A controlled study of oral self-care and self-perceived oral health in type 2 diabetic patients

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A controlled study was carried out in mid-Sweden with the aim of comparing oral self-care and self-perceived oral health in 102 randomly sampled type 2 diabetic patients with that of 102 age-and-gender-matched non-diabetic controls. Oral health variables were also related to glycemic control (HbA_{1c}), duration, anti-diabetic treatment, and late complications. Questionnaires were used to collect data on oral self-care and self-perceived oral health. Diabetes-related variables were extracted from medical records. Eighty-five percent of the diabetic subjects had never received information about the relation between diabetes and oral health, and 83% were unaware of the link. Forty-eight percent believed that the dentist/dental hygienist did not know of their having diabetes. Most individuals, but fewer in the diabetic group, were regular visitors to dental care and the majority felt unaffected when confronted with dental services. More than 90% in both groups brushed their teeth daily and more than half of those with natural teeth did proximal cleaning. Subjects in the diabetic group as well as in the control group were content with their teeth and mouth (83% vs 85%). Those with solely natural teeth and those with complete removable dentures expressed most satisfaction. Sensation of dry mouth was common among diabetic patients (54%) and subjects with hypertension exhibited dry mouth to a greater extent (65%) than those who were normotensive. Our principal conclusion is that efforts should be made to give information about diabetes as a risk factor for oral health from dental services to diabetic patients and diabetes staff. □ *Oral health behaviour; oral self-care; self-perceived oral health; type 2 diabetes*

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Prevention and treatment of oral diseases as well as diabetes require persistent daily self-care (1). Many authors have emphasized that diabetes increases the risk of oral manifestations (2–14) and many different biological aspects behind this association have been studied. Health-related behavior might also be an important factor to assess in regard to that relationship. Good oral health is strongly dependent on attitudes and personal behavior, such as oral self-care, e.g. habits at home and regular dental visits. As determinants, Frandsen (15) also included previous dental care experiences, knowledge of oral disease, perception of own oral health, dietary habits, belief in dental treatment, and barriers to treatment. Subjects who have the knowledge of risk factors, personal risk, and beliefs about control over their own health have been found to practice more health-promoting behavior (16). A theory of self-efficacy, a principle connection between knowledge and action, has been described by Bandura (17). In many areas of health behavior, this theory has been applied to find factors that determine for example oral health behavior among diabetic subjects (1, 18–21). A close association has been reported between beliefs and behavior for health (22), and for regular dental check-ups and the frequency of tooth brushing (19). Syrjälä et al. (19) have shown that there is a strong association between perception of how subjects with type 1 diabetes manage their self-care concerning tooth brushing, proximal cleaning, dental visiting, and reported oral health behavior. They also concluded that individuals with higher HbA_{1c} levels have lower frequencies of tooth brushing and higher plaque level. The relationships were independent of age, sex, and education. Kneckt et al. (20, 23) found that good self-care management had a positive influence on diabetes adherence among subjects with type 1 diabetes. Self-reported oral hygiene among primary care patients with diabetes has been described (24). One finding has been that patients with type 2 diabetes who are more likely to exercise oral health behavior were also more prone to visit the dental services annually. Torstensson et al. (25) found that a fairly large group of diabetic subjects (type 1) did not visit a dentist annually.

In an earlier study, we found that individuals with type 2 diabetes in some respects have poorer oral health than non-diabetic subjects (8). For that reason we explored the relation between diabetic subjects' oral self-care and self-perceived oral health and compared this with that of age-and-gender-matched non-diabetic controls. In addition, oral health variables were related to glycemic control (HbA_{1c}), diabetes duration, anti-diabetic treatment, and late complications. Diabetic patients' knowledge about the link between diabetes and oral health was also investigated.

Materials and methods

This study on oral self-care and self-perceived oral health

Table 1. Characteristics of type 2 diabetic subjects concerning diabetes-related variables

Diabetes duration (year) mean ± *s*	9.9 ± 6.1
Treatment	
Oral anti-diabetic treatment (%)	68
Insulin treatment (%)	22
Combined treatment (oral anti-diabetic agents and insulin) (%)	10
Glycemic control	
Good ($HbA_{1c} \leq 6.0$) (%)	21
Acceptable (HbA_{1c} 6.1–7.5) (%)	45
Unsatisfactory ($HbA_{1c} > 7.5$) (%)	34
HbA_{1c} (%)	
Mean ± *s*	7.1 ± 1.4
Range	3.9–11.1
Late complications	
Neuropathy (%)	29.8
Nephropathy (%)	6.9
Retinopathy (%)	37.5
Hypertension (%)	65

s = standard deviation.

is part of more comprehensive research on diabetes self-care and health, including oral health, carried out in a county in mid-Sweden. A random sample of patients with type 2 diabetes was compared with age-and-gender-matched non-diabetic controls from the same residential area. Diabetes-related variables were extracted from medical records. Oral self-care, self-perceived oral health, and diabetic subjects' knowledge about the relation between diabetes and oral health were explored with the use of a questionnaire. All patients were informed about the aim of the study and its voluntary nature. The medical ethics committee at Uppsala University approved the study design.

Patients with type 2 diabetes

One-third of all type 2 diabetic patients ≤75 years of age were randomly selected ($n = 210$) from the local diabetes register in Primary Health Care. Twenty-three patients were unable to participate because of ill health and 29 declined. A total of 158 patients (75.2%) with type 2 diabetes participated in another of the health studies (an interview). Of those, 102 (64.6%) also accepted a clinical oral examination free of charge at either of two adjacent Public Dental Service (PDS) clinics (reported elsewhere) (8); they also answered the questionnaire. Characteristics of the diabetic subjects concerning diabetes-related variables are given in Table 1.

Dropout analysis

Dropouts were analyzed to ascertain that the studied sample did not differ from the original randomized sample in any important variables. The percentage of insulin-treated patients seemed to be higher in the studied sample but not significantly so (Table 2). Many of the patients on diet/oral anti-diabetic treatment viewed diabetes as a trivial aspect of life and commented on their non-participation as follows: 'I nearly don't have diabetes any more, so I'm the wrong person to take part in a diabetes study.' This might be one explanation for the slightly higher number of insulin-treated patients in the studied sample.

Non-diabetic control group

The controls were matched from the register at the same PDS clinics as the diabetic patients visited for the clinical examination (8) and comprised 102 age-and-gender-matched non-diabetic subjects. There were no significant differences between the groups in other demographic characteristics (Table 3). At the clinical examination they received the questionnaire.

Measurements

Questionnaire

Questions in this paper were taken from the questionnaire from the more comprehensive research on diabetes self-care and health. Initially, questions on general socio-economic conditions, such as education, occupation, and economy, were asked. The 16 questions on oral self-care and self-perceived oral health, with a total of 82 items, were almost identical to the questions in the epidemiological studies by Uhrbom & Bjerner (26, 27).

The questions concerning *oral self-care* included dental visiting (regularity, intervals, reason for not visiting, feelings when confronted with dental service and oral

Table 2. Demographic and diabetes-related variables in the originally randomized sample, the participants in the interview, and those who also participated in the present study

	Randomized sample ($n = 210$)	Interview study ($n = 158$)	Present study ($n = 102$)
Males (%)	60	64	63
Mean age (years ± *s*)	64.0 ± 9.0	64.6 ± 8.5	64.8 ± 8.4
Mean duration of diabetes (years ± *s*)	9.0 ± 6.0	8.9 ± 6.2	9.9 ± 6.1
Patients on insulin treatment (%)	17	18	22
Mean HbA1c (% ± *s*)	7.1 ± 1.7	7.1 ± 1.5	7.1 ± 1.4

s = standard deviation.

Table 3. Demographic characteristics of patients with 2 diabetes and non-diabetic control subjects (NS)

Characteristics	Type 2 diabetes ($n = 102$)	Controls ($n = 102$)
Age* (years)		
Mean ± s	64.8 ± 8.4	64.9 ± 8.5
Range	34–76	34–77
Gender* (F/M)	38/64	38/64
Education (%)		
Elementary school and senior high school	92.1	89.2
University college/degree	7.9	10.8
Occupation (%)		
Blue-collar worker	81.6	74
Employee/Official/Graduate	18.4	26
Economy (%)		
Good/very good	42.7	46.1
Neither good nor poor	42.7	44.1
Poor/very poor	14.6	9.8
Smokers (%)	8.9	8.8
Snuffers (%)	9.0	11.8

* Matched variables. s = standard deviation.

health information obtained) as well as oral health behavior (oral health habits, e.g. tooth brushing, proximal cleaning, and fluoride supply).

The questions on *self-perceived oral health* dealt with patients' experiences of their oral conditions (satisfaction/dissatisfaction with teeth and mouth, problems and functions, e.g. chewing ability).

Diabetes and oral health. Subjects in the diabetic group were faced with 3 questions comprising 8 items. These dealt with information obtained about the relationship between diabetes and oral health and who had provided the information, their opinion about the relationship between diabetes and oral health and whether the dentist/dental hygienist knew about their having diabetes.

Glycemic control. Glycemic control was measured as mean value of 3–4 measurements of HbA_{1c} during 1 year. HbA_{1c} had been assayed using a liquid chromatographic method (Pharmacia HPLC system). The same method of analysis was used at all primary health care units and the normal range was between 3.8 and 5.2%.

Procedures

The diabetic patients who participated in another of the health studies (an interview) were given the questionnaire and requested to return it within 1 week. The control subjects received the questionnaire at the clinical examination (8) and were asked to fill in and mail it to one of the authors (GS) within 1 week. Information on the diabetic patients' age, diabetes duration, anti-diabetic treatment, glycemic control, and the presence of late complications was extracted from medical records at the primary health care units.

Data analysis

Results are presented as mean values with standard deviation (s) and range. Chi-squared tests were used for comparing discontinuous data. When analyzing variables on the use of proximal aids and fluoride supply, the totally edentulous subjects were excluded.

Results

Oral self-care

Regularity in dental visiting. Fewer diabetic (85.1%) than control subjects (95.1%) paid regular visits to the dentist ($P < 0.05$). The other 14.9% diabetic and 4.9% control subjects reported that they never, or only if stricken with acute problems, visited dental services. Eight diabetic individuals did not answer the question. According to patient reports, the main reason for not visiting dental services was the belief that it was not necessary since they were wearing completely removable dentures.

Feelings when visiting the dental services

Most individuals, 77.2% in the diabetic group and 72.6% in the control group, felt unaffected when visiting dental services. Only 8 diabetic and 3 control subjects experienced very unpleasant feelings, such as anxiety and dental fear.

Information to the patients about oral hygiene

Patients in both groups reported that the information about oral hygiene had been given to them first and foremost by dental hygienists and dentists, but to a lower extent in the diabetic than in the control group (79.3% vs 95.1%; $P < 0.001$). Fifteen percent of the diabetic and 5% of control subjects reported that 'no one in particular' had informed them ($P < 0.05$).

Table 4. Oral health aids and their frequency of use

	At least once a day or more (%)		Sometimes seldom/never (%)	
	Type 2 diabetes	Controls	Type 2 diabetes	Controls
Tooth brush	91.3	94.1	8.7	5.9
Proximal cleaning aids*	52.0	59.6	48	40.3
Fluoride supply*	93.9	89.5	6.1	10.5

* Subjects without natural teeth were excluded.

Oral health habits, aids, and their frequency of use

Frequency of cleaning the mouth was high in both groups. Cleaning by tooth brushing was carried out by 91.3% of the diabetic subjects and by 94.1% of the control subjects. More than half of those in both groups with natural teeth carried out proximal cleaning of their teeth with different aids (tooth picks, proximal brushes, and/or flossing). They also made extensive use of fluoride toothpaste and/or other forms of fluoride supply (e.g. tablets, chewing gum, rinsing) (Table 4). More than 90% of the patients in both groups never rinsed their mouth with solutions that could be bought on the open market.

Self-perceived oral health

Satisfaction. Some diabetic patients (16.7%) were dissatisfied with their teeth and mouth; however, most were satisfied (83.3%). Six diabetic subjects did not answer the question. In the control group, 85.3% expressed satisfaction and 14.7% dissatisfaction. In both groups, subjects with natural teeth were satisfied to a high degree (84% vs 84%). Patients with complete dentures in both jaws were also to a great extent satisfied (82% diabetic and 100% control subjects). Diabetic subjects with combinations of natural teeth and dentures expressed most dissatisfaction. Almost all patients in both groups (95% vs 94%) could chew all kinds of food (e.g. apples and meat).

Problems. Those who reported problems with teeth and mouth stated various reasons for these. A common problem was the sensation of dry mouth, especially among diabetics (53.5% vs 28.4% for controls; $P < 0.001$). Examples of other problems mentioned and of comments in this area are given in Table 5.

Relationship between oral self-care, self-perceived oral health, and diabetes related variables

Diabetes-related variables are listed in Table 1. No significant relation between diabetes duration, anti-diabetic treatment, and oral self-care or self-perceived oral health was found. Diabetic patients with good/acceptable glycemic control ($n = 66$) tended, however, to report less sensation of dry mouth (46%) than did patients with HbA_{1c} values above 7.5% (64%). Subjects with hypertension exhibited sensation of dry mouth to a greater extent than those who were normotensive (65.1% vs 34.9%) ($P < 0.005$). No differences could be found, however, between those who were treated for their hypertension and those without pharmacological anti-hypertensive treatment.

Diabetic patients' knowledge of the relationship between diabetes and oral health

The greater number of diabetic patients (84.8%) had never received any information about any relationship between diabetes and oral health and were of the opinion that diabetes did not have any influence on their oral health status (83%). Almost half of the patients (47.7%) were convinced that their dentist/dental hygienist did not know of their having diabetes. Those who had received information got it first via the dental services ($n = 9$) and second via nurses in primary health care ($n = 5$).

Discussion

The main finding in the present study was that the great majority (85%) of diabetic subjects had never received information about the association between diabetes and oral health. Almost as many were of the opinion that their diabetes did not have any influence on their oral health status. Only a few subjects reported that they believed their diabetes had affected the periodontal status and their dry mouth. Almost half of the diabetic subjects asserted that their dentist/dental hygienist did not know about their having diabetes. This may depend upon failure to ask

Table 5. Self-perceived problems with teeth and mouth (besides the feeling of dry mouth) among patients with diabetes and non-diabetic control subjects (% patients)

Self-perceived problems	Type 2 diabetes ($n = 102$)	Controls ($n = 102$)
Periodontitis	13.8	11.7
Caries	13.8	10.4
Too few teeth	25.3	34.0
Appearance	16.7	18.3
Other problems*	9.1	9.4

*Examples of diabetic patients' comments in this area: *'I am afraid of amalgam'*; *'I have too many fillings from my childhood'*; *'My pivot teeth become loose'*; *'I have an inflammation around my gold tooth'*.
*Examples from control subjects' comments in this area: *'I have vomit reflexes with my prostheses'*; *'I have bad breath'*; *'I have an injury to one nerve'*; *'My fillings become loose'*.

about this issue in dental care and/or that patients have withheld from giving information about their disease. Many of the patients on diet/oral treatment regarded themselves as 'nearly not having diabetes, only just slightly higher sugar levels'. Perhaps they thought that the dental services did not need to know about their diabetes, especially as most of them were also of the opinion that there was no association between the disease and oral health.

As the study group did not differ significantly from the originally randomized group in any of the diabetes-related variables, we believe that our sample is representative of type 2 diabetic patients. Furthermore, concerning age, HbA_{1c} level, and duration, our group corresponds quite well with type 2 diabetic subjects in other Swedish studies (28–31). The careful matching of the non-diabetic control group with subjects from the same residential area acts as a control for some factors that may affect the results.

Most individuals in both groups (70%) were regular visitors and as many felt unaffected when visiting dentistry, but more diabetic subjects than controls refrained from visiting dental care unless they were forced to by acute problems. Nowadays, a tendency in dental care is to decide individually how often dental recalls should be done. Many of the adult population do not need to come for annual check-ups and no one seems to be deprived of dental care these days. The problem, however, is to find methods to determine optimal intervals between dental visits (32).

It was the dental services that primarily had informed the patients in both groups about oral hygiene but to a lower extent in the diabetic group. Diabetic subjects, however, asserted to a higher degree that no one in particular had informed them. Patients with chronic diseases meet different kinds of health personnel and it is not always easy for them to report on who said what. Moreover, they are exposed to various types of information of considerable proportions, which is why it can be difficult to assimilate everything.

Subjects with natural teeth and those with complete dentures expressed most satisfaction with their teeth and mouth. Dry mouth was frequent among the diabetic patients. Other studies have reported the same pattern (8, 33–36). The control group ($m = 64.9$ years), however, reported dry mouth to an equal extent (29%) as a cohort of a 65 years population in Dalecarlia (27).

Gilbert et al. (37) reported that mouth dryness was highly associated with the number of potentially xerostomic medication. After stratification by medical usage, diabetes was significantly associated with mouth dryness and the impact of dry mouth on daily dryness-related behavior was significant.

Syrjälä et al. (19) reported that compliance with dental recommendations in subjects with type 1 diabetes was related to HbA_{1c} level. In our study, oral self-care and self-perceived oral health were not related to diabetes duration or anti-diabetic treatment. Those with good/acceptable glycemic control tended, however, to report less feeling of dry mouth. Certainly, diabetic subjects with hypertension exhibited dry mouth to a high extent, but those who were on treatment for their hypertension did not report dry mouth any more often than did those without pharmacological anti-hypertensive treatment.

Necessary conditions for practicing health behavior are beliefs about control over one's own health (22) and knowledge about risk factors for health (15, 16). In our study, 8 of 10 diabetic subjects seemed to have had deficient knowledge about diabetes as a risk factor for oral health, as they were of the opinion that their diabetes did not influence their oral health status. Besides, just as many had never received information about any relationship between diabetes and oral health. Moore et al. (38) have reported that patients with diabetes appear to lack important knowledge about the oral health complications of their disease. It is thus a great challenge for professionals in oral health and primary health care to contribute to the diabetic patients' awareness of the relationship between oral health and diabetes. Oral and general health education and primary prevention programs can be planned and realized and be a way of improving health-related behavior.

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