Oral Health Behaviors and Associated Factors in Patients with Diabetes

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博　士　論　文

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糖尿病患者の口腔保健行動の実態とその関連要因

平成 25 年 6 月 21 日

神戸大学大学院保健学研究科保健学専攻

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Oral Health Behaviors and Associated Factors in Patients with Diabetes

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Contents

Abstract

[Objective] This study assessed self-management of oral health behaviors and associated factors in patients with type 1 or type 2 diabetes.

[Methods] A total of 128 dentulous outpatients (71 males, 57 females) on drug therapy completed a questionnaire compiled from a pre-semi structured interview and the literature. Logistic regression analysis was used to determine factors associated with oral health behaviors, consist of oral hygiene behaviors and dental visits.

[Results] Oral health behaviors of patients were relatively better compared with the data from general survey. Logistic regression analysis showed that a positive perception of the relationship between diabetes and oral conditions (OR, 0.02), no occluding difficulties (OR, 0.06), efficacy of toothbrushing (OR, 0.06), no gingival swelling (OR, 13.51), perception of habits (OR, 0.07), and no diabetic retinopathy (OR, 9.23) were associated strongly with oral hygiene behaviors. No tooth movement (OR, 8.04), and injection therapy such as insulin or glucagon-like peptide-1 agonist (OR, 0.15) for diabetes therapy were associated strongly with dental visits.

[Conclusions] Factors promoting oral health behaviors included, good oral conditions, no diabetic retinopathy, self-care habits, and a positive perception of the " relationship between oral conditions and diabetes" and "efficacy of good dental habits for diabetes".

Key words : Oral health behaviors, Oral hygiene behaviors, Dental visits, Self-management, Diabetes

Introduction

The main aim of education for patients with diabetes (hereafter termed patients) is to motivate them to achieve their targets for diabetes control[1]. Self-management is therefore an important concept in diabetes care. Patients engage in the management of diet and exercise therapy, drug therapy, and general hygiene, required for diabetes care in the course of their daily lives. It is important that this management achieves the targets for diabetes treatment[2]. In other words, treatment objectives for diabetes are to ensure a life expectancy and maintain a good quality of life (QOL) that do not differ from those of healthy individuals. This is achieved by preventing the development and progression of diabetic complications and atherosclerotic disease[2].

There have been numerous reports on the care of patients with respect to matters such as diet and exercise, drug, and foot care. In particular, many initiatives have been reported that pertain to diet. One method of eating that has been reported to lead to improved blood glucose control is to "eat vegetables before carbohydrates, which may be beneficial in preventing postprandial hyperglycemia"[3]. Dealing with the stress associated with diet therapy is also an important issue from the perspective of QOL, with methods such as increasing the number of times food is chewed[4][5], and using the sense of taste[4] providing satisfaction[4] with meals and combating hunger[5]. Although this was not clearly stated in previous papers, the effective action of oral organs such as the teeth and tongue enable proper mastication, with the upper and lower teeth being essential for increasing vegetable intake and chewing a greater number of times. Needless to say, the teeth are important organs for eating.

The main cause of tooth loss is periodontal disease. Periodontal disease is the seventh complication of diabetes, with the two conditions having a two-way relationship[6]. Severe periodontitis increases the risk of cardiorenal mortality in patients with end-stage renal disease[7]. Maintaining oral hygiene and preserving good tooth and oral function not only helps to prevent the onset and progression of periodontal disease, but can also prevent arteriosclerotic disease caused by periodontal disease.

In light of these findings, maintaining oral conditions in as good a state as possible is important for implementation of diet therapy for diabetes, improving QOL, and preventing the development and progression of complications. In dentistry, both self-care and professional care are considered to be important for maintaining oral health. For patients, this means it is important to self-manage oral hygiene behaviors taking diabetes into account, and attend dental examinations for treatment of diabetic complications. Previous reports on diabetes and periodontal disease have addressed the following issues: the relationship between the severity of periodontal disease and blood glucose levels[8)-10)], changes in blood glucose levels associated with treatment of periodontal disease[11]; the relationships between blood glucose levels and factors such as toothbrushing frequency[12];use of tools such as fluoridated toothpaste and dental floss and, relationship with a family dentist and regular examinations[13]; awareness of the relationship between diabetes and periodontal disease and oral hygiene behaviors[14]; the external appearance of the gingiva and tongue and physical assessment of body sensations[15]; rate of use of oral care assistance during home-visit nursing[16]; and rate of use of oral care in diabetes education programs[17)18)]. However, to our knowledge no study has addressed self-management of oral health

behaviors as one aspect of a comprehensive understanding of care by patients in their everyday life. Patients must carry out a large number of actions to care for their diabetes. Rather than viewing oral health behaviors in isolation, it is important that patients are able to engage in self-management of oral health behaviors as one aspect of a comprehensive perspective of targets set for diabetes care.

The purpose of this study was to assess self-management of oral health behaviors and associated factors in patients with type 1 or type 2 diabetes, in order to identify and formulate recommendations for nursing support that would enable the adoption of more effective oral health behaviors.

Methods

1. Conceptual Framework

The study framework is presented in Fig.1. Self-management behaviors are required in the treatments of patients with diabetes and involve the need to manage incidents that may occur during daily life. Toobert et al.[19] classified self-management behaviors in diabetic treatment into those involving diet, exercise, self-monitoring of blood glucose (SMBG), medication management, foot care, and smoking cessation, and reported these as the Summary of Diabetes Self-Care Activities Measure (SDSCA). For the purposes of this study we added "hygiene behaviors" and subdivided the factors "foot care" and "oral health behaviors". In addition, when considering patient behaviors in the "health belief model[20]" or the "lay[21]" or "commonsense models[22]", it is known that patient perception[23] may influence behaviors. It is important to know the illness experiences of patients[21], and therefore original items regarding "perception factors" were created and added to the framework for the study. Accordingly, the research framework in

this study comprised “oral health behaviors” as a dependent variable and “demographic factors”, “oral factors”, “perception factors”, and “self-management behaviors” as independent variables influencing oral health behaviors.

2. Terminology and definitions

“Oral health behaviors for patients” were defined as individually performed self-management behaviors to prevent or delay the onset or progression of complications that accompany progression of diabetes, with a view to providing diabetic treatment. This also includes dealing with the interpretation of symptoms, signs, and objective data by focusing only on oral conditions as an individual physical organ, and also providing care based on diagnosis and interpretation of oral conditions by perceiving the diabetic body, or patient’s own body, holistically. Lower order concepts consisted of “oral hygiene behaviors” and “dental visits” (Fig. 1). Oral hygiene behavior is an aspect of physical maintenance involving individually practiced hygiene behaviors for the purpose of maintaining dental function, and is performed to maintain oral hygiene. Dental visits are for the purpose of obtaining safe and effective specialist care and treatment, while taking diabetic status into consideration.

3. Study participants and period of study

The participants included patients with type 1 or type 2 diabetes who were receiving treatment at the outpatient department of Hospital A. An informed consent form was used to explain the purpose of this study, with the participants providing written, informed consent prior to enrollment in the study. The study was carried out between August 1 and September 30, 2012.

4. Data gathering methods and contents of the investigation

1) Measurements

A structured questionnaire was used in this study. Patients were requested to provide their answers with regards to the usual, everyday conditions in their household. The patients selected the method for their response by choosing between either a self-recorded form or having a researcher read the question items aloud and dictate the answers. The average time required to complete the interview was 20 min per person. When the surveys were conducted at co-operating institutions, the time for medical examinations and investigations, as well as the waiting time for accounting processes were used to ensure the least possible burden for the trial participants. In addition, a separate space was used when conducting the interviews, with every effort made to maintain privacy, and the burden as a result of the physical condition being taken into consideration at all times. Consent was obtained from the participants to obtain information from their medical records including the type of diabetes, treatment methods, complications, and levels of hemoglobin A_{1c} (HbA_{1c}), among other.

2) Contents of investigation (Fig. 1)

The oral factors were created with reference to Standardized Adult Dental Examination Program and Health Guidance Manual (July 2009)[24] (Table 2).This manual was created with the intention of not only detecting oral diseases, but also ensuring to adopt appropriate health behaviors. Approval from the creators was obtained before use in this study.

Perception factors are important in order for patients to express a comprehensive understanding of their

disease for the purpose of controlling the disease. Through perception of the disease, an understanding of the goals of disease control, behaviors, and plans, and the scales for assessment of success and response effects can be created. To date, the choices in disease-coping plans have not been considered in patient education in which information is uniformly provided. Based on these ideas, interviews were conducted before the start of the study to determine how patients with diabetes perceived oral health behaviors. The questions were created based on the results of these interviews[25)] and review of previous literature (Table 3).

For diabetic self-management behaviors, consent was obtained for the use of the Japanese edition of SDSCA (J-SDSCA) developed by Daitoku et al.[26)], with its reliability and validity then being verified (Table 4). This scale has been used extensively worldwide as it conveniently assesses multiple self-management behaviors, irrespective of the type of diabetes [27-30)]. In this scale, scoring involved assigning one point per day to each day on which self-management behaviors were performed during the past 7 days. Therefore, a score between 0 and 7 points for 7 days was possible. Furthermore, analysis of items associated with SMBG and medications was performed depending on the background of the participants. Since Japanese health insurance system covers the cost of SMBG in diabetic patients treated with injection therapy such as insulin or glucagon-like peptide-1(GLP-1) agonist, diabetic patients treated with only oral hypoglycemic agents did not practice SMBG. It was also a reason why medication use was different. We checked the items of J-SDSCA, chose 16 items, and used them (Table 4).

Oral health behaviors were created by referring to the Survey of Dental Diseases[31)] conducted by Japanese Ministry of Health, Labour and Welfare, relevant literature, and previous clinical interviews of patients (Table 5). For dental visits, items were created independently on the basis of the interviews on oral care and diabetes conducted to date.

5. Methods of analysis

Data analysis was conducted using IBM SPSS statistics for Windows 19.0. The descriptive statistics used were mean, standard deviation, range, and percentage. Comparisons between oral health behaviors and demographic, oral and perception factors, and self-management behaviors were performed using chi square test, Fisher's exact test, or the Mann-Whitney U test**.** Multivariate logistic regression was used to determine factors associated with oral health behaviors. Statistical significance was set at $p < 0.05$.

6. Ethical Considerations

The aim of this study was to ensure that the patient did not incur any disadvantage from either doctors or nurses by not participating in the study. The patients were therefore not identified in the statistical analyses by the use of reference numbers, and they were able to unconditionally withdraw their participation at any time. This was explained to the patients verbally and in writing. Approval for the study was obtained from the hospital clinical research ethical review board at the University of Tokushima Clinical Trial Center for Developmental Therapeutics (23 July 2012, number 1470). All participants provided their written, informed consent prior to enrollment in the study.

Results

The patients were referred to the researchers by doctors or registered nurses at the participating research institutions. The research objectives were explained to the patients in a separate room. A total of 160 individuals gave consent to participate in the study and were given the questionnaire. A total of 157 patients (98.1%) completed the study. Of these, 128 patients stated they were dentulous and on drug therapy for diabetes. For their responses, 36 patients (28.1%) completed the questionnaire by themselves, 31 patients (24.2%) answered some of the questions themselves, while the researcher read the question items aloud and dictated the answers in the remaining 61 patients (47.7%).

1. Demographic and clinical characteristics

The demographic characteristics of the patients are shown in Table 1. Mean age was 55.6 yr (SD, 15.5 yr; range, 21-84 yr), and 67.2% of patients were on injections such as insulin or GLP-1 agonist. One-hundred patients (78.1%) reported physical subjective symptoms, while 117 patients (91.4%) were receiving treatment for diseases other than diabetes.

The oral condition of the patients is shown in Table 2. Data on current number of teeth showed that 96 patients (75%) had 20 or more teeth, and 31 patients (24.2%) were using dentures (mean, 64.6 yr; SD, 11.5 yr; range, 42-80 yr), including 19 males (61.3%) and 12 females (31.7%).

Knowledge of the relationship between diabetes and teeth was shown in 109 patients (85.2%). The perception of oral health behaviors are shown in Table 3. About 80% of patients agreed or slightly agreed with perceptions of brushing, whereas 63% of patients agreed or slightly agreed to being sensitive about

oral esthetics. One-half of patients did not agree or slightly agreed to eating anything after brushing their teeth. Regarding the perception of the relationships between diabetes and oral conditions, 89% of patients agreed or slightly agreed that teeth were part of the body, and 74% of patients agreed or slightly agreed that maintaining good oral health was effective in the treatment of diabetes.

Diabetes self-care activities are shown in Table 4. Diet-related behaviors were implemented on average more than 4 days a week, while exercise was completed about 2 days a week. In addition, there was a difference in foot care behaviors between washing feet (mean, 6.6; SD, 1.3) and inspecting the inside of shoes (mean, 2.1; SD, 2.9).

2. Oral health behaviors

Table 5 shows oral health behaviors. A total of 114 patients (91.9%) brushed their teeth every day, 10 patients (8.1%) sometimes, with no patient not brushing their teeth. A chi square test on data of "remaining teeth more than 20" revealed significant relationships between "toothbrushing carefully around the border between the teeth and gingiva" (p=0.007) and "brushing each tooth carefully to remove debris completely" (p=0.025). Overall, 78.9% of participants had a family dentist, and 47.6% received periodic dental examinations. When the patients visited their family dentists, 87 patients (76.3%) reported diabetes, 25 (21.9%) reported their physical condition, 40 patients (35.1%) reported their clinical data of HbA_{1c} and other blood chemistry, 50 (43.9%) reported drug therapy (use of injections or oral hypoglycemic agents), and 28 (32.2%) provided information regarding other concurrent disease.

3. Factors associated with oral health behaviors

The factors for oral hygiene behaviors (6 items) and dental visits (6 items) that showed relationship tendencies in the chi square and Mann-Whitney U tests were designated as independent variables.

1) Factors associated with oral health behaviors (Table 6)

(1) Regular brushing was associated strongly with daily toothbrushing (OR, 0.07; 95%CI, 0.01-0.66). "Not feeling sharp pain" or "washing feet" were also associated with the frequency of daily toothbrushing in descending order. (2) Brushing regularly, clinical diagnosis of type 1 diabetes, washing feet, and setting time aside specifically for exercise were also associated in descending order with the number of times the teeth were brushed daily. (3) Wanting to know about the relationship between diabetes and oral conditions was associated very strongly with “toothbrushing carefully around the border between the teeth and gingiva” (hereafter toothbrushing in marginal areas) (OR, 0.02; 95%CI, 0.002-0.17). Expecting a brushing effect (OR, 0.06; 95%CI, 0.01-0.41), no gingival swelling (OR, 13.51; 95%CI, 1.56-117.11), and no diabetic retinopathy (OR, 9.23; 95%CI, 1.57-54.16) were associated strongly with toothbrushing in marginal areas. Checking the feet was also associated with toothbrushing in marginal areas. (4) Occlusion by a natural molar tooth or wearing dentures was associated strongly with brushing each tooth carefully to remove debris completely (OR, 0.06; 95%CI, 0.01-0.29). Diabetic nephropathy and diabetic retinopathy were associated with brushing each tooth carefully to remove debris completely. (5) Diabetic retinopathy (OR, 3.86), no gingival bleeding (OR, 3.30), cleaning and drying toes and between toes (OR, 1.28), and lower BMI (OR, 0.90) were associated with using interdental brush or dental floss. (6) Perception of teeth as a part of the body (OR, 0.20), no diabetic retinopathy (OR, 3.94), and inspecting

the insides of shoes (OR, 1.24) were associated with checking teeth and gingiva in the mirror.

2) Factors associated with dental visits (Table 7)

(1) No tooth movement (OR, 8.04; 95%CI, 1.74-37.21) was related strongly to having a family dentist. Patients who did not feel tooth movement were more likely to have a family dentist than those who felt tooth movement. (2) Chewing well and eating slowly were associated with periodic dental examinations. (3) Injections (OR, 0.15) and following a healthful eating plan[19)] were associated with giving a dentist information about diabetes. (4) Diabetic nephropathy and chewing well and eating slowly were associated with giving a dentist information about medical treatment. (5) Being sensitive about oral esthetics and dyslipidemia were associated with giving a dentist information about physical conditions. (6) The perception that maintaining good oral health was effective in the treatment of diabetes was associated with giving a dentist information about clinical data of HbA_{1c} and other blood chemistry.

Discussion

Logistic regression analysis showed that wanting to know relationships between oral conditions and diabetes were associated strongly with oral hygiene behaviors, while no tooth movement and injection therapy were associated strongly with dental visits.

The frequency of toothbrushing every day in the patients was slightly lower at 91.9% compared with 95.5% reported in the 2011 Survey of Dental Diseases[31)]. Use of interdental cleaning tools such as dental floss or interdental brush (43.7%) was similar to the use of dental floss (16.4%) and interdental brush (25.8%) reported in the 2010 National Health and Nutrition Survey[32)] (age range, 50–59 years), and

there was also similar with the Japan Dental Association Model Project 2006–2008[24] (mean number of remaining teeth, 27.04; SD, 3.64) (44.4%). The figures for patients with a family dentist (78.9% vs. 61.1%) and those undergoing regular dental examinations (47.6% vs. 22.0%) were better than those reported in the model project. The awareness of patients to brush in marginal areas was higher than that of people without diabetes[33] (84.9% vs. 35%). These results suggested that the subjects were engaged in oral health behaviors. There are only a few surveys on the details of brushing in patients with diabetes. Further studies are needed to clarify the nursing interventions to toothbrush effectively.

To ensure that patients undergo safe, effective dental treatment, measures to deal with prolongation of wound healing[34] and susceptibility to infection[35] associated with hyperglycemia are important. Delayed meals due to dental treatment may also cause hypoglycemia, and detailed consideration is necessary on these issues. Providing the person doing the dental treatment with information on drugs, blood glucose level, and state of health at the time of treatment is therefore extremely important from the perspective of self-care. Although collaboration between medical and dental care has been the subject of considerable discussion, to our knowledge, no study has investigated the provision of information by patients, and therefore the present study is extremely significant. We found that many patients did not inform dentists of their physical conditions and results of examinations and drug therapy, until they developed advanced complications or started insulin injections. We also found that sufficient practical information on diabetes was not provided to dentists, and the quality of information provided by people with advanced-stage diabetes who were injecting insulin or had developed retinopathy was not adequate. The present findings

suggest that support is required to enable patients to understand what practical information must be provided to dentists in order to receive safe, effective treatment, as well as assisting with the timing and rationale of the treatment.

In this study, oral health behaviors were found to be associated strongly with an interest in the relationship between diabetes and oral conditions. These behaviors were probably affected by the strength of interest in the relationship between diabetes and oral conditions currently expressed by the patients, rather than generalized knowledge on oral conditions. In a previous qualitative study[25)], we examined patients' ideas on the practical effect of the relationship between diabetes and teeth in their daily life. This included factors such as concerns about the effect of diabetes on teeth and fears about the effect of the state of teeth on diabetes treatment. The results of the current study confirm the findings of this earlier study. Our finding of a strong association between oral hygiene behaviors and awareness on the efficacy of toothbrushing was also consistent with the results of previous studies on dental self-efficacy. Expressions of resignation, such as "I have bad teeth, so nothing can be done," were also reported in these earlier studies[25)]. These findings indicate that patients require support in order to view teeth as part of their body as a whole and to understand the efficacy of oral hygiene behaviors. Such recognition would result in the patients putting these actions into practice.

Oral hygiene behaviors were also associated with the development of the diabetic complications, nephropathy and retinopathy. In order to use interdental brush and dental floss inside the mouth, patients must be able to see clearly what they are doing. Age and the development of retinopathy associated with

progression of diabetes makes it more difficult to carry out and observe detailed tasks inside the mouth. In previous interview surveys, we investigated tactile perception, such as the teeth feeling rough when touched by the tongue, and the sensation of tasting blood in the mouth. As the mouth is one of the few parts of the body whose state can be observed visually, changes in visual information are significant as they can be understood immediately. However, only about 10% of patients in our study checked their teeth and gingiva in the mirror. It is possible that age and the progression of diabetes may make these tasks more difficult. When patients were asked in detail about their use of mirrors, in some cases they were looking into them from a distance whilst standing at a washbasin. Methods of support must therefore be devised to make it easier for patients to examine themselves, such as the use of a magnifying mirror close at hand, or the use of senses other than sight. The reason for such strategies is that studies have shown that periodontal disease becomes more severe with progression of diabetes, and that worsening of periodontal disease results in deterioration of diabetes. This emphasizes the importance of support for oral health behaviors in people with advanced diabetes and those with severe periodontal disease.

In terms of the association with diabetes self-management behaviors, foot care was related with oral hygiene behaviors. This confirmed that both the feet and teeth are objects of hygiene behaviors. It has been reported that although foot care is included enthusiastically during care instructions, advice on oral care is often insufficient. A synergistic effect could therefore be obtained by adding an explanation about teeth while patients are receiving foot care. In addition, dental visits were also associated with eating by chewing slowly, which is a basic aspect of diet therapy for diabetes. This finding is supported by the fact

that undergoing dental examinations and treatment is one aspect of self-management behavior that is coupled with other types of self-management behaviors. This suggests that health instructions may be more effective if they are provided in a linked manner.

Regarding suggestions for nursing, we consider that when nurses are providing information on the relationship between diabetes and oral conditions, an interest in the oral conditions with respect to its relationship with diabetes should be understood as a strength for self-management by patients. The explanations should also be given to make links with other diabetes self-management behaviors, such as foot care. This would enable the patients to imagine and implement practical behaviors in their everyday lives. In addition to providing support that enables patients to understand the importance of providing information on their diabetes to dental professionals and to carry out preventive behaviors, nurses also have an important role in coordinating patient-centered collaboration between medical and dental care.

As this study was carried out in an institution that includes an advanced dental center, there are limits to the generalizability of the findings. Future investigations with a larger number of participating institutions and patients are therefore required to examine the environmental factors affecting the results of the present study. It is also necessary to devise a scale capable of measuring oral health behaviors simply over a short period, and to verify its reliability and validity. This would be achieved by verifying the association between this scale and other self-management behaviors or conditions. These include HbA_{1c}, progression of complications, dental examinations for periodontal disease, and caries, to name a few. This would enable appropriate screening of patients who require support for oral health behaviors, provide

evidence-based information on oral health behaviors, and implement appropriate support. Ultimately this would lead to the development of an educational program including diabetes care behaviors, potentially contributing to an improvement in the state of oral health of patients with diabetes.

In conclusion, this study provides activity data on oral health behaviors. The results showed that positive perception of the relationship between oral conditions and diabetes, the efficacy of good dental habits for diabetes, good oral conditions, no diabetic retinopathy, and habits of self-care were factors promoting oral health behaviors. Further research is needed to design interventions on oral health related to diabetes and nursing intervention is required for patients with poor oral health and diabetic retinopathy.

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References

1) Japan Diabetes Society (Ed.). Treatment Guide for Diabetes 2012-2013. Tokyo,Bunkodo, pp.33. 2012 (in Japanese).

2) Japan Diabetes Society (Ed.). Treatment Guide for Diabetes 2012-2013. TokyoBunkodo, pp.24, 2012 (in Japanese).

3) ImaiMatsuda S, Fujimoto S, Miyatani S, et al. Crossover Study of the Effect of “Vegetables Before Carbohydrates” on Reducing Postprandial Glucose and Insulin in Japanese Subjects with Type 2 Diabetes Mellitus. J. Japan Diab. Soc.53(2):112-115, 2010 (in Japanese. Abstract in English).

4) Taru C, Yada M, Miyawaki I.The Development of a Dietary Self-management Behavior Questionnaire in Patients with Type 2 Diabetes. Journal of Japan Academy of Diabetes Education and Nursing 11(1):4-18, 2007 (in Japanese. Abstract in English).

5) Uchibori M, Inoue T. The Contrived Behavior in Daily Life of Maintaining Controlled Blood Sugar Levels with Diabetes Patients. Journal of Japan Academy of Diabetes Education and Nursing 10(2):141-149, 2006 (in Japanese).

6) Grossi SG, Genco RJ. Periodontal Disease and Diabetes Mellitus: A Two-Way Relationship. Ann Periodontal 3:51-61, 1998.

7) Preshaw PM, Alba AL, Herrera D, et al. Periodontitis and diabetes: a two-way relationship. Diabetologia. 55(1): 21-31, 2012.

8) Tervonen T, Karjalainen K. Periodontal disease related to diabetic status. A pilot study of the response to periodontal therapy in type 1 diabetes. J Clin Periodontol 24(7):505-10, 1997.

9) Firatli E. The relationship between clinical periodontal status and insulin-dependent diabetes mellitus. Results after 5 years. J Periodontol. 68(2):136-40, 1997.

10) Tsai C, Hayes C, Taylor GW. Glycemic control of type 2 diabetes and severe periodontal disease in the US adult population. Community Dent Oral Epidemiol . 30(3):182-192, 2002.

11) Rodrigues DC, Taba MJ, Novaes AB, et al. Effect of non-surgical periodontal therapy on glycemic control in patients with type 2 diabetes mellitus. J Periodontol 74(9):1361-1367, 2003.

12) Syrjälä AM, Niskanen MC, Knuuttila ML. The theory of reasoned action in describing tooth brushing, dental caries and diabetes adherence among diabetic patients. J Clin Periodontol 29(5):427-32, 2002.

13) Aggarwal A, R Panat S. Oral health behavior and HbA1c in Indian adults with type 2 diabetes. J Oral Sci 54(4):293-301, 2012.

14) Yuen HK, Wolf BJ, Bandyopadhyay D,et al. Oral health knowledge and behavior among adults with diabetes. Diabetes Res Clin Pract. 86(3):239-46, 2009.

15) Yoneda A. Development of a Body Sensation Care Model for Patients with Type2 Diabetes. Journal of Japan Academy of Diabetes Education and Nursing 7(2):96-106, 2003 (in Japanese. Abstruct in English).

16) Masaki H, Yamamoto N, Yamamoto-Mitani N, et al.Developing Quality Indicators for Diabetes Care in Geriatric Home Healthcare Nursing. Journal of Japan Academy of Diabetes Education and Nursing 12(2) : 136-144,2008 (in Japanese).

17) Shiramizu M, Sugimoto T, Mase Y, et al. Actual condition of diabetes education program for patients with type 2 diabetes in facilities to which certified nurse in diabetes nursing or certified nurse specialist in chronic care nursing belongs—Focusing on contents and methods of program—. Journal of Japan Academy of Diabetes Education and Nursing 15(2):179-187, 2012(in Japanese).

18) Yuen HK, Onicescu G, Hill EG, et al. A survey of oral health education provided by certified diabetes educators. Diabetes Res Clin Pract. 88(1):48-55, 2010.

19) Toobert DJ, Hampson SE, Glasgow RE. The Summary of Diabetes Self-Care Activities Measure Results from 7 studies and a revised scale, Diabetes Care 23:943–950, 2000.

20) Rosenstock IM.Historical Origins of the Health Belief Model. Health Education Monographs 2:328-335, 1974.

21) Redman BK, Patient Lay Models of Disease. (In) Redman BK, Advances in Patient Education, (Ed.) New York Springer Publishing Company, pp.24-30, 2004.

22) Leventhal H, Brissette I, Leventhal EA. The common-sense model of self-regulation of health and illness. (In) Cameron LD, Leventhal H, (Ed.) The Self-Regulation of Health and Illness Behavior. London: Rutledge, pp.42–65, 2003.

23) Broadbent E, Donkin L, Stroh, JC. Illness and treatment perceptions are associated with adherence to medications, diet, and exercise in diabetic patients. Diabetes Care 34: 338-340, 2011.

24) Japan dental association,www.jda.or.jp/program/main.pdf (in Japanese)

25) Kuwamura Y, Ichihara T, Minagawa T, et al. Perceptions of the relationships between diabetes and periodontitis: Part I about information (auther's translate), Journal of Japan Academy of Diabetes Education and Nursing 16 supplement:17,2012 (in Japanese).

26) Daitoku M, Honda I, Okumiya A, et al. Validity and Reliability of the Japanese Translated "The Summary of Diabetes Self—care Activities Measure". J. Japan Diab. Soc. 49: 1-9, 2006(in Japanese. Abstract in English).

27) Choi EJ, Nam M, Kim SH, et al. Psychometric properties of a Korean version of the summary of diabetes self-care activities measure. Int J Nurs Stud 48(3): 333-337,2011.

28) Vivienne W SF, Courtney M, Edwards H, et al. Development and validation of the Chinese version of the Diabetes Management Self-efficacy Scale. Int J Nurs Stud. 45(4): 534–542, 2008.

29) Kav S, Akman A, Dogan N, et al. Turkish validity and reliability of the summary of diabetes self-care activities measure for patients with type 2 diabetes mellitus. J Clin Nurs. 19: 2933–2935, 2010 .

30) Vincent D, McEwen MM, Pasvogel A. Th e validity and reliability of a Spanish version of the summary of diabetes self-care activities questionnaire. Nurs Res. 57(2) :101-106, 2008.

31) Ministry of Health, Labour and Welfare. the 2011 Survey of Dental Diseases conducted. http://www.mhlw.go.jp/toukei/list/62-23.html (in Japanese).

32) Ministry of Healthand WelfareLabour. the Results of the National Health and Nutrition Survey Japan, 2011. http://www.mhlw.go.jp/bunya/kenkou/eiyou/dl/h23-houkoku.pdf (in Japanese).

33) Haresaku S, Tsutsui A, Sakai K, et al. Relationships of Dental Factors for Behavior Change with the Effects of an Intervention Program in the Workplace and Consciousness of the Oral Health of Workers. Journal of the Dental Health 54: 122-131, 2004 (in Japanese. Abstract in English).

34) Markuson M, Hanson D, Anderson J, et al. The relationship between hemoglobin A(1c) values and healing time for lower extremity ulcers in individuals with diabetes. Adv Skin Wound Care. 22(8):365-72, 2009.

35) Joshi N, Caputo GM, Weitekamp MR, et al. Infections in patients with diabetes mellitus. N Engl J Med. 341: 1906–1912, 1999.

Figure legend

Fig. 1 The figure shows the mutual relationships between the various components of "self-management behaviors", and that there is a relationship between "oral health behaviors" and other "self-management behaviors" such as diet and exercise.

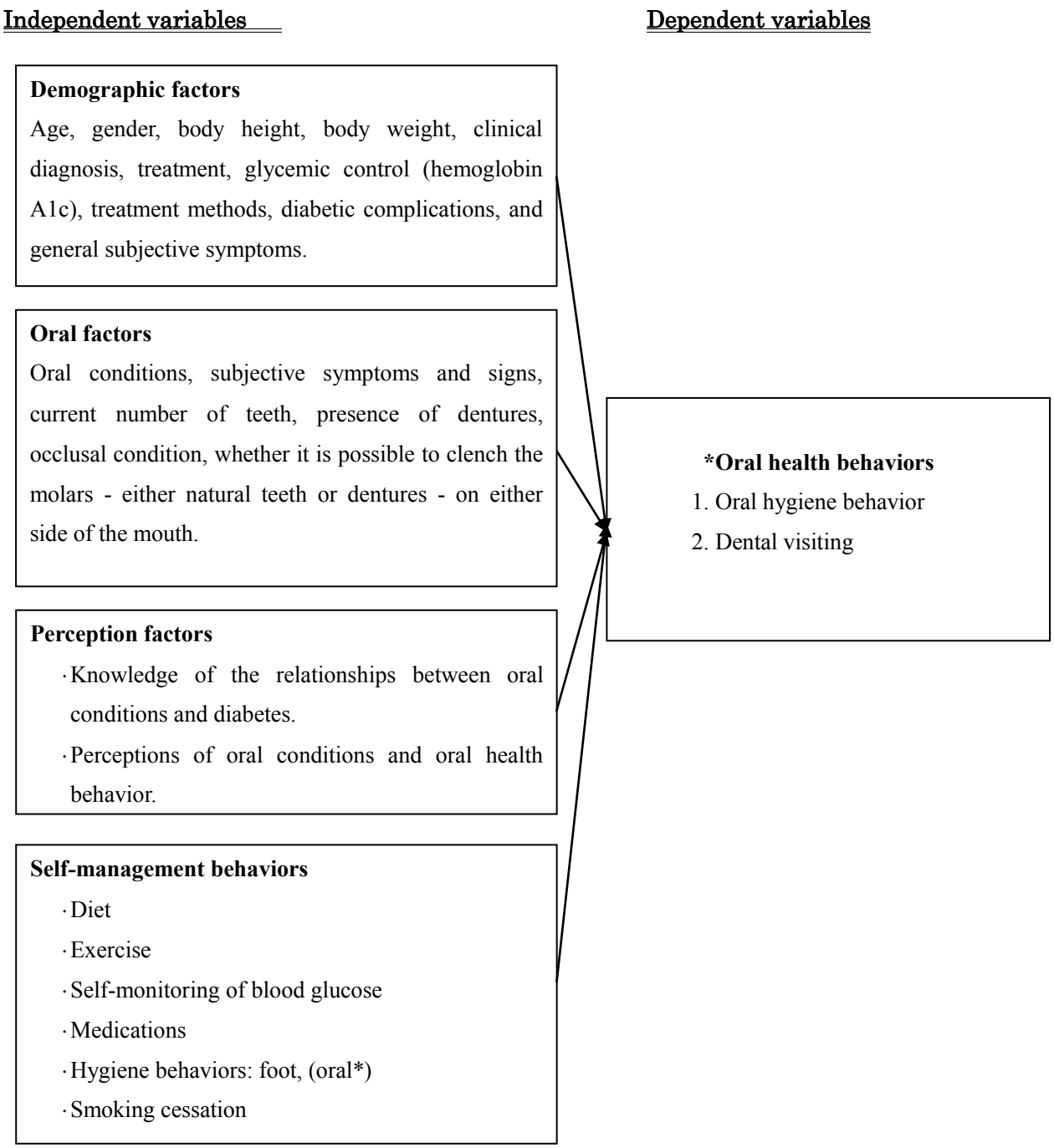

Fig. 1 Conceptual Framework of This Study

Table 1 Demographic and Clinical Characteristics

Items		n	Mean	±	SD	(Range)
Age (yr)		128	55.6	±	15.5	(21 - 84)
Body mass index (BMI) (kg/m^2)		128	25.1	±	5.2	(15.7 - 45.2)
HbA1c level (%)		126	7.1	±	1.2	(5.0 - 12.3)
Age at diagnosis (yr)		128	42.9	±	15.8	(4 - 76)
Duration of diabetes mellitus (yr)		128	12.8	±	10.0	(0 - 44)
Gender (n = 128)	Male[1*]	71	(55.5 %)			
	Female*	57	(44.5 %)			
Clinical diagnosis (n = 128)	Type 1 diabetes mellitus (T1DM)*	36	(28.1 %)			
	Type 2 diabetes mellitus (T2DM)*	92	(71.9 %)			
Therapy (n = 128)	Oral hypoglycemic agent*	42	(32.8 %)			
	Insulin or glucagon-like peptide-1 (GLP-1) agonist injection *	58	(45.3 %)			
	Combination therapy *	28	(21.9 %)			
General symptoms[2]	Thirst*	33	(26.0 %)			
	Polyuria*	31	(24.4 %)			
	Cramps in the calves*	29	(22.8 %)			
	Numbness of hands and feet*	35	(27.6 %)			
	Lassitude*	44	(34.6 %)			
	Poor vision*	56	(44.1 %)			
	Painful feet*	29	(22.8 %)			
	Diarrhea/constipation*	46	(36.2 %)			
	Impotence* (1)	12	(17.1 %)			
Complications[2]	Having complications*	117	(91.4 %)			
	Cerebral (brain) infarction*	10	(7.8 %)			
	Angina pectoris, myocardial infarction*	16	(12.5 %)			
	Diabetic nephropathy, other renal diseases*	49	(38.3 %)			
	Diabetic retinopathy, other ophthalmic diseases*	47	(36.7 %)			
	Dyslipidemia*	50	(39.1 %)			
	Diabetic neuropathy*	21	(16.4 %)			

SD: standard deviation; *: n (%); (1): calculated only for males; 2: multiple answers.

Table 2 Characteristics of Oral Conditions and Subjective Symptoms

(n = 128)

Items		n	(%)
Number of present teeth	<19	32	(25.0)
	≥20	96	(75.0)
Wearing dentures	Yes	31	(24.2)
Masticatory difficulty: occlusion by natural molar tooth (teeth) (or dentures) on right and left sides.	Can not occlude	14	(11.0)
	Can occlude right or left side/can occlude both sides	113	(89.0)
Eating way: Chewing well and eating slowly	Every day or sometimes	85	(66.9)
Gingival bleeding		32	(25.0)
Gingival swelling		15	(11.7)
Tooth movement		8	(6.3)
Feeling recession of the gums		26	(20.3)
Feeling something sticky in the mouth		39	(30.5)
Feeling a sharp pain when eating hot or cool food		25	(19.5)
Difficult mastication		23	(18.0)
Sensitive about oral appearance		17	(13.3)
Oral malodor		50	(39.1)
Toothache		5	(3.9)
Feeling difficulty when talking		11	(8.6)

Table 3 Perception of Oral Health Behaviors

Items			n	(%)
Perception of brushing	I want to avoid oral malodor (n = 127)	Agree/ Slightly agree	113	(89)
		Barely agree / No	14	(11)
	Teeth are important for eating food (n = 126)	Agree/ Slightly agree	110	(87)
		Barely agree / No	16	(13)
	I brush regularly (n = 126)	Agree/ Slightly agree	110	(87)
		Barely agree / No	16	(13)
	Brushing is comfortable (n = 125)	Agree/ Slightly agree	106	(85)
		Barely agree / No	19	(15)
	I would like to avoid toothache (n = 124)	Agree/ Slightly agree	90	(73)
		Barely agree / No	34	(27)
	I am sensitive about my oral esthetics (n = 126)	Agree/ Slightly agree	79	(63)
		Barely agree / No	47	(37)
	After brushing my teeth, I do not eat anything (n = 126)	Agree/ Slightly agree	63	(50)
		Barely agree / No	63	(50)
Perception of the relationships between diabetes and oral conditions	I want to know about the relationships between diabetes and oral conditions (n = 125)	Agree/ Slightly agree	105	(84)
		Barely agree / No	20	(16)
	I want to know how to brush my teeth and keep my mouth clean (n = 124)	Agree/ Slightly agree	99	(80)
		Barely agree / No	25	(20)
	Brushing is not expected to be effective (n = 124)	Agree/ Slightly agree	37	(30)
		Barely agree / No	87	(70)
	Teeth are part of the body, so there is a two-way relationship between the teeth and body (n = 126)	Agree/ Slightly agree	112	(89)
		Barely agree / No	14	(11)
	Because I have diabetes, I would like to maintain good oral health (n = 126)	Agree/ Slightly agree	102	(81)
		Barely agree / No	24	(19)
	Maintaining good oral health is effective in the treatment of diabetes (n = 126)	Agree/ Slightly agree	93	(74)
		Barely agree / No	33	(26)

Table 4 Diabetes Self-Care Activities

Items		n	Mean	SD	Min	Max
Diet	Following a healthful eating plan*	123	4.6	2.3	0	7
	Eating a lot of vegetables	124	4.5	2.3	0	7
	Avoiding eating high fat foods	128	4.7	1.5	0	7
	Distributing all food uniformly over 3 meals	125	4.1	2.5	0	7
Exercise	Managing more than 30 minutes of exercise	127	2.6	2.6	0	7
	Setting time aside specifically for exercise	127	2.8	2.7	0	7
Blood glucose monitoring	Blood glucose monitoring (※Patients treated with injection therapy such as insulin or glucagon-like peptide-1[GLP-1] agonist)	86	6.5	1.5	0	7
	Blood glucose monitoring in accordance with doctor's instructions (※Patients treated with injection therapy such as insulin or GLP-1 agonist)	85	5.8	2.1	0	7
Foot care	Carefully checking the feet *	127	3.3	3.1	0	7
	Inspecting the inside of shoes	126	2.1	2.9	0	7
	Washing the feet	127	6.6	1.3	0	7
	Cleaning and drying the toes and between the toes	127	4.0	3.1	0	7
Drug therapy	Taking the recommended number of oral hypoglycemic agent(OHA)* (※Patients taking OHA)	69	5.8	2.4	0	7
	Taking the recommended injections *(※Patients on injections)	84	7.0	.2	5	7
	Taking the recommended diabetes medication* (combination therapy)	125	6.2	2.1	0	7
		n		(%)		
Smoking (n = 126)	Every day	18		(14.3)		
	Sometimes	4		(3.2)		
	Never	104		(82.5)		

*; English expressions of the questions in the SDSCA[19] were used in this study.

Table 5 Oral Health Behaviors: Oral Hygiene Behaviors and Dental Visits

Items			n	%
Oral hygiene behaviors	Toothbrushing frequency (n = 124)	No	0	(0)
		Sometimes	10	(8.1)
		Every day	114	(91.9)
	Toothbrushing times per day (n = 127)	Once	40	(31.5)
		Twice	56	(44.1)
		≥3	31	(24.4)
	Toothbrushing carefully around the border between the teeth and gingiva (n = 126)	No	19	(15.1)
		Sometimes	41	(32.5)
		every day	66	(52.4)
	Brushing each tooth carefully to remove debris completely (n = 126)	No	40	(31.7)
		Sometimes	35	(27.8)
		every day	51	(40.5)
	Using interdental brush or dental floss (n = 126)	No	71	(56.3)
		Sometimes	36	(28.6)
		Every day	19	(15.1)
	Checking teeth and gingiva in the mirror (n = 126)	No	49	(38.9)
		Sometimes	63	(50.0)
		Every day	14	(11.1)
Dental visits	Having a family dentist (n = 128)		101	(78.9)
	Periodic dental examinations (at least once a year) (n = 126)		60	(47.6)
	Giving a dentist information about diabetes (n = 114)		87	(76.3)
	Giving a dentist information about physical conditions (n = 114)		25	(21.9)
	Giving a dentist information about clinical data of HbA_{1c} and other blood chemistry(n = 114)		40	(35.1)
	Giving a dentist information about medical treatment (n = 114)		50	(43.9)
	Giving a dentist information about another disease. (Note: patients having any other disease) (n = 87)		28	(32.2)

Table 6 Logistic Regression Model for Oral Hygiene Behavior

Dependent variable	n	Independent variable	p	OR	95%CI	
(1) Toothbrushing frequency. (0: sometimes, 1: every day)*	124	I brush regularly (0: Yes, 1: No)*	.020	.07	.01	.66
		Feeling sharp pain when I eat hot or cool food (0: Yes, 1: No)*	.040	8.55	1.10	66.20
		Foot care (washing)	.024	1.83	1.08	3.11
		Age	.027	1.07	1.01	1.14
		Gender (0: female, 1: male)*	.189	.17	.01	2.43
(2) Toothbrushing times per day. (0: once, 1: >1 time)*	125	I brush regularly (0: Yes, 1: No)*	.005	.13	.03	.55
		Clinical diagnosis (0: T2DM, 1: T1DM)*	.032	4.61	1.14	18.67
		Foot care (washing)	.008	1.63	1.14	2.33
		Setting time aside specifically for exercise	.009	1.30	1.07	1.59
		Age	.613	.99	.96	1.03
		Gender (0: female, 1: male)*	.031	.31	.11	.90
(3) Toothbrushing carefully around the border between the teeth and gingiva. (0: No,1: sometimes/every day)*	119	I want to know about relationships between diabetes and oral conditions (0: Yes, 1: No)*	.000	.02	.002	.17
		Brushing is not expected to be effective. (0: effective, 1: uneffective)*	.004	.06	.01	.41
		Swelling of gingiva (0: Yes, 1: No)*	.018	13.51	1.56	117.11
		Diabetic retinopathy, other ophthalmic disease (0: Yes, 1: No)*	.014	9.23	1.57	54.16
		Foot care (checking the feet)*	.005	1.54	1.14	2.08
		Age	.489	1.02	.97	1.06
		Gender (0: female, 1: male)*	.016	.10	.02	.65
(4) Brushing each tooth carefully to remove debris completely. (0: No,1: sometimes/every day)*	113	Occluding by natural molar tooth or dentures (0: Yes, 1: No)*	.001	.06	.01	.29
		Diabetic nephropathy, other renal diseases (0: Yes,1 : No)*	.033	2.91	1.09	7.79
		Diabetic retinopathy, other ophthalmic diseases (0: Yes,1 : No)*	.043	2.79	1.03	7.55
		Age	.021	1.04	1.01	1.08
		Gender (0: female, 1: male)*	.016	.28	.10	.79
(5) Using interdental brush or dental floss. (0: No,1: sometimes/every day)*	126	Diabetic retinopathy, other ophthalmic disease (0: Yes, 1: No)*	.003	3.86	1.57	9.49
		Gingival bleeding (0: Yes, 1: No)*	.024	3.30	1.17	9.30
		Foot Care (Cleaning and drying the toes and between the toes)	.001	1.28	1.11	1.48
		BMI	.014	.90	.82	.98
		Age	.443	1.01	.98	1.04
		Gender (0: female, 1: male)*	.152	.53	.22	1.27
(6) Checking teeth and gingiva in the mirror. (0: No,1: sometimes/every day)*	123	Teeth are part of the body, so there is a two-way relationship between the teeth and body (0: Yes, 1: No)*	.034	.20	.04	.88
		Diabetic retinopathy, other ophthalmic diseases (0: Yes, 1: No)*	.003	3.94	1.59	9.79
		Foot care (inspecting the inside of shoes)	.011	1.24	1.05	1.46
		Age	.451	1.01	.98	1.04
		Gender (0: female, 1: male)*	.011	.31	.13	.76

Multiple logistic regression analysis (backward elimination method: likelihood ratio).
* dummy variable; OR, odds ratio; 95%CI, 95% confidence interval. Age and gender forced to enter the model.

Table 7 Logistic Regression Model for Dental Visits

Dependent variable	n	Independent variable	p	OR	95%CI	
(1) Having a family dentist (0: No, 1: Yes)*	128	Tooth movement (0: Yes, 1: No)*	.008	8.04	1.74	37.21
		Age	.093	1.03	1.00	1.06
		Gender (0: female, 1: male)*	.663	.82	.33	2.03
(2) Periodic dental examinations (0: No, 1: Yes)*	125	Chewing well and eating slowly (0: Yes, 1: No)*	.037	.43	.19	.95
		Age	.043	1.03	1.00	1.05
		Gender (0: female, 1: male)*	.314	.68	.32	1.45
(3) Giving a dentist information about DM. (0: No, 1: Yes)*	113	Injection therapy such as insulin or glucagon-like peptide-1 agonist (0: Yes, 1: No)*	.003	.15	.04	.51
		Following a healthy eating plan	.033	1.28	1.02	1.60
		Age	.040	1.04	1.00	1.08
		Gender (0: female, 1: male)*	.409	.63	.21	1.87
(4) Giving a dentist information about medical treatment. (0:No, 1:Yes)*	113	Diabetic nephropathy, other renal diseases (0: Yes, 1: No)*	.006	.31	.13	.71
		Chewing well and eating slowly (0: Yes, 1: No)*	.011	.31	.13	.76
		Age	.219	1.02	.99	1.04
		Gender (0: female, 1: male)*	.272	.62	.27	1.45
(5) Giving a dentist information about physical conditions. (0: No, 1: Yes)*	112	I am sensitive about my oral esthetics (0: Yes, 1: No)*	.008	4.34	1.47	12.78
		Dyslipidemia (0: Yes, 1: No)*	.013	.28	.10	.77
		Age	.683	1.01	.97	1.04
		Gender (0: female, 1: male)*	.038	.32	.11	.94
(6) Giving a dentist information about blood test results. (0: No, 1: Yes)*	112	Maintaining good oral health is effective in the treatment of diabetes (0: Yes, 1: No)*	.015	.24	.07	.75
		Age	.223	1.02	.99	1.05
		Gender (0: female, 1: male)*	.392	.69	.30	1.60

Multiple logistic regression analysis (backward elimination method: likelihood ratio).
*: dummy variable; OR: odds ratio; 95%CI: 95% confidence interval. Age and gender forced to enter the model.