

Oral Health Behaviour and Periodontal Treatment Needs in a Group of Iranian Adults With Diabetes One Year After an Oral Health Intervention

Soheila Bakhshandeh¹, Heikki Murtomaa², Miira M. Vehkalahti³, Rasoul Mofid⁴, Kimmo Suomalainen⁵

¹ D.D.S. Researcher, Department of Oral Public Health, Institute of Dentistry, University of Helsinki, Helsinki, Finland. Institute of Dentistry, Shaheed Beheshti University of Medical Sciences, Tehran, Iran. ² Ph.D., D.D.S. M.Fh. Professor Department of Oral Public Health, Institute of Dentistry, University of Helsinki, Helsinki, Finland. ³ Ph.D., D.D.S. Adjunct Professor, Department of Oral Public Health, Institute of Dentistry, University of Helsinki, Helsinki, Finland. ⁴ D.D.S. Periodontologist, Department of Periodontology, Institute of Dentistry, Shaheed Beheshti University of Medical Sciences, Tehran, Iran. ⁵ Ph.D., D.D.S. Docent. Adjunct Professor in Periodontology, Department of Oral Public Health, Institute of Dentistry, University of Helsinki, Helsinki, Finland.

Abstract

Aim: To investigate changes in oral health behaviour and periodontal treatment needs among adults with diabetes one year after an oral health intervention. **Methods:** The study subjects consisted of 299 dentate adults with diabetes who were regular attenders at a diabetic clinic in Tehran, Iran. A self-administered questionnaire was used to collect information on the subjects' oral health behaviour and background. The participants were randomly assigned to two intervention groups and one control group. In one group, oral-health-related information was delivered by an educational booklet only; in the other intervention group, in addition to distributing the same booklet, an oral hygienist also gave personal oral health care instructions. Plaque and the need for periodontal treatment were assessed using the Plaque Index (Silness & L oe 1964) and the Community Periodontal Index of Treatment Needs (CPITN) and were recorded during clinical periodontal examinations before and one year after intervention. The statistical significance of differences between the groups was evaluated by means of ANOVA, chi-square test, paired t-test, and logistic regression models. **Results:** In comparison to the control group, both interventional groups showed a statistically significant decrease in visible plaque and periodontal treatment needs. In the active intervention group, the fall in the number of participants with a CPITN score of 4 was from 13 to 9 and for CPITN 3 from 33 to 22. In the passive intervention group, the falls were from 27 to 22 for the score CPITN 4 and from 34 to 24 for CPITN 3. In the control group, the number with a CPITN score of 4 fell from 18 to 13 and the number with a CPITN score of 3 rose from 30 to 33. The mean reduction in the sum of Plaque Index (PI) scores for all sextants was 1.3 (SD 2.6) in the active intervention group and 2.0 (SD 2.4) in the passive intervention group, these changes being greater than in the control group (0.3, SD 2.2, $P=0.03$, and $P<0.001$, respectively). **Conclusion:** The results indicated the potential of intervention in oral health education aiming at improvement of oral health behaviour and reduction of periodontal treatment needs among adults with diabetes in countries with a developing health care system.

Key Words: Diabetes, Oral Health Behaviour, Periodontal Disease, Oral Health Promotion, Iran

Introduction

In many parts of the developing world, the prevalence of oral diseases and many other chronic conditions is rising [1]. Periodontal disease contributes significantly to the global burden of oral disease [2]. Diabetes is a global problem with a devastating human, social and economic impact. Today, there are more than 221 million people worldwide with

diabetes [3]. Due to population growth, aging, urbanisation, and the rising prevalence of obesity and physical inactivity, the number of people with diabetes has been estimated to reach 366 million within the next 20 years [4].

Adults with diabetes have both a higher prevalence and more severe forms of periodontal diseases [5-9]. In particular, individuals who fail to

Corresponding author: Soheila Bakhshandeh, Institute of Dentistry, University of Helsinki, P.O. Box 41, FIN-00014, Helsinki, Finland; e-mail: Soheila.Bakhshandeh@helsinki.fi

maintain good oral hygiene are at higher risk of periodontal diseases [10]. This risk seems lower for those who control both their diabetes and oral health by maintaining comprehensive self-care [11].

In spite of the fact that inflammatory periodontal diseases are largely preventable [12], the high prevalence of these diseases indicates that both dental practitioners and patients need a better understanding of how to achieve and maintain this state of health. Good oral health is largely a result of optimal self-care. Thus, it is important to make individuals aware of their own role in maintaining good oral health [13,14]. Baseline findings of the present data revealed an excess of periodontal treatment needs and caries in adults with diabetes in Tehran, Iran [15,16].

In the prevention of oral diseases, the high-risk approach is the most well known [17]. The prevention and treatment of periodontal diseases as well as of diabetes require dedicated daily self-care. Common determinants for both dental health behaviour and diabetes self-care have been described [18]. There is also accumulating evidence of shared predisposing factors for the development of periodontal disease and diabetes [19]. At present, there is no special treatment system for subjects belonging to this group in Iran.

Aim

The aim of the present community trial was to evaluate long-term impacts of two oral health interventions on oral health behaviour, oral hygiene, and periodontal treatment needs among adults with diabetes in Iran.

Methods

Study population

For the present one-year intervention study, a disease-based approach was chosen. The intervention was incorporated in the existing diabetes control programme. Six thousand adult subjects with diabetes, covering a wide range of levels of education and social background in Tehran, Iran, who attended an established clinic associated with the Iranian Diabetic Association, served as the basic population. From among the regular adult attenders, during a two-month period (May-July 2005), 299 volunteer dentate subjects with diabetes were randomly selected for the study and, using daily rosters, invited by telephone to a dental clinic near the diabetes clinic.

The criteria for inclusion were being at least 25

years of age and having at least one natural tooth. A self-administered questionnaire was distributed to the patients during their dental appointment in order to obtain information about birth year, year of onset of diabetes, education, and complications related to diabetes [15].

All participants underwent a periodontal examination and were invited to participate in a follow-up examination one year later. Their periodontal treatment needs were assessed using the Community Periodontal Index of Treatment Needs (CPITN) [20]. Individual CPITN scores were recorded for each sextant containing at least two functional teeth, excluding third molars. The presence of dental plaque on four surfaces of the six index teeth (upper-right first molar, upper-right central incisor, upper-left first molar, lower-left first molar, lower-left central incisor, and lower-right first molar) was measured [21] and recorded by tooth according to its highest plaque index (PI) score. The proportions of CPITN and PI values by sextant, as well as the individual sum of CPITN scores and that of PI scores, were used in the analysis.

The study design was tested by conducting a pilot study, after which the questionnaire, which had been created for this study, was re-evaluated and revised accordingly. Participation in the study was voluntary and informed consent was acquired from all subjects before the study. The subjects were entered into the database with a numerical code only. The Ethics Committee of the Shaheed Beheshti University of Medical Sciences, Tehran, approved the study protocol.

Intervention

After the baseline examination, the study subjects were randomly allocated into three groups: two intervention groups and one control group. In order to reduce bias, the study was designed as an examiner-blinded trial. The clinical examinations were carried out by one of the authors (S. B.), who was kept strictly unaware of the allocation of the subjects to the groups, carried out by a trained dental hygienist. The allocation into the three groups was accomplished by random selection of the starting group and with a subsequent three-day rotation in the assignment to the groups. All interventions were administered by the same dental hygienist. At baseline and follow-up (one year later), a self-administered questionnaire on oral self-care habits was handed to the subjects in the waiting room, to be returned before their dental examination.

At the baseline and one year later at the follow-up examinations, the clinical examiner informed the patients of their periodontal findings. After the baseline examination, those who required periodontal treatment (having a CPITN ≥ 2) were referred to the Shaheed Beheshti Dental School clinic. At baseline, all study subjects were informed of the follow-up examination to be performed one year later.

The intervention groups were designated "active" and "passive". In the active intervention group ($n=56$), the intervention was both informational and educational, accomplished by means of an eight-page booklet on periodontal disease and its relation to diabetes, created for the present purpose by one of the authors (S. B.). The booklet covered the following topics of periodontal health in relation to diabetes: the definition of periodontal disease, dental plaque, and periodontal pockets; the symptoms and aetiology of periodontal disease; the relationship between diabetes and periodontal disease; the effect of smoking on periodontal health; the prevention of periodontal disease; and the importance of regular dental visits and oral self-care. Simple language and coloured illustrations were used to catch the readers' attention. In addition to the booklet, a trained dental hygienist explained the content of the booklet with the help of larger pictures, focusing on periodontal disease, tooth structure, food debris, plaque formation, and periodontal pockets. For this group, the dental hygienist also gave a custom-selected interdental brush and, with the help of a model, instructions for its proper use. No particular method of manual toothbrushing was advised, but the necessity of thorough twice-daily brushing of all surfaces of the teeth was emphasised to obtain a sufficient degree of cleanliness.

In the passive intervention group ($n=70$), the subjects received only the above-mentioned booklet.

The control group ($n=56$) received neither information on oral health promotion nor instructions at the baseline examination. After the follow-up examination, these subjects also received the same booklet. Toothbrushes and toothpastes were distributed among the three study groups as a courtesy for their participation both at the baseline and at the follow-up dental examination.

Evaluation of the intervention

Only subjects who participated in the follow-up examination were included in the evaluation of the

intervention. Similarly, each unavailable sextant at the follow-up was excluded from the evaluation. The outcomes concerning periodontal treatment needs were determined as the mean change in the subjects' maximum CPITN scores and the mean change in the sum of plaque scores in respective interventional groups. Further, a positive outcome per subject was defined as improvement in the CPITN score in at least 50% of sextants. The outcomes regarding oral health behaviour were defined as change in proportion of subjects reporting twice-daily tooth brushing, daily interdental cleaning, and a dental visit within one year.

Statistical analysis

The statistical significance of differences between the subjects was evaluated with ANOVA for mean values and with the chi-square test for frequencies. Paired *t*-test was used for within-group comparisons. Logistic regression models were fitted to the data, and corresponding odds ratios were calculated for evaluation of the strength of associations for the intervention groups in comparison with the control.

Results

At baseline examination, the mean age of the study population was 49 years (SD=7.5 years, range 25-69) with a mean number of 23.1 teeth (SD=4.4, range 6-28). There were no differences between the three groups according to the subjects' background information (gender, age, and level of education), diabetes-related factors (type, duration, and metabolic control of diabetes) and oral self-care (frequencies of tooth brushing and interdental cleaning, and dental attendance during the previous year). No differences were seen between the three groups in CPITN scores ($P=0.31$) and PI scores ($P=0.19$) at the baseline examination, and no differences were observed in the mean number of teeth either at the baseline examination ($P=0.99$) or at the follow-up examination ($P=0.93$) in all study groups of those subjects who completed the oral health intervention programme. The mean HbA_{1c} value was 7.4% (SD 1.8%) at baseline and 7.5% (SD 1.2%) at follow-up, with no statistical differences between the study groups.

By the time of follow-up, one participant had died, 18 had moved, one had received full dentures, one was pregnant, six were in-patients, six refused to participate, and 85 failed to attend their appointments, even after three phone calls. Thus, of the 299 study subjects invited, 182 (61%) participated

in the follow-up examination. No differences were observed between the participants and the drop-outs according to their characteristics and CPITN scores at baseline (*Table 1*) or in the sum of their PI scores for all sextants (mean=7.6, SD=2.2 vs. mean=7.4, SD=2.3; $P=0.51$). Furthermore, there was no difference in the mean number of teeth between the participants and the drop-outs (23.1 vs. 22.9; $P=0.68$).

In all three groups, periodontal treatment needs decreased from the baseline to the follow-up exam-

ination when assessed as the subjects' distributions according to their highest CPITN scores (*Figure 1*). The mean reduction in the subjects' maximum CPITN score was 0.5 (SD 0.99) in the active intervention group and 0.4 (SD 0.83) in the passive intervention group, both of which showed a statistically significant improvement when compared to the control group (0.2, SD 0.78, $P=0.01$ and $P=0.04$, respectively). Within these mean values in the active intervention group, the fall in the number of participants with a CPITN score of 4 was from

Table 1. Characteristics of the Study Subjects ($n=299$), According to Their Participation in the Follow-Up Examination

	Participants ($n=182$)		Drop-outs P ($n=117$)		
	n	%	n	%	
Gender					NS*
Male	52	29	30	26	
Female	130	71	87	74	
Age					NS
<45 years	51	28	27	23	
45-54 years	91	50	56	48	
=55 years	40	22	34	29	
Level of education					NS
Low	74	40	47	40	
Medium	72	40	50	43	
High	36	20	20	17	
Diabetes type					NS
Type 1	29	16	21	19	
Type 2	148	84	90	81	
Duration of diseases					NS
<7 years	70	39	51	44	
7-12 years	61	33	31	26	
=13 years	51	28	35	30	
Complication					NS
No	104	57	57	49	
Yes	78	43	60	51	
HbA _{1c} -value					NS
<7.6	102	57	58	53	
7.6-8.5	38	21	24	22	
8.6+	38	21	27	25	
CPITN					NS
1	11	6	5	4	
2	16	9	6	5	
3	97	53	59	51	
4	58	32	47	40	
Plaque Index (PI)					NS
1	22	12	13	11	
2	160	88	104	89	

Statistical analysis by chi-square test for differences according to participation.

* NS = No statistical significance.

13 to 9 and for CPITN 3 from 33 to 22. In the passive intervention group, the falls were from 27 to 22 for the score CPITN 4 and from 34 to 24 for CPITN 3. In the control group, the number with a CPITN score of 4 fell from 18 to 13 and the number with a CPITN score of 3 rose from 30 to 33.

The mean change in sum of the CPITN scores was 3.4 (SD 3.3) in the active intervention group compared with 2.3 (SD 3.2; $P=0.07$) in the control group. The passive intervention group showed statistically significant improvement (4.0, SD 3.4; $P=0.004$) when compared with the controls.

Similar changes were observed when the CPITN scores were analysed by sextant (*Figure 2*). The mean change of reduction in the sum of Plaque Index (PI) scores was 1.3 (SD 2.6) for the active intervention group and 2.0 (SD 2.4) for the passive intervention group, changes which were statistically significantly greater than in the control group (0.3, SD 2.2, $P=0.03$ and $P< 0.001$, respectively). The distribution of the PI values by sextant before and after the intervention is presented in *Figure 3*.

Baseline data on self-reported twice-daily tooth brushing were as follows: 27% in the active

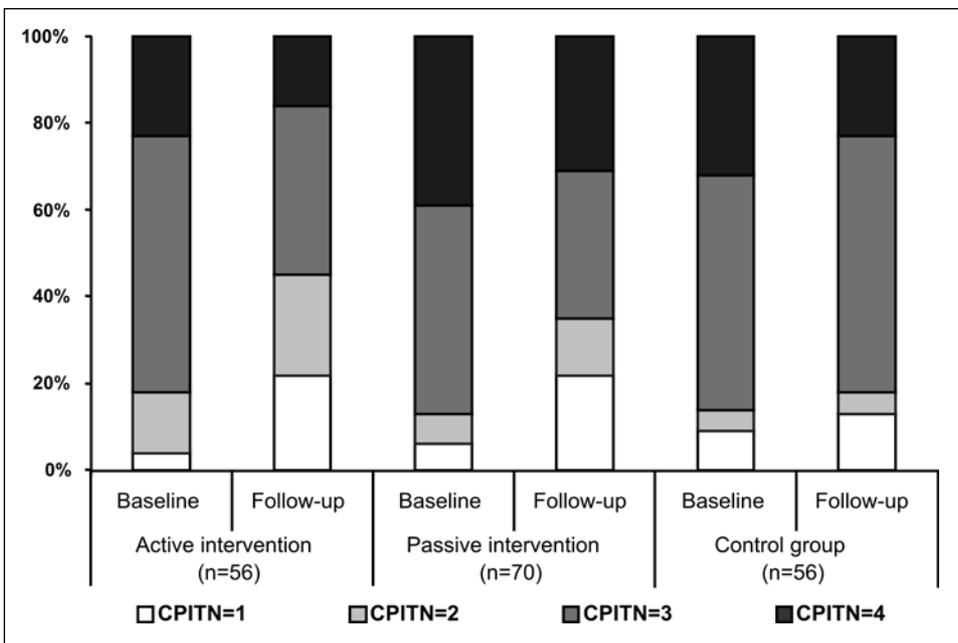
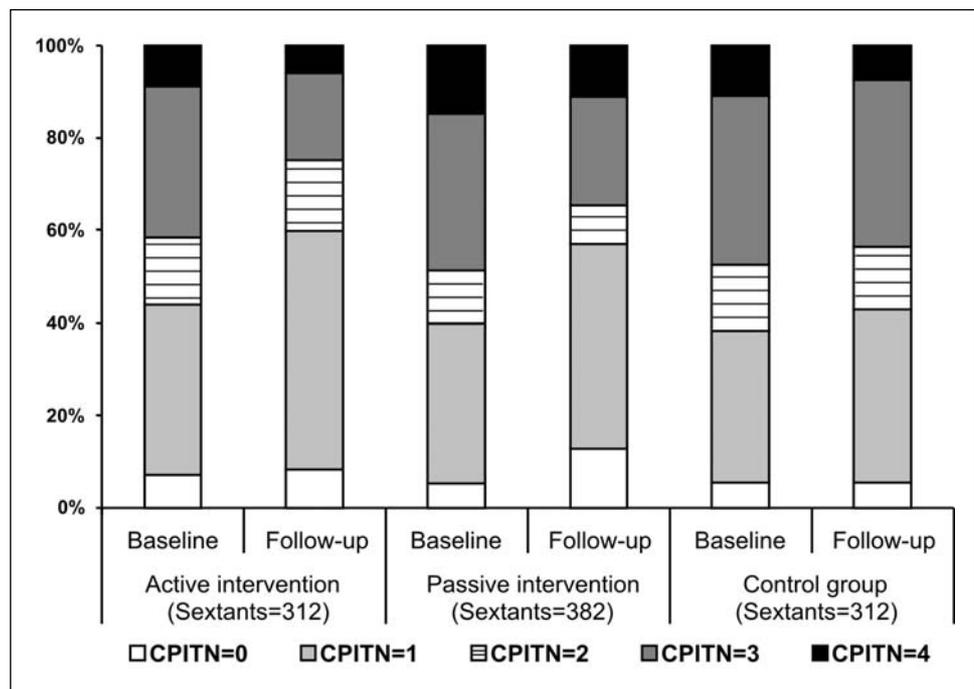


Figure 1. Distribution of the highest individual Community Periodontal Index of Treatment Need (CPITN) value among the study groups at baseline and at the follow-up examination.

Figure 2. Distribution of the Community Periodontal Index of Treatment Need (CPITN) value by sextant among the study groups at baseline and at the follow-up examination.



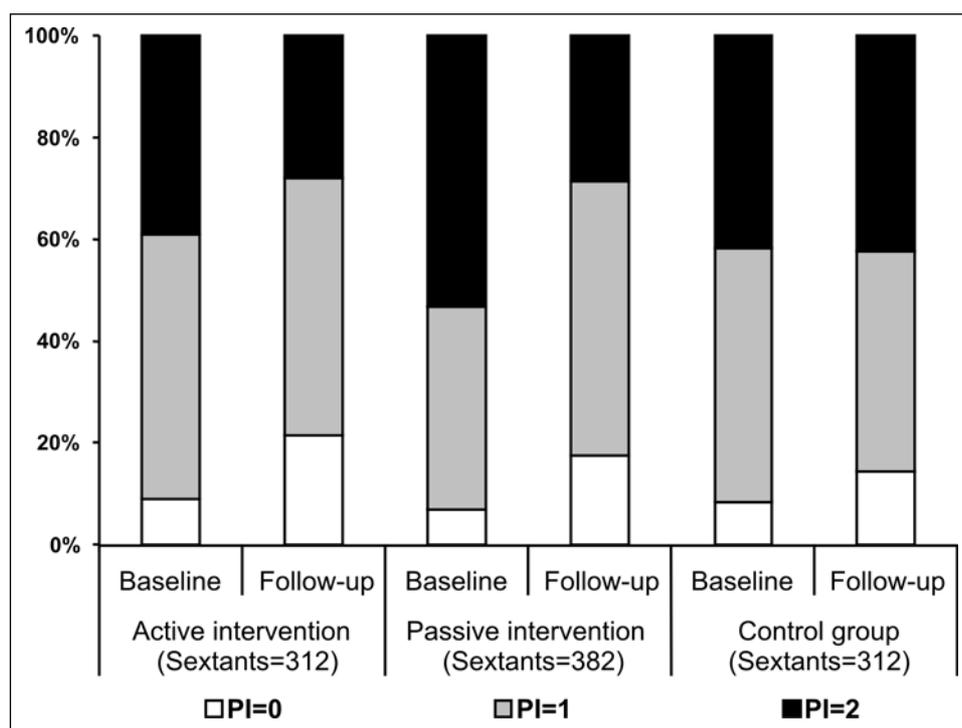


Figure 3. Distribution of the Plaque Index (PI) value by sextant among the study groups at baseline and at the follow-up examination.

intervention group, 24% in the passive intervention group, and 32% in the control group, with no statistically significant difference ($P=0.90$). Minor changes were found in twice-daily toothbrushing at the follow-up examination, the corresponding percentages being 38%, 30%, and 30%, respectively, with no statistically significant differences between the groups ($P=0.60$). At baseline, 47%, and at follow-up, 48% of all subjects reported interdental cleaning at least once daily with no difference between the groups ($P=0.669$).

Of all the subjects, 65% reported having had a dental visit during the previous year, a higher percentage than reported at baseline (47%, $P<0.001$). The number of those who reported having had a dental visit during the study period was similar in all study groups (active intervention group = 61%, passive intervention group = 70%, control group = 65%; $P=0.55$). As a reason for their dental visit, subjects in the active intervention group reported periodontal treatment more often (62%, $P=0.02$) than did those in the passive intervention group (48%) or control group (29%).

To show the impact of the factors on the reduction of periodontal treatment needs, separate logistic regression models were fitted to the data (Table 2). The passive intervention group with $OR=3.4$ appeared to be the strongest explanatory factor for the reduction in periodontal treatment needs in at least 50% of the sextants.

Discussion

Effective removal of dental plaque is essential for dental and periodontal health [22,23]. A review has suggested that in the majority of oral health promotion studies, a reduction in plaque and gingival bleeding was achieved [24]. A similar result was obtained in this study. Participation in the present study was on a voluntary basis, which may have resulted in the over-representation of subjects eager to learn about their health and more willing to change their health behaviour. Both intervention groups exhibited a clear reduction in plaque scores as well as in periodontal treatment needs. In multivariate analysis, the passive intervention appeared stronger than the active one. The lowest number of drop-outs in the passive intervention group suggests that the subjects in this group may be even more concerned with their health than are the subjects in the other study groups.

The observed improvement in periodontal treatment needs in the control group can, at least in part, be attributed to the trial effects. Exposing diabetics to a dentist's examination and a questionnaire can have positive effects on their self-care [25] and oral health [26].

In 1987, some 23 years ago, the CPITN, which has subsequently become CPI, was recommended for evaluation of the long-term results of preventive efforts [27]. The use of CPI has been recommended by the World Health Organisation (WHO) [2,28]

to increase the international uniformity of epidemiological studies in periodontology. However, both the CPITN and the CPI have their failings [29-31] and doubts have been raised about their reliability. Nevertheless, they are simple to use and, at the time that the current study was performed, the authors considered CPITN suitable for use in assessing change in the present community trial. Doubts about the reliability of using mean scores for indices such as CPITN have also been expressed. Nevertheless, advice from statisticians was that the approach was valid and an alternative analysis of the results using change in maximum CPITN scores by band clearly showed the improvements in the test groups in comparison with the control group. The questionnaire included information on the subjects' oral health behaviour such as their self-reported frequency of toothbrushing and the time and reason of their most recent dental visit.

However, as in any questionnaire study, a tendency to give favourable responses, also referred to as social desirability [32], may affect the respondents' answering. Thus, respondents' self-reported oral health behaviour may have been over estimated in the present study. The finding of low rates of recommended oral health behaviour at the baseline examination places even more emphasis on the necessity of an oral health promotion programme among adults with diabetes in Iran.

The answers to the questions of the questionnaire provide no direct information about how effectively the respondents cared for their teeth, but nevertheless offer some indication of their motivation towards oral health. Only minor changes in brushing frequency were observed in this study. However, the decrease in the overall PI scores could presumably be related to a change in brushing quality. The present findings emphasise the

Table 2. Outcomes of Two Different Interventions on Oral Self-Care Among Iranian Adults With Diabetes ($n=182$). A positive Outcome Was Defined as Improvement in CPITN Scores in at Least 50% of Sextants; Odds Ratios Were Estimated by Means of Logistic Regression Models Controlling for Diabetes-Related Factors and Subjects' Background

Models	Estimate of strength		Odds ratio (OR) and its 95% confidence interval		P
	Estimate	SE	OR	95% CI	
Model for active intervention					
Gender (0=Female, 1=Male)	0.384	0.513	1.5	0.5- 4.0	NS*
Age in years	0.002	0.032	1.0	0.9- 1.1	NS
Level of education	-0.112	0.255	0.9	0.5- 1.5	NS
Diabetic control (poor → good)	0.148	0.223	1.2	0.7- 1.8	NS
Duration of diabetes in years	0.077	0.036	1.1	1.0- 1.2	0.032
Complications (0=Yes, 1= No)	0.734	0.505	2.1	0.8- 5.6	NS
Group (0=Controls, 1=Active intervention)	0.799	0.481	2.2	0.9- 5.7	NS
Constant term	-3.591	2.457			
Goodness of fit: $P=0.476$					
Model for passive intervention					
Gender (0=Female, 1=Male)	0.864	0.494	2.4	0.9- 6.2	NS
Age in years	0.007	0.030	1.0	1.0- 1.1	NS
Level of education	0.012	0.258	1.0	0.6- 1.7	NS
Diabetic control (poor → good)	0.451	0.205	1.6	1.1- 2.3	0.028
Duration of diabetes in years	0.103	0.035	1.1	1.0- 1.2	0.003
Complications (0=Yes, 1=No)	0.723	0.482	2.1	0.8- 5.3	NS
Group (0=Controls, 1=Passive intervention)	1.231	0.466	3.4	1.4- 8.5	0.008
Constant term	-6.464	2.138			
Goodness of fit: $P=0.814$					

* NS = No statistical significance

importance of better patient guidance with regard to the qualitative aspects of oral hygiene at home. Illiteracy is one of the many problems and restrictions faced in countries with developing education systems when planning health education programmes. The illiterate subjects (n=15 at the baseline and n=10 at the follow-up examination) were given assistance in completing the questionnaire. The active intervention was superior to the passive intervention for illiterate as well as literate subjects.

Multiple studies have examined the role of improved oral hygiene in diabetes control, with some leading to positive [33-35] and others negative results [36,37]. To date, it is uncertain whether or not improvement in oral health improves glycaemic control. However, given the potential link between periodontal disease and diabetes, management of oral health and regular follow-up seem a reasonable approach in subjects with diabetes.

One study [18] concluded that there are some common determinants for both dental health behaviour and self-care of diabetes. In that study, the most common cause reported by diabetics for failure with their metabolic control was failure to follow the treatment instructions. This demonstrates that diabetics have assimilated the instructions given to them by health professionals and that adherence to the self-care regimen is an essential part of diabetic care. Because oral health and self-care is important for diabetics, combined instructions can be recommended to improve both oral and general health.

Frequent dental visits correlate with better periodontal health [38]. For diabetics, who are at risk for periodontal diseases, the importance of regular dental visits is indisputable [39,40]. In previous reports, the present subjects (among the 35- to 44-year-olds) showed at baseline better dental status [16] but worse periodontal health [15] than were found in the national data [41,42]. This may indicate insufficient professional dental care had been received and might call for greater emphasis

References

1. Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century: The approach of the WHO Global Oral Health Programme. *Community Dentistry and Oral Epidemiology* 2003; **31**: 3-23.
2. Petersen PE, Ogawa H. Strengthening the prevention of periodontal disease: the WHO approach. *Journal of Periodontology* 2005; **76**: 2187-2193.
3. Amos AF, McCarty DJ, Zimmet P. The rising global burden of diabetes and its complications: Estimates and projections to the year 2010. *Diabetic Medicine* 1997; **14** Suppl 5: S1-S85.

on undergraduate periodontal training and up-to-date continuing education.

Individuals with diabetes may be unaware of their increased risk for periodontal disease [43,44] and providing them with information is a fundamental factor in improving periodontal health. Therefore, for individuals with diabetes, the significance of good oral health should be emphasised just as with any other aspects of diabetic complications. Emphasising the importance of oral health and the relationship between diabetes and periodontal disease can be the key aspect for motivating diabetics to learn how to maintain good oral health. The common risk approach recognises that chronic non-communicable diseases such as obesity, heart disease, stroke, cancer, diabetes, mental illness and oral disease share a set of common risk conditions and factors [45]. In diabetes care, the common risk factor approach can be implemented to promote oral health as well as control the diabetic condition [26]. As recommended by the WHO, national health authorities should therefore ensure that the prevention of periodontal disease becomes an integral part of the prevention of diabetes and other chronic diseases, as well as of general health promotion [1].

Conclusions

The present study demonstrated that an educational intervention may be effective in improving the periodontal health of diabetics. Because the type of intervention used in the present study can also be executed by health care personnel other than oral health care professionals, it can especially be recommended for countries with a developing health care system.

Acknowledgements

The authors wish to thank all the diabetics for their participation, and Oral-B and Golpasand for providing the toothbrushes and toothpastes as a courtesy for the participants.

4. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004; **27**: 1047-1053.
5. Bacic M, Plancak D, Granic M. CPITN assessment of periodontal disease in diabetic patients. *Journal of Periodontology* 1988; **59**: 816-822.
6. Loe H. Periodontal disease. The sixth complication of diabetes mellitus. *Diabetes Care* 1993; **16**: 329-334.
7. Page RC, Beck JD. Risk assessment for periodontal diseases. *International Dental Journal* 1997; **47**: 61-87.

8. Sandberg GE, Sundberg HE, Fjellstrom CA, Wikblad KF. Type 2 diabetes and oral health: a comparison between diabetic and non-diabetic subjects. *Diabetes Research and Clinical Practice* 2000; **50**: 27-34.
9. Guneri P, Unlu F, Yesilbek B, Bayraktar F, Kokuludag A, Hekimgil M, et al. Vascular endothelial growth factor in gingival tissues and crevicular fluids of diabetic and healthy periodontal patients. *Journal of Periodontology* 2004; **75**: 91-97.
10. Katz PP, Wirthlin MR Jr, Szpunar SM, Selby JV, Sepe SJ, Showstack JA. Epidemiology and prevention of periodontal disease in individuals with diabetes. *Diabetes Care* 1991; **14**: 375-385.
11. Oliver RC, Tervonen T, Flynn DG, Keenan KM. Enzyme activity in crevicular fluid in relation to metabolic control of diabetes and other periodontal risk factors. *Journal of Periodontology* 1993; **64**: 358-362.
12. Sheiham A, Watt RG. Oral health promotion and policy. In: Murray JJ, Nunn JH, Steele JG, editors. *Prevention of Dental Disease*. 4th ed. Oxford: Oxford University Press; 2003: pp. 241-258.
13. Axelsson P, Lindhe J. Effect of controlled oral hygiene procedures on caries and periodontal disease in adults: results after 6 years. *Journal of Clinical Periodontology* 1981; **8**: 239-248.
14. Hugoson A, Lundgren D, Asklöv B, Borgklint G. Effect of three different dental health preventive programmes on young adult individuals: a randomized, blinded, parallel group, controlled evaluation of oral hygiene behaviour on plaque and gingivitis. *Journal of Clinical Periodontology* 2007; **34**: 407-415.
15. Bakhshandeh S, Murtomaa H, Vehkalahti MM, Mofid R, Suomalainen K. Periodontal treatment needs of diabetic adults. *Journal of Clinical Periodontology* 2007; **34**: 53-57.
16. Bakhshandeh S, Murtomaa H, Vehkalahti MM, Mofid R, Suomalainen K. Dental findings in diabetic adults. *Caries Research* 2008; **42**: 14-18.
17. Watt RG. Strategies and approaches in oral disease prevention and health promotion. *Bulletin of the World Health Organization* 2005; **83**: 711-718.
28. Knecht MC, Syrjälä AM, Knuutila ML. Attributions to dental and diabetes health outcomes. *Journal of Periodontology* 2000; **27**: 205-211.
19. Southerland JH, Taylor GW, Moss K, Beck JD, Offenbacher S. Commonality in chronic inflammatory diseases: periodontitis, diabetes, and coronary artery disease. *Periodontology* 2000; **40**: 130-143.
20. World Health Organization (WHO). *Community Periodontal Index of Treatment Needs; Development, Field-Testing and Statistical Evaluation*. Geneva: WHO Oral Health Unit; 1984.
21. Silness J, Loe H. Periodontal disease in pregnancy II. Correlation between oral hygiene and periodontal condition. *Acta Odontologica Scandinavica* 1964; **22**: 121-135.
22. Loe H. Oral hygiene in the prevention of caries and periodontal disease. *International Dental Journal* 2000; **50**: 129-139.
23. Albandar JM, Tinoco EMB. Global epidemiology of periodontal diseases in children and young persons. *Periodontology* 2000; **29**: 153-176.
24. Watt RG, Marinho VC. Does oral health promotion improve oral hygiene and gingival health? *Periodontology* 2000; **37**: 35-47.
25. Baranowski T, Allen DD, Masse LC, Wilson M. Does participation in an intervention affect responses on self-care questionnaires? *Health Education Research* 2006; **21**: 98-109.
26. Karikoski A, Ilanne-Parikka P, Murtomaa H. Oral health promotion among adults with diabetes in Finland. *Community Dentistry and Oral Epidemiology* 2003; **31**: 447-453.
27. Ainamo J, Tervonen T, Nordblad A, Kallio P. Use of CPITN-tabulations: a research perspective. *International Dental Journal* 1987; **37**: 173-178.
28. World Health Organization. *Oral Health Surveys: Basic Methods*. 4th ed. Geneva, Switzerland: WHO Library Cataloguing in Publication Data; 1997: pp. 36-38.
29. Pilot T, Barmes DE. An update on periodontal conditions in adults, measured by CPITN. *International Dental Journal* 1987; **37**: 169-172.
30. Baelum V, Papapanou PN. CPITN and the epidemiology of periodontal disease. *Community Dentistry and Oral Epidemiology* 1996; **24**: 367-368.
31. Leroy R, Eaton KA, Savage A. Methodological issues in epidemiological studies of periodontitis: How can it be improved? *BMC Oral Health* 2010; **10**: 8. doi: 10.1186/1472-6831-10-8.
32. Sjöström O. Validity of a questionnaire survey: response patterns in different subgroups and the effect of social desirability. *Acta Odontologica Scandinavica* 2002; **60**: 136-140.
33. Grossi SG, Skrepicinski FB, DeCaro T, Robertson DC, Ho AW, Dunford RG, et al. Treatment of periodontal disease in diabetics reduces glycated hemoglobin. *Journal of Periodontology* 1997; **68**: 713-719.
34. Stewart JE, Wager KA, Friedlander AH, Zadeh HH. The effect of periodontal treatment on glycemic control in patients with type 2 diabetes mellitus. *Journal of Clinical Periodontology* 2001; **28**: 306-310.
35. Rodrigues DC, Taba MJ, Novaes AB, Souza SL, Grisi MF. Effect of non-surgical periodontal therapy on glycemic control in patients with type 2 diabetes mellitus. *Journal of Periodontology* 2003; **74**: 1361-1367.
36. Promsudthi A, Pimapsri S, Deerochanawong C, Kanchanasavita W. The effect of periodontal therapy on uncontrolled type 2 diabetes mellitus in older subjects. *Oral Diseases* 2005; **11**: 293-298.
37. Jones JA, Miller DR, Wehler CJ, Rich SE, Krall-Kaye EA, McCoy LC, et al. Does periodontal care improve glycemic control? The Department of Veterans Affairs Dental Diabetes Study. *Journal of Clinical Periodontology* 2007; **34**: 46-52.
38. Lang WP, Ronis DL, Farghaly MM. Preventive behaviors as correlates of periodontal health status. *Journal of Public Health Dentistry* 1995; **55**: 10-17.
39. Moore PA, Weyant RJ, Mongelluzzo MB, Myers DE, Rossie K, Guggenheimer J, et al. Type 1 diabetes mellitus and oral health: assessment of periodontal disease. *Journal of Periodontology* 1999; **70**: 409-417.
40. Oliver RC, Tervonen T. Periodontitis and tooth loss: comparing diabetics with the general population. *Journal of the American Dental Association* 1993; **124**: 71-76.
41. Pakshir HR. Oral health in Iran. *International Dental Journal* 2004; **54**: 367-372.
42. Hessari H, Vehkalahti MM, Eghbal MJ, Murtomaa HT. Oral health among 35- to 44-year-old Iranians. *Medical Principles and Practice* 2007; **16**: 280-285.
43. Moore PA, Orchard T, Guggenheimer J, Weyant RJ. Diabetes and oral health promotion: a survey of disease prevention behaviors. *Journal of the American Dental Association* 2000; **131**: 1333-1341.
44. Sandberg GE, Sundberg HE, Wikblad KF. A controlled study of oral self-care and self-perceived oral health in type 2 diabetic patients. *Acta Odontologica Scandinavica* 2001; **59**: 28-33.
45. Sheiham A, Watt RG. The common risk factor approach: a rational basis for promoting oral health. *Community Dentistry and Oral Epidemiology* 2000; **28**: 399-406.