Oral Self-Care and Use of Dental Services Among Adults With Diabetes Mellitus

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Purpose: To investigate the oral health behaviour and the smoking habits among diabetic adults with regard to diabetes-related factors and their background information.

Materials and Methods: In 2005, a questionnaire was conducted among diabetic adults (N = 299) in Tehran, Iran. The subjects were invited to the dental clinic and were asked to complete a self-administered questionnaire. In addition to their background information, the questionnaire requested information on smoking, oral self-care, dental attendance, year of onset of diabetes and organ complications related to diabetes. The data related to the type of diabetes and the latest value of glycosylated haemoglobin level (HbA_{1c}) were obtained from the patient records at the diabetic clinic. Chi-square test and binary logistic regression model were used for statistical analyses.

Results: Of all the subjects, 29% reported brushing their teeth on a twice-daily basis. Women ($P = 0.05$) reported higher frequencies of twice-daily tooth brushing. Subjects with moderate diabetic control (HbA_{1c} = 7.6–8.5%) showed the highest rate for twice-daily tooth brushing ($P < 0.001$). Of all the subjects, 47% reported having visited a clinician within the past 12 months; this rate was the highest among those without diabetes-related complications (52% versus 41%; $P = 0.05$). Subjects who had a physician referral were more likely to report having had a dental visit within the past 12 months (OR = 4.4; CI = 1.9–10.2).

Conclusions: The present results call for improvement in the level of oral self-care and the regularity of dental checkups among diabetic adults to compensate for their increased risk for oral diseases.

Key words: diabetes mellitus, oral self-care, use of dental services

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Oral self-care, as part of general health self-care, has clearly shown its importance in the prevention of oral diseases such as periodontal diseases and caries (Axelsson et al, 2004; Jonsson et al, 2006). In addition, regular dental visits provide opportunities for professional care in prevention, early detection and treatment of periodontal diseases among dentate adults.

Adults with diabetes have both higher prevalence and more severe forms of periodontal diseases (Bacic et al, 1988; Löe, 1993; Page and Beck, 1997; Sandberg et al, 2000; Guneri et al, 2004). Further, individuals who fail to maintain good oral hygiene are at higher risk for periodontal diseases (Katz et al, 1991). Consequently, this risk seems to be lower for subjects who control both their diabetes and oral health by maintaining comprehensive self-care (Oliver et al, 1993). Regular professional dental cleaning may improve glycaemic control, even for patients with poorly controlled diabetes (Grossi et al, 1997). Furthermore, previous studies have reported the relationship between smoking and

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periodontal disease (Holm, 1994): diabetics who smoke are more prone to periodontal diseases than are their non-smoking counterparts (Orbak et al, 2002; Syrjälä et al, 2003; Jansson et al, 2006).

Because of the established relationship between diabetes and periodontal diseases, the prevention and treatment of periodontitis involving consistent daily oral self-care and regular dental visits are particularly important for diabetic patients. Despite the increased risk of periodontal diseases among diabetics, their oral self-care and use of dental services have been scarcely studied.

The purpose of the present study was to investigate the oral health behaviour among diabetic adults with regard to diabetes-related factors. It was hypothesised that good oral health behaviour is associated with good diabetic control.

MATERIALS AND METHODS

The survey was conducted for a 2-month period (May to July) in 2005, and the details of the data collection had been published previously (Bakhshandeh et al, 2007). The subjects consisted of 299 dentate patients with diabetes who were regularly attending a diabetic clinic in Tehran, Iran, and who had volunteered to participate in the survey. The criteria for inclusion were being at least 25 years of age and having at least one tooth. Subjects' mean age was 49 years (SD 7.6, range 25–69 years) and the mean duration of diabetes was 9.6 years (SD 6.6, range 1 to 44 years).

Questionnaire

A self-administered questionnaire was distributed to the patients during their dental appointment. Illiterate subjects (n = 15) were interviewed by a secretary, who assisted them in completing the questionnaire. The questions were grouped into four categories, and the study covered: (1) oral self-care and smoking, (2) use of dental services, (3) medical history and (4) subject's social background. Questions about their oral self-care and use of dental services are given in Table 1.

Information related to individual characteristics and medical history, including the type of diabetes and the latest value of glycosylated haemoglobin level (HbA_{1c}), was obtained from the patient records at the diabetic clinic. Diabetes-related variables were categorised as follows: diabetes mellitus (DM) type 1 or 2; the presence or absence of complications; and the duration of diabetes, which in turn, was categorised into three: < 7 years, 7 to 12 years and > 12 years. Diabetic control was considered good if the HbA_{1c} value was < 7.6%, moderate if it ranged from 7.6% to 8.5% and poor if it was > 8.5% (Karikoski et al, 2002b). For 12 subjects, no recent information on HbA_{1c} was available and they were excluded from further analysis. Subjects' level of education was categorised into the following: a university degree represented a high level of education; a high school diploma a medium level of education; and all others a low level of education. Subjects' age was categorised according to the following: < 45 years, 45 to 54 years and $\geq$ 55 years. The details of the characteristics of the study population are presented in Table 2.

Statistical evaluation included the chi-square test for comparison of frequencies and the logistic regression modelling for multivariable analyses. The impacts of the diabetes-related factors on the probability of reporting twice-daily tooth brushing and of having had a dental visit within the past 12 months were investigated with a logistic regression model, controlling for the subjects' background information. The level of significance was set at $P \leq 0.05$.

RESULTS

Of all the subjects (N = 299), 29% reported brushing their teeth on a twice-daily basis, 54% once daily and 17% less frequently; twice-daily tooth brushing was more frequent among women than men (32% versus 21%; $P = 0.05$).

Smoking reported by the subjects was rare (9%). The smokers reported tooth brushing on a twice-daily basis more frequently than did the non-smokers (50% versus 27%; $P = 0.01$).

The highest rates for twice-daily tooth brushing were reported by those subjects with moderate diabetic control (HbA_{1c} = 7.6 to 8.5) in the following subgroups: women, those < 45 years of age, those with a low level of education, those with type 1 DM, a short duration of diabetes and no diabetes-related complications (Table 3).

In the oldest age group, those subjects with no diabetes-related complications reported twice-daily tooth brushing more frequently than did their counterparts with diabetes-related complications (46% versus 13%; $P = 0.001$). The reverse was observed for younger subjects; those with no complications reported twice-daily tooth brushing less frequently (23% versus 46%; $P = 0.04$).

Table 1 Questions about oral self-care and use of dental services

Questions	Alternatives	Categorisation
Oral self-care		
How often do you brush your teeth?	a. Occasionally	Twice daily (c)
	b. Once daily	Less (a, b, d)
	c. More often than once daily	
	d. I do not brush my teeth	
Which of the following do you use to clean the spaces between your teeth? (multiple choices)	a. Dental floss	
	b. Toothpick	
	c. Interdental brush	
	d. Nothing	
How often do you clean the spaces between your teeth?	a. Almost every day	Daily (b)
	b. Once daily	Less (a, c, d)
	c. Weekly	
	d. Never	
Do you smoke?	a. Regularly	Smoker (a, b)
	b. Occasionally	Non-smoker (c, d)
	c. I did, but I have quit	
	d. I do not smoke	
Use of dental services		
When was your most recent dental visit?	a. < 1 year ago	Within 12 months (a)
	b. 1–2 years ago	> 12 months ago (b–e)
	c. 3–5 years ago	
	d. > 5 years ago	
	e. I do not remember	
What was the main reason for your most recent dental visit?	a. Pain or emergency treatment	Dental checkup (b)
	b. Dental checkup	No checkup (a, c–f)
	c. Preparing or fixing a denture	
	d. Extraction of tooth	
	e. Other reason	
	f. I do not remember	
If you have had no dental visit for 2 years, what is the reason? (multiple choices)	a. Dental care is unpleasant	
	b. Dental care is too expensive	
	c. I have had no problems	
	d. Due to my work, it is difficult to fix an appointment	
	e. I did not know that I need a dental checkup	
	f. Other reason	
Have you ever received a physician referral for dental care?	a. Yes	Yes (a)
	b. No	No (b, c)
	c. I do not know	

The most common device for interdental cleaning was the toothpick (45%), followed by dental floss (31%) and the interdental brush (10%); 25% of the subjects reported no interdental cleaning, whereas 35% reported interdental cleaning at least once daily. When analysed according to the diabetes-related factors, subjects with no diabetes-related complications showed a higher rate of daily interdental cleaning (41% versus 28%; $P = 0.02$) than did those with complications.

Of all the subjects, 47% reported a dental visit within the past 12 months and 27% in the past 1 to 2 years, with no gender difference. Those subjects who brushed their teeth twice daily reported a dental visit within the past 12 months more frequently than did those who brushed their teeth less frequently (56% versus 43%; $P = 0.04$).

The prevailing reason for the most recent dental visit was pain and emergency (24%), followed by tooth extraction (20%) and a regular dental checkup

Table 2 Characteristics of the diabetic adults studied (N = 299)

Characteristics	n
Gender	
Male	82
Female	217
Age	
< 45 years	78
45–54 years	147
≥ 55 years	74
Level of education	
Low	121
Medium	122
High	56
Diabetic type	
Type 1	50
Type 2	238
Other	11
Duration of disease	
< 7 years	121
7–12 years	92
≥ 13 years	86
Diabetic control (HbA_{1c} value)	
< 7.6 (good)	160
7.6–8.5 (moderate)	62
≥ 8.6 (poor)	65
Missing data	12
Complications	
No	161
Yes	138
Smoking	
No	273
Yes	26

(14%). Reporting a checkup as the reason for the most recent dental visit was more prevalent among subjects who had visited a clinician within the past 12 months (21% versus 8%; $P = 0.002$) than those who had not.

Those who reported no visit to a clinician within the past 2 years indicated their main reason as having no perceived need to see a clinician (46%), followed by high cost (40%) and being unaware of the necessity of regular dental checkup (18%); 12% of the subjects had received a physician referral for dental care and the subjects reported having visited a clinician during the past 12 months more frequently than did those without a physician referral (74% versus 43%; $P = 0.001$).

Table 4 shows the data of evaluation, according to diabetic control and having had a dental visit within the past 12 months. The lowest rates occurred among those with poor diabetic control as well as having a complication (18%), or a low (27%) or medium (30%) level of education, or with type 2 DM (30%).

When analysed according to diabetes-related complications, a dental visit during the past 12 months was most frequent among those without complications (52% versus 41%; $P = 0.05$), in particular for women (53% versus 39%; $P = 0.03$). Highly educated subjects without complications tended to most frequently report a dental visit within the past 12 months (60% versus 35%; $P = 0.06$), whereas subjects with complications and poor diabetic control less often reported such a visit (18% versus 49%; $P = 0.01$).

To show the strength of factors related to reporting twice-daily tooth brushing, a logistic regression model was fitted to the data (Table 5). Smokers (odds ratio, OR = 2.9; 95% confidence interval, CI = 1.2–7.0) and women (OR = 2.1; 95% CI = 1.1–4.1) were more likely to report twice-daily tooth brushing when controlling for diabetes-related factors and the subjects' sociodemographic background information. A corresponding model revealed the high impact of a referral from a physician (OR = 4.4; 95% CI = 1.8–10.2) on subjects who had a dental visit within the past 12 months.

DISCUSSION

Oral diseases are increasingly considered as behavioural diseases (Petersen et al, 2005). Adopting healthy habits, including sufficient oral self-care (Löe, 2000; Axelsson et al, 2002) and regular dental visits (Richards and Ameen, 2002), is essential to control such diseases. Self-care emphasises the individual's role as a decision-maker. Good oral health strongly depends on attitude and personal care, such as oral self-care and regular dental visits (Frandsen, 1985). The prevention and treatment of oral diseases, as well as diabetes, require persistent daily self-care (Kneckt et al, 1999). Some common determinants appeared both for dental health behaviour and for diabetes self-care; good self-care management positively influences compliance to diabetes treatment among subjects with type 1 DM (Kneckt et al, 2000). The inter-relationship between diabetes and periodontal inflammation suggests that routine preventive dental care (dental prophylaxis or cleaning) may be important in preventing complications of both diseases.

The questionnaire included information on subjects' frequency of oral health behaviour. The answers to these questions provide no direct information

Table 3 Rates (%) of twice-daily tooth brushing among diabetic adults (N = 287) according to their level of diabetic control (HbA_{1c} value)

	Diabetic control (HbA_{1c} value)						
	Good (n = 160)		Moderate (n = 62)		Poor (n = 65)		
	n	%	n	%	n	%	*P*
Gender							
Male	46	20	15	27	15	7	NA
Female	114	26	47	55	50	24	0.001
Age							
< 45 years	40	10	18	72	17	35	0.000
45–54 years	83	31	27	30	29	21	0.58
≥ 55 years	37	24	17	53	19	5	NA
Level of education							
Low	63	19	28	70	28	18	0.000
Medium	70	27	22	27	23	35	0.77
High	27	30	12	42	14	0	NA
Diabetic type*							
Type 1	19	16	15	67	13	23	0.005
Type 2	136	25	44	39	50	20	0.10
Duration of disease							
< 7 years	68	25	25	52	20	25	0.04
7–12 years	47	23	19	47	24	18	0.06
≥ 13 years	45	24	18	44	21	19	0.17
Complication							
No	84	26	32	56	37	22	0.003
Yes	76	22	30	40	28	18	0.10

Statistical evaluation by chi-square test.
NA = not applicable.
*Other types (n = 10) excluded.

about how effectively the respondents take care of their teeth, but nevertheless offer some indications of their motivation towards oral health.

The rate of twice-daily tooth brushing among the subjects in this study was 29%, a rate far below the rates reported for the general population, for example in the UK (74%) (Kelly et al, 2000). This result is in accordance with Karikoski et al (2002a), who found that the rate of twice-daily tooth brushing (38%) among diabetic adults was considerably lower than that reported for the general population (61%). We found, however, that the rates of twice-daily tooth brushing were the highest for subjects with moderate diabetic control and the lowest for those with poor diabetic control. The association between poor metabolic control of diabetes and low frequency of tooth brushing suggests that dental health education is important, especially in diabetic patients with poor metabolic control (Syrjälä et al, 1999). However, Sandberg et al (2001) reported no significant relation between diabetes-related factors and oral self-care.

Patients with poorly controlled diabetes have an increased rate of surgical wound infections and poor wound healing (Weringer and Arquilla 1981; Shah et al, 1983; Piche et al, 1989; Christgau et al, 1998). As prevention plays a primary role in hindering the development of periodontal disease among diabetic subjects, they may require more frequent plaque control and scaling than do the non-diabetic subjects (Galili et al, 1994).

In the present study, as in other dental health behaviour studies among diabetics, female gender was a strong predictor for twice-daily tooth brushing (Sakki et al, 1998; Karikoski et al, 2002a). A similar gender-based difference occurred among diabetics who smoked. Smokers in general, but smoking women in particular, reported more twice-daily tooth brushing than non-smokers. In fact, smoking is the best predictor for severe periodontal disease in

Table 4 Rates (%) of reporting a dental visit within the past 12 months among diabetic adults (N = 287) according to their level of diabetic control (HbA_{1c} value)

	Diabetic control (HbA_{1c} value)						
	Good		Moderate		Poor		
	n	%	n	%	n	%	*P*
Gender							
Male	46	46	15	60	15	40	0.51
Female	114	50	47	49	50	34	0.15
Age							
< 45 years	40	50	18	44	17	53	0.76
45–54 years	83	52	27	52	29	31	0.14
≥ 55 years	37	35	17	59	19	26	0.11
Level of education							
Low	63	62	28	54	28	27	0.01
Medium	70	41	22	46	23	30	0.55
High	27	37	12	58	14	57	0.32
Diabetes type							
Type 1	19	42	15	40	13	54	0.73
Type 2	136	51	44	57	50	30	0.02
Duration of disease							
< 7 years	68	53	25	60	20	40	0.40
7–12 years	47	49	19	37	24	33	0.39
≥ 13 years	45	42	18	56	21	33	0.37
Complication							
No	84	51	32	56	37	49	0.81
Yes	76	46	30	47	28	18	0.03

Statistical evaluation by chi-square test.

subjects with type 2 DM (Jansson et al, 2006). Due to the increased risk of periodontal diseases, diabetics should be made aware of the health hazards of smoking and encouraged to act accordingly.

Almost half of all the subjects in this study reported having had a dental visit within the past 12 months; subjects with complications and poor diabetic control showed the lowest rates. Reporting a dental visit in the past 12 months was more frequent among twice-daily tooth brushers. This result is in line with the findings of Spangler and Konen (1994) that subjects with type 2 DM who have good oral hygiene habits were more prone to use dental services annually. This implies that dental personnel can improve oral health behaviour by both specific intervention and verbal persuasion, including encouragement and positive feedback to patients (Anderson et al, 1995; Stewart et al, 1996; Wolfe et al, 1996).

In this study, reporting a dental checkup as a reason for the most recent dental visit was very rare (14%). Sandberg et al (2001) found that fewer patients with diabetes (85%) paid a regular visit to the clinician than the non-diabetic control subjects (95%). Patients with diabetes miss more dental appointments (Pohjamo et al, 1995), and dentate adults with diabetes are less likely to have seen a clinician within the preceding 12 months than those without diabetes (Tomar and Lester, 2000).

With regard to the use of dental services, Thorstensson et al (1989) found that many diabetic patients fail to visit their clinician annually, and that the diabetic patients require more emergency treatment than do healthy controls. The most frequent reason for the recent dental visit in the present study was pain and emergency, followed by tooth extraction. A physician referral was a strong factor for having had a dental visit within the past 12 months; this speaks for the importance of physicians' awareness of good oral health. Among our diabetic subjects, oral self-care and awareness of the need for regular dental checkups seem insufficient to cope with the increased risk for periodontal diseases.

Table 5 The OR for reporting twice-daily tooth brushing and having had a dental visit within the past 12 months among diabetic adults (N = 287) by means of a logistic regression model, according to their characteristics

Models	Estimate of strength		OR and its 95% CI		
	Estimate	SE	OR	95% CI	*P*
Twice-daily tooth brushing					
Gender (0 = male, 1 = female)	0.731	0.343	2.1	1.1–4.1	0.03
Age in years	−0.003	0.019	1	1.0–1.0	0.88
Level of education	−0.082	0.153	0.9	0.7–1.2	0.6
Smoking (0 = non-smoker, 1 = smoker)	1.066	0.451	2.9	1.2–7.0	0.02
Diabetic control	0.03	0.074	1	0.9–1.2	0.68
Duration of diabetes in years	0.014	0.022	1	1.0–1.1	0.52
Complications (0 = yes, 1 = no)	0.234	0.285	1.3	0.7–2.2	0.41
Constant term	−1.710	1.215			
Goodness of fit: *P* = 0.40					
Dental visit within the past 12 months					
Gender (0 = female, 1 = male)	0.031	0.286	1	0.6–1.8	0.91
Age in years	−0.025	0.017	1	0.9–1.0	0.16
Level of education	−0.114	0.138	0.9	0.7–1.2	0.41
Diabetic control	−0.110	0.071	0.9	0.8–1.0	0.12
Duration of diabetes in years	0.01	0.02	1	1.0–1.1	0.63
Complication (0 = yes, 1 = no)	0.368	0.262	1.4	0.9–2.4	0.16
Physician's referral to clinician (0 = no, 1 = yes)	1.473	0.434	4.4	1.9–10.2	0.001
Constant term	1.696	1.16			
Goodness of fit: *P* = 0.67					

Patients with diabetes are at increased risk for developing oral diseases. Thus, reliable and up-to-date information regarding perceptions of oral health behaviour among the diabetics is required for dental practitioners to develop effective and useful prevention strategies. Diabetics require generalised health promotion activities related to dental care. Physicians, clinicians and other primary health care providers may target educational messages, in particular, regarding the importance of regular dental care for diabetic patients. In conclusion, improvement in the level of oral health behaviour among diabetics is essential to compensate for their increased risk for oral diseases.

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