

Oral self-care and periodontal health indicators among adults with diabetes in Finland

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We assessed the effects of oral self-care on periodontal health indicators among adults with diabetes. The sample consisted of 120 dentate individuals, all of whom were regular patients at the Salo Regional Hospital Diabetes Clinic in southwest Finland. Clinical periodontal examination included identification of visible plaque, the presence of calculus, and use of the Community Periodontal Index of Treatment Needs (CPITN). A questionnaire focused on self-treatment, self-prevention, and self-diagnosis of oral diseases, utilization of dental services, and patients' knowledge and attitudes towards oral health. The New Century model of oral health promotion was used as a theoretical framework for analysis of determinants of oral self-care. Although individuals aged 40 years or older were more frequent interdental cleaners, significantly better oral health indicators were found among younger patients. Women reported brushing their teeth more frequently, and differences in plaque and calculus indices were significantly lower than those of men. Self-reported good oral condition was strongly associated with frequent dental visits and less plaque and calculus. No missing teeth and age less than 40 years were predictors of lower plaque, calculus, and CPITN scores. A significant association was found only between frequent dental visits and reduced amount of calculus. Self-reported frequency of oral health habits among adults with diabetes seemed to have little effect on periodontal health indicators. Adults with diabetes should benefit from comprehensive oral self-care, and more attention is needed for improving the quality and outcome of these habits. □ *Diabetes; oral self-care; periodontal health*

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Many studies have provided information about the relationship between diabetes and periodontal disease (1–3), which should be considered a potential complication of diabetes (4–6). Among patients with diabetes a long history of disease (7), other organ complications (8, 9), and poor glycemic control (10, 11) increase the risk for periodontal disease. Besides those individuals who fail to maintain good oral hygiene (1), teenagers and pregnant women are at high risk for periodontal diseases because of changes in hormonal functions (1). On the other hand, for those who control both their diabetes and oral health through comprehensive self-care, the risk for periodontal disease seems to be low (12).

The role of oral self-care in maintaining and promoting periodontal health can be seen in the prevalence of periodontal disease varying with individual health behavior. Oral self-care as part of general health self-care (13) comprises a wide spectrum of activities, ranging from self-diagnosis, -treatment, and -prevention to seeking lay and professional care (14). Despite their high risk for periodontal disease, oral self-care in patients with diabetes has been insufficiently studied.

Our aim was to examine the relationship of periodontal treatment needs, plaque, and calculus with brushing, interdental cleaning, and dental visits among adults with diabetes in Finland. Moreover, the determinants of these behaviors and oral health indicators are examined in the

theoretical framework of the New Century model of oral health promotion (15).

Subjects and methods

Patients

The subjects consisted of 120 dentate patients with diabetes (51 female and 69 male), who were regular visitors at the Salo Regional Hospital Diabetes Clinic in southwest Finland. The diagnosis of diabetes was originally confirmed by an oral glucose test using the diagnostic criteria of the World Health Organization (WHO). Seventy-six patients had type-1 diabetes, 22 type 2, and 3 patients type 3. The total number of patients visiting the clinic annually was about 250, and patients visit the clinic at individual intervals, usually 3 to 4 months. Diabetes nurses interviewed all patients attending the diabetes clinic between November 1998 and February 1999. Thirteen patients who filled the inclusion criteria declined to participate in the study; six patients did not want to participate, and seven refused for various practical reasons. Twelve others, who had initially agreed to participate, could not finally make the dental appointment. The mean age (standard deviation (*s*)) of the study population was 44.6 years (± 13.5 years). Criteria for inclusion were age

between 18 and 70 years, having own teeth at least in one jaw, and diabetes requiring tablet or insulin treatment. Subjects received an information letter and gave signed consent. The Ethics Committee of the Salo Regional Hospital approved the protocol.

Methods

Questionnaire. The pre-tested, self-completed questionnaire contained 29 items. Questions were closed and mostly multiple choice with alternative statements. Grouped into five categories, the questions covered 1) social background, 2) medical history, 3) self-treatment, -prevention, and -diagnosis of oral diseases, 4) utilization of dental services, and 5) knowledge, values, and attitude with regard to oral health. The questions have been successfully used in earlier Finnish oral health care behavior studies (16–18). For statistical analyses, most items were dichotomized. Oral health habits were dichotomized as follows: brushing at least twice a day versus more seldom, cleaning interdental spaces daily versus more seldom, and dental visits at least once a year versus more seldom. Self-diagnosis of periodontal diseases was measured in two ways, either as having a current perception of bleeding gums or as having a current perception of inflammation of the gums. Because there was a significant relationship between these two variables, perception of bleeding gums was chosen to be the variable for further reporting.

Factors based on the New Century model of oral health promotion (15) were chosen for analysis. The model can be summarized as follows: patients' behavior appears to be formed by cognitive, affective, and behavior factors interacting in a complex pattern with the time perspective and the patients' life situation (15). Situational factors included age, sex, and education. Cognition was evaluated with a question about knowledge: 'Do you have information about the relationship between diabetes and gum diseases?', with an attitude statement: 'I want to keep my natural teeth as long as possible', and with a self-related belief about oral health condition. The latter was dichotomized into not good and good instead of the five original alternatives, which were good, quite good, average, quite bad, and bad. Behavior was assessed with questions about missing teeth and smoking habit. Affective factors were evaluated with a value statement: 'Oral health is not as important as general health'. Alternatives for the statements were as follows: fully agree, almost agree, I do not know, almost disagree, and fully disagree, but for the analysis they were dichotomized: fully agree and almost agree as agree, and fully disagree and almost disagree as disagree, and I do not know was classified as a missing value.

Clinical periodontal examination. One examiner (A. Karikoski) performed all clinical measurements in a regular dental clinic. The examination included calibrated recordings for all remaining teeth, excluding third molars.

The following variables were included: 1) Plaque: The presence of visible plaque on 4 surfaces of each tooth was

assessed after drying with air. This corresponds to criteria for scores 2 and 3 of the Plaque Index System (19). The percentage of surfaces with visible plaque was calculated. 2) Calculus. The presence of supra- and subgingival calculus was measured using a World Health Organization (WHO) probe in the six sites of each tooth. The percentage of surfaces with calculus was calculated. For data analysis, visible plaque and calculus indices were dichotomized into $\leq 60\%$ versus $>60\%$. 3) Community Periodontal Index of Treatment Needs (CPITN). Periodontal treatment needs were assessed by means of the CPITN system (20). The recordings were based on the code number observed after examination of all remaining teeth, excluding the third molars, in each of the six segments (sextants) containing at least two functional teeth. The subjects and sextants were classified in accordance with the highest code number recorded (codes 0–4). The number of missing sextants and teeth was recorded separately. The examination was performed using a 2.5 magnification surgical telescope. CPITN recordings were made using the following code numbers: code 0 = healthy periodontal tissue; code 1 = bleeding after probing; code 2 = supra- or subgingival calculus and/or overhang(s) of filling(s) or crown(s); code 3 = pathologic pocket(s) of 4 or 5 mm; code 4 = pathologic pocket(s) ≥ 6 mm.

Statistical analysis

Frequencies were compared by means of the Pearson chi-squared test. Logistic regression analysis was used to assess associations between frequent brushing, frequent interdental cleaning, and frequent dental visits and the potential predictive factors used in Table 1. The Mann-Whitney test was used to analyze associations between periodontal variables and oral health habits and between periodontal variables and the same potential predictive factors used in Table 1. The level of significance was set at $P < 0.05$. Statistical analyses were performed using SPSS for Windows 7.5.

Results

Oral self-care

Self-treatment and prevention. Of the total number of subjects ($n = 120$) 29% reported brushing their teeth more than once a day, 46% once a day, and 22% less frequently. When the participants were allowed to select several options for interdental cleaning, the toothpick was the most common device (68%), with a further 24% using dental floss, and 5% using an interdental brush. More than one-fifth (21%) reported cleaning the interdental space at least once a day, 51% almost once a day, and 27% never.

Self-diagnosis. A current perception of bleeding gums was reported by 21% of the subjects. Less than half (42%) reported past experience of bleeding gums. The proportion of those having never noticed bleeding was 23%, and

Table 1. Bivariate associations between oral health habits and some situational (¶), cognitive (||), behavioral**, and affective†† factors

	Frequent tooth brushing			Frequent interdental cleaning			Frequent dental visits		
	<i>n</i>	%	<i>P</i> value	<i>n</i>	%	<i>P</i> value	<i>n</i>	%	<i>P</i> value
Age¶									
< 40 years	10	21	0.116	3	6	0.001	33	69	0.936
≥ 40 years	25	35		22	31		50	69	
Sex¶									
Female	23	46	0.001	13	26	0.273	37	73	0.490
Male	12	17		12	18		46	67	
Education¶									
Low	23	28	0.536	19	23	0.426	56	67	0.365
High	12	33		6	17		27	75	
* Information									
No	13	20	0.013	9	14	0.039	46	71	0.679
Yes	22	41		16	30		37	67	
† Condition									
Not good	20	32	0.553	15	23	0.515	37	58	0.004
Good	15	27		10	19		46	82	
‡ Statement 1									
Disagree	3	60	NA	3	60	NA	3	60	NA
Agree	31	28		21	19		77	70	
Missing teeth**									
Some	23	30	0.786	21	28	0.021	54	70	0.760
None	12	28		4	10		29	67	
Smoking**									
Smoking	7	24	0.453	7	24	0.654	18	62	0.360
No smoking	28	32		18	20		64	71	
§ Statement 2††									
Disagree	33	31	NA	22	20	NA	73	68	NA
Agree	2	20		3	30		8	80	

Statistical evaluation using the chi-squared test. NA = not applicable.

* Information: Do you have information about the relationship between diabetes and gum diseases?

† Self-reported condition of oral health.

‡ Statement 1: I want to keep my natural teeth as long as possible.

§ Statement 2: Oral health is not as important as general health.

11% could not take a stand on this question. When the participants were asked to choose several alternatives from 14 presenting oral symptoms, the most common self-reported symptoms were calculus (42%), a broken tooth or filling and bleeding gums (18%), and bad-smelling breath (13%). The proportion of those currently having no oral symptoms was 28%. Nearly half (47%) thought that their mouth was in good or quite good condition, 34% in average condition, 14% in quite bad or bad condition, and 5% could not say.

Utilization of professional care. During the past year 69% of the subjects had had a dental appointment, and a further 19% had had one from 1 to 2 years ago. An interval of more than 5 years was found for 6% of those surveyed. The main reason for the last dental visit was a normal check-up (58%), and pain or some other reason requiring urgent treatment was reported by 23%. A physicians' referral for dental care had been received by 3% of subjects. Most (90%) found it important for the diabetes nurse also to offer tips about dental care.

The bivariate associations of oral health habits with potential explaining factors are shown in Table 1. When oral health habits were used as a dependent variable, logistic regression analysis showed that female sex was a very significant variable in determining frequent tooth

brushing, age 40 years or more in determining frequent interdental cleaning, and self-reported good condition of oral health in determining frequent dental visits (Table 2).

Oral health

The mean number (*s*) of surfaces with calculus was 33.5% ($\pm 24.3\%$) and with visible plaque 28.2% ($\pm 21.8\%$). Pathologic pockets (CPITN 3 or 4) were found in 79% of subjects and 49% of sextants ($n = 654$). No patient but 2% of the sextants scored CPITN value zero. Periodontal pockets of 6 mm or deeper were not detected in patients less than 30 years old, being most frequent in sextants of the age group 40–49 years. In contrast, healthy sextants were most frequent in subjects less than 40 years old and were not found in those more than 60 years old.

Although the beneficial effect of frequent dental visits could be seen in all oral health indicators, a significant relationship was found only between regular dental visits and reduced amount of calculus (Table 3). Frequent tooth brushing had almost the same effect on amount of calculus. Age less than 40 years, female sex, self-reported good oral health, and no missing teeth were significantly associated with less plaque and calculus (Table 4). Moreover, low age and no missing teeth indicated low

Table 2. Logistic regression analysis for frequent oral health habits

Dependent variable	Independent variable	B	Standard error	Odds ratio	95% CI	P
Frequent tooth brushing	Male sex	-1.452	0.495	0.23	0.09-0.62	0.001
	* Information: yes	0.935	0.479	2.55	1.00-6.51	0.051
Frequent interdental cleaning	Age ≥40 years	1.382	0.538	6.60	1.39-11.43	0.010
	* Information: yes	0.399	0.486	1.49	0.58-3.86	0.412
	No missing teeth	-0.021	0.537	0.98	0.34-2.80	0.969
Frequent dental visits	† Good oral condition	1.821	0.878	6.18	1.11-34.50	0.038

CI = confidence interval.

* Information: Do you have information about the relationship between diabetes and gum diseases?

† Self-reported condition of oral health.

CPITN scores, which were also significantly related to the value statement 'Oral health is not as important as general health'.

Discussion

During the past decade improvements in oral hygiene have been seen as the primary factor explaining improved periodontal health, not only in children but also in adults (21). The benefits of good oral self-care in preventing dental diseases are well known, but implementation on the individual level requires continuous motivation and guidance. Oral health care practices are habitual tasks that need to be well established, and only large increases in motivation to perform optimal oral care will affect oral health care behavior (15). In Finland the importance of consistent oral health care behavior has been emphasized in the national instructions for care of type-1 diabetes, but dental care is not included in the guidelines for type-2 diabetes. Our results show that Finnish adults with diabetes fail to engage in regular oral health care behavior.

The proportion of those who reported brushing their teeth more than once a day (29%) was lower than that

found in earlier oral health care behavior studies among Finnish people (61%) (18). In a nationwide study (22) 36% of the men and 67% of the women reported brushing more than once a day. In addition, the low rate of those who reported cleaning the interdental space daily (21%) indicates that better oral hygiene practices among adults with diabetes should be promoted.

Altogether 69% of participants had had a dental appointment within the past year, which is considerably higher than the rate reported by Murtooma & Metsäniitty (53%) (18). However, in a nationwide study (22) 61% of

Table 3. Associations between oral health habits and indicators of periodontal health

	n	Visible plaque, P value	Calculus, P value	*CPITN, P value
Brushing				
< Twice daily	84	0.099	0.057	0.185
≥ Twice daily	35			
Interdental cleaning				
< Once daily	93	0.573	0.678	0.496
≥ Once daily	25			
Dental visits				
≥ 1 year ago	37	0.076	0.033	0.649
< 1 year ago	83			

Statistical evaluation using Mann-Whitney test.

* Community Periodontal Dental Index of Treatment Needs.

Table 4. Associations between indicators of periodontal health and situational (¶), cognitive (||), behavioral (**), and affective (††) factors

	n	Visible plaque, P	Calculus, P	CPITN, P
Age¶				
<40 years	44	0.002	0.000	0.000
≥40 years	76			
Sex¶				
Female	51	0.019	0.007	0.630
Male	69			
Education¶				
Low	84	0.001	0.017	0.879
High	36			
* Information				
No	65	0.966	0.273	0.343
Yes	55			
† Condition				
Not good	58	0.004	0.000	0.151
Good	56			
‡ Statement 1				
Disagree	5	0.989	0.380	0.150
Agree	110			
Missing teeth**				
Some	77	0.002	0.008	0.036
None	43			
Smoking**				
Smoking	29	0.226	0.227	0.754
No smoking	90			
§ Statement 2††				
Disagree	107	0.114	0.116	0.042
Agree	10			

Statistical evaluation using the Mann-Whitney test.

* Information: Do you have information about the relationship between diabetes and gum diseases?

† Self-reported condition of oral health.

‡ Statement 1: I want to keep my natural teeth as long as possible.

§ Statement 2: Oral health is not as important as general health.

the men and 72% of the women reported having a dental appointment within the past year. It is noteworthy that in the present study an alarmingly high percentage of patients (23%) required emergency treatment, in accordance with our previous nationwide questionnaire study, in which the corresponding proportion was 19% (23). Our result is also supported by the finding of Thorstenssen et al. (24) that patients with diabetes require more emergency dental care (13%) than their non-diabetic counterparts (4%).

Consistent with the study by Syrjälä et al. (25), we found that frequency of interdental cleaning was higher in older people. The frequency of toothbrushing was higher in women, who also had less plaque and calculus, which is an encouraging result, bolstering the twice-a-day brushing recommendation. No difference in oral health habits was found between patients with low and high education, but those with high education did have less plaque and calculus.

The results of this study corroborate the belief that a low correlation exists between oral health habits reported and the results of clinical measurements of these habits, with the exception of frequent dental visits and reduced amounts of calculus. Consistent with Lang et al. (26), we found no statistically significant differences in plaque and calculus indices or CPITN scores between those with a frequent and those with a less frequent brushing habit. The frequency of interdental cleaning was low in the present study, and the quality of this habit can be suspected, because no beneficial effect was found on periodontal health indicators. In the studies by Lang et al. (26, 27), when attention was paid to the quality of oral health practices, a positive association was found between oral health care behavior and periodontal health, indicating that comprehensive oral self-care has a strong impact on periodontal health.

Whereas answers to a questionnaire study on oral health habits and related background variables might be reliable, they could also be influenced by individuals' perceptions of ideal oral self-care. To diminish any effect of social desirability, the instructions at the top of the questionnaire advised participants to answer in accordance with their first impulse when hesitating between alternatives.

In Finland, adults with diabetes are entitled to state-subsidized public dental care, the extent of which is contingent on the resources of municipalities. In addition, when insulin-dependent patients have a physician's referral for treatment of oral infections, they are eligible for the National Health Scheme, which partly reimburses the use of private dental services. According to the present findings and our previous national diabetes study (23), it seems that these benefits are not fully utilized.

Because not all patients with diabetes are regular dental visitors, motivation for good oral care should be included in diabetes care. Furthermore, since patients are much more likely to have an appointment with a physician or a diabetes nurse, all medical professionals involved in diabetes care should be informed about the importance

of good oral health. Diabetes nurses have a central role in the guidance of diabetic patients in the systematic medical follow-up system in Finland. They meet patients at 3- to 4-month intervals and are well aware of the diabetes status of each patient. Moreover, as suggested by Knecht et al. (28), some common psychological determinants are associated with both oral health behavior and diabetes self-care. Thus, the possibility that nurses might encourage patients to practice better oral self-care, as a part of diabetes self-care counseling, should be considered.

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