained from all participants. The study was conducted in accordance with the Helsinki Declaration.

Table I. Demographic data of both the diabetic and non-diabetic patients expressed as number and percentage for all the variables except age as the mean and standard deviation (SD).

| | | Diabetics ($n=88$) | Non-diabetics ($n=80$) | $p$-value |
|---|---|---|---|---|
| Age | | 41.8 (4.07) | 41.3 (5.33) | NS |
| Gender | | | | |
| Male | | 50 (57%) | 43 (54%) | NS |
| Female | | 38 (43%) | 37 (46%) | NS |
| Education | | | | |
| Primary | | 6 (7%) | 0 (0%) | 0.017 |
| Secondary | | 22 (25%) | 30 (37%) | NS |
| Intermediate | | 14 (16%) | 21 (26%) | NS |
| Bachelor | | 35 (40%) | 25 (31%) | NS |
| Master | | 8 (9%) | 3 (4%) | NS |
| Betel quid | Y | 25 (28%) | 17 (21%) | NS |
| Betel nut | Y | 16 (18%) | 26 (32%) | NS |
| Smoking | Y | 19 (22%) | 19 (24%) | NS |

*Statistical calculations*

Statistica, version 7 (Statsoft, Tulsa, Okla., USA) was used for the statistical analyses. Univariate comparisons between groups were made with unpaired *t*-tests or the Mann-Whitney U-test, where applicable. Frequency differences between various groups were calculated with the chi-squared test. The odds ratio (OR) for diabetic patients to have more plaque and missing or fewer teeth was calculated with a stepwise multivariate logistic regression model, adjusting for age and education.

## Results

The diabetic patients had an average of 24 teeth, compared to 26 for the non-diabetics. The OR for "fewer teeth" was 2.3 times higher for the diabetic patients than for the non-diabetics (CI 1.32–4.14; $p < 0.001$) (Table II).

Plaque and bleeding on probing were prevalent among both diabetic patients and non-diabetic individuals, with diabetic patients showing a higher percentage of sites with plaque than did non-diabetics (OR 1.96 (CI 0.99–3.88); $p < 0.056$) (Table II). Calculus and gingival recession were common findings among both groups (data not shown).

Diabetic patients had more bone loss than non-diabetic individuals 3.8 (1.3) vs 3.5 (1.3) (Table II). No association was found between bone height and income or educational standard. Moderate to severe periodontitis was significantly more common in the diabetic patient group ($p < 0.007$). Moderate periodontitis was more prevalent among the diabetics patients ($p = 0.029$) (Table II)

Diabetic patients tended to have more decay than non-diabetic individuals. The DMFT and DMFS scores were significantly higher for diabetic patients than for non-diabetics ($p < 0.001$) (Table II). No significant associations were disclosed between caries status and income or educational level.

Most of the participants cleaned their teeth daily. More diabetic patients than non-diabetic individuals were toothbrush-users and fewer diabetic patients were finger-users. However, the differences did not reach significance (Table II)

Fewer diabetic patients than controls consumed sweets once or more daily ($p = 0.027$). Similarly,

Table II. Mean (SD) values for number of teeth, % of sites with plaque, % of sites with bleeding on probing (BOP), and bone height. Median and interquartile range for all decay, fillings, DMFT, DMFS. Frequency (number and%) of dental visits, cleaning frequency, cleaning regime, sweets and tea with sugar. PerioDiagnosis number (%) of individuals with gingivitis, mild, moderate, severe, and aggressive periodontitis.

| Variables | Diabetics | Non-diabetics | *p*-value |
|---|---|---|---|
| No. of teeth | 24.6 (4.4) | 26.5 (1.9) | <0.001 |
| Periodontal data | | | |
| Plaque (%) | 92.1 (17.1) | 86.9 (21.3) | 0.056 |
| Bleeding on probing (%) | 75.5 (30.4) | 75.3 (27.2) | NS |
| Bone height | 3.8 (1.3) | 3.5 (1.3) | NS |
| Cariological data | | | |
| All decay | 2.0 (4.0) | 1.0 (3.0) | NS |
| Fillings | 0 (6.0) | 0 (1.0) | NS |
| DMFT | 6.0 (8.0) | 3.5 (5.5) | ≤0.001 |
| DMFS | 18.5 (26.5) | 8.0 (14.0) | <0.001 |
| Dental history and oral hygiene history | | | |
| Dental visits | | | |
| Never/seldom | 62 (70) | 63 (79) | NS |
| Sometime | 26 (30) | 17 (21) | |
| Cleaning frequency | | | |
| Daily | 77 (87) | 71 (89) | NS |
| Occasional | 11 (12) | 9 (11) | |
| Cleaning regime | | | |
| Finger | 15 (75) | 20 (25) | NS |
| Toothbrush | 75 (85) | 60 (75) | |
| Dietary habits | | | |
| Sweets | | | |
| Never/seldom | 41 (47) | 24 (30) | 0.027 |
| Once or more | 47 (53) | 56 (70) | |
| Tea with sugar | | | |
| Never/seldom | 44 (50) | 15 (19) | |
| Once or more | 44 (50) | 65 (81) | <0.001 |
| PerioDiagnosis | | | |
| Gingivitis | 18 (21) | 24 (30) | NS |
| Mild periodontitis | 21 (24) | 28 (35) | NS |
| Moderate periodontitis | 44 (50) | 22 (28) | 0.029 |
| Severe periodontitis | 3 (3) | 2 (3) | NS |
| Aggressive periodontitis | 2 (2) | 4 (5) | NS |

fewer patients with diabetes drank tea with sugar once or more daily ($p < 0.001$) (Table II).

## Discussion

More missing teeth among diabetic patients seems to be characteristic of a population with poor oral hygiene [13]. A Saudi study has shown that 81% of those in the diabetic patient group had 9–20 missing teeth compared to 19% in the non-diabetic group [13]. Kawamura and co-workers [10] showed that diabetic patients had 6.7 missing teeth compared to 4.3 teeth in the control group. Studies conducted on populations with better oral hygiene have not disclosed differences in the number of teeth in the dentition [19–21]. A recent meta-analysis [6] does not report the number of missing teeth, but shows no difference in DMFT.

In the present study, there was a higher frequency of moderate to severe periodontitis in the diabetic patients than in the non-diabetic individuals. This finding concurs with that of many previous studies proposing that diabetes is a risk factor for periodontal disease [6,22]. The study also showed that diabetic patients tended to have more decay than non-diabetic individuals, with significant DMFT and DMFS values, attributable to the "M" (missing) component. These results are in accordance with those of many previous studies [11,21,23,24].

The diabetic patients in our study had more plaque, despite the fact that the use of a toothbrush was more common than among the non-diabetic individuals and that the proportion of people cleaning their teeth daily was similar in both groups. Poorer oral hygiene among patients with diabetes is reported in a number of earlier studies [6,12,21,23]. One reason for the accumulation of more plaque in diabetic patients could be poor self-efficacy, resulting in less effective cleaning. Another possibility could be the increased level of glucose in GCF and saliva *per se*, leading to a higher accumulation of plaque [25]. Several studies have shown poorer self-efficacy regarding oral health among diabetic patients. In two Finnish studies it was concluded that perception of dental self-efficacy plays a decisive role in relation to oral health behavior in diabetic patients and has a positive influence on compliance [26,27]. As expected, the study also showed a significant association between dietary habits with respect to sugar intake, with the diabetic patients consuming less than non-diabetic individuals.

Lack of appropriate screening is the limitation to this study, as we did not measure plasma glucose or glycosylated hemoglobin ($HbA1_c$). In this context, attendance for dental examination could offer an important opportunity to identify individuals unaware of their diabetic status. Our findings were restricted to subjects already diagnosed with type 2 diabetes. Hence, any undiagnosed, asymptomatic, or misdiagnosed patient would not be identified as a diabetic patient, but might be included with the non-diabetic individuals as controls. This implies that it is worthwhile screening for unidentified diabetes among subjects in the control group, as suggested by Borrell [28].

We conclude that, in this disadvantaged population with poor oral hygiene, diabetes has a strongly negative influence on oral health, as evidenced by fewer teeth, more plaque, and a higher prevalence of moderate to severe periodontal disease among diabetic patients than among non-diabetics. Thus, diabetes acts as an added risk for periodontal disease in a population that is already at risk.

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