ORIGINAL ARTICLE

Evaluation of the Diabetes Regional Coordination Path using the Diabetes Coordination Notebook in community-based diabetes care

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Abstract

Aims A number of epidemiologic surveys have demonstrated that improving lifestyle habits, providing patient education, and regular screening of patients for early diabetic symptoms and complications through multidisciplinary collaboration are crucial for the management of diabetes.

Methods To evaluate the Diabetes Coordination Notebook and the Diabetes Regional Coordination Path in management of diabetes, 217 community pharmacies conducted a survey by questionnaire in Gifu Prefecture, Japan.

Results A reply to the questionnaire was obtained from 27,016 individuals, of whom 5,572 claimed to have diabetes or prediabetes. The rate of usage of the Diabetes Coordination Notebook and the Diabetes Regional Coordination Path was 40% and 7%, respectively. Interestingly, patients using the Diabetes Regional Coordination Path more frequently visited an ophthalmic clinic ($p < 0.001$) and a dental clinic ($p < 0.05$) than those not using it. Furthermore, multivariate logistic regression analysis revealed that use of the Diabetes Regional Coordination Path was the only factor associated with control of HbA1c $< 7.0\%$ (OR: 0.613, 95% CI: 0.395–0.951, $p = 0.029$).

Conclusions The usage of the Diabetes Regional Coordination Path together with the Diabetes Coordination Notebook is associated not only with regular visits to both an ophthalmic clinic and a dental clinic but also with the maintenance of appropriate HbA1c.

Keyword Questionnaire · Diabetes Coordination Notebook · Retinopathy · Periodontal disease · Diabetes Regional Coordination Path · Diabetic Eye Notebook

Introduction

The population of people with diabetes and prediabetes is a major public health problem worldwide [1]. The World health organization estimates that 422 million adults in the world are affected with diabetes mellitus and that its prevalence has doubled to 8.5% in three decades, largely due to increasing overweight and obesity [2]. Diabetes is a chronic and progressive disease characterized by elevated blood glucose. A prolonged state of high blood glucose is associated with various complications including retinopathy, nephropathy, neuropathy and macroangiopathy [1, 2]. The symptoms associated with diabetes mellitus significantly impair a patient's quality of life (QOL) and cause life-threatening events as well as the attendant medical expenses [3–8]. Thus, the main objective of management of diabetes is prevention

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of the development and progression of these complications and maintenance of the patient's QOL and life expectancy.

A number of epidemiologic surveys have demonstrated that favorable control of blood glucose delays onset and progression of early-stage diabetic complications [9–14]. Furthermore, control of body weight by improving lifestyle habits [15, 16], providing patient education [17, 18], and regular screening of patients for early diabetic symptoms and complications [19–22] are crucial, as is pharmacotherapy employing several anti-diabetes drugs. These findings suggest that usage of the Diabetes Regional Coordination path together with the Diabetes Coordination Notebook fulfills an unmet need [17, 18].

The Diabetes Coordination Notebook, which is published by the Japanese Association for Diabetes Education and Care (JADEC) [23], has prevailed as the most useful tool for recording laboratory data, treatment choices, and findings regarding diabetes complications in Japan. We recently developed the Diabetes Regional Coordination Path utilizing collaboration of diabetes specialists and family doctors to be used in conjunction with the Diabetes Coordination Notebook mentioned above, and implemented this for multidisciplinary collaboration in 2008 in Gifu prefecture, in central Japan. In the present study, we evaluated the Diabetes Coordination Notebook and the Diabetes Regional Coordination Path in management of diabetes by a survey conducted by 217 community pharmacies by questionnaire.

Materials and methods

Diabetes Coordination Notebook

The Diabetes Coordination Notebook published by the JADEC [23] comprises laboratory data, prescriptions and treatments, clinical findings regarding diabetic complications, and was originally used for patient self-management and as a tool for the coordination of healthcare providers such as family physicians, diabetes specialists, dentists, ophthalmologists, nurses, dieticians, pharmacists, clinical laboratory technicians, physical therapists, care managers, and other healthcare professionals.

Questionnaire

The questionnaire consists of the following 16 items: Question 1: "Have you ever answered this questionnaire before?", Question 2: "Have you been diagnosed with diabetes or prediabetes?", Question 3: "Have you ever received diabetes education in a hospital?", Question 4: "How long have you seen a doctor regularly?", Question 5: "What is your most recent HbA1c level?", Question 6: "Where have you seen a doctor?", Question 7: "Have you been diagnosed with diabetic retinopathy?", Question 8: "Do you receive periodical ophthalmologic examinations?, "Question 9: "Have you been diagnosed with periodontal disease?", Question 10: "Do you receive periodical dental examinations?", Question 11: "Have you ever been instructed regarding use of the Diabetes Coordination Notebook?", Question 12: Do you presently use the Diabetes Coordination Notebook or Diabetic Eye Notebook?", Question 13: "If so, how do you use the Diabetes Coordination Notebook and/or the Diabetic Eye Notebook?", Question 14: "Have you ever been instructed regarding use of the Diabetes Regional Coordination Path?", Question 15: "What is your age?", Question 16: "What is your sex?".

Questionnaire survey

This study is a cross-sectional study. We first asked 959 community pharmacies in a wide area of Gifu prefecture to conduct the survey; 217 pharmacies, 22.6%, not located in a special area, agreed to do it. Thus, the survey was conducted in 217 of 962 community pharmacies during 2 weeks between June 13th 2016 and June 25th 2016. The questionnaire was collected from 27,016 individuals who visited these community pharmacies during the study period; 5,722 individuals had prediabetes or diabetes. Persons who replied yes to question 1 were excluded from the present study.

Diabetes Regional Coordination Path in Gifu prefecture

The Diabetes Regional Coordination Path was developed by Gifu University Hospital, Gifu Prefecture Medical Association and Gifu City Medical Association for community-based management of diabetes collaboration with patients, diabetes specialists and family doctors. This program was introduced to outpatients who visited clinics in Gifu prefecture, and was begun in 2008. The Diabetes Regional Coordination Path is a paper and pencil record consisting of the examination schedule sheet (Fig. 1a) and the management evaluation sheet (Fig. 1b). These sheets are attached to the Diabetes Coordination Notebook. This record comprises three parts that include basic demographic information related to diabetes such as body weight, abdominal girth, blood pressure, urine examination, blood glucose level, HbA1c, general biochemical examinations, serum C-peptide immunoreactivity (CPR), creatine kinase (CK), chest X-ray and electrocardiogram, data associated with diabetes complications such as microalbuminuria, cervical ultrasonography, funduscopy data and periodontal examination, and various other items such as nutrition assessment and patient referral documents (Fig. 1a, b). The form was checked by family doctors every month and by diabetes specialists every 6 months. The target values were set with

a

Regstration date : Year / Month / day		Start time	1 M	2 M	3 M	4 M	5 M	6 M	7 M	8 M	9 M	10 M	11 M	12 M
Year / Month		/	/	/	/	/	/	/	/	/	/	/	/	/
Basic	Exam, Weight	●	○	○	○	○	○	●	○	○	○	○	○	●
	Abdominal girth (every 6 months)						○						○	
	Blood-pressure measurement	●	○	○	○	○	○	●	○	○	○	○	○	●
	Urinalysis	●	○	○	○	○	○	●	○	○	○	○	○	●
	Blood glucose level (fasting or postprandial), HbA1c	●	○	○	○	○	○	●	○	○	○	○	○	●
	General biochemical examination	●	○	(○)	○	(○)	(○)	●	(○)	(○)	○	(○)	(○)	●
	Others: s-CPR, CK	●						●						●
	Chest X-ray, Electrocardiogram	●											○	
Diabetes complications	Microalbuminuria	●			(○)			(●)			(○)			(●)
	Cervical ultrasonic echo							(○)						(● ○)
	Other diagnostic imaging	●						(●)						●
	Fundoscopy by an ophthalmologist	●						(○)						○
	Periodontal disease checkup by a dentist	●						(○)						(○)
Others	Nutrition assessment	●			(○)			●			(○)			●
	Evaluation sheet	●						●						●
	Referral document	●				○		●					○	●

b

	Discharge time	Start point	( ) month later	Assessment by diabetes specialist		( ) month later	Assessment by diabetes specialist
	Year / Month / day	Goal	Reservation (/)		Goal	Reservation (/)	
Outcome		Continuous treatment Good glycemic control			Continuous treatment Good glycemic control		
Weight	measured value	target value	measured value		target value	measured value	
Blood glucose level	measured value	target value	measured value		target value	measured value	
HbA1c	measured value	target value	measured value		target value	measured value	

Assessment (on four-point scale): 1. Goal achievement, 2. Improvement, 3. No improvement, 4. Worse

Fig. 1 The examination schedule sheet (**a**) and the management evaluation sheet (**b**) of the paper-based Diabetes Regional Coordination Path. These are attached on the Diabetes Coordination Notebook. ○ checked by family doctors, ● checked by diabetes specialists

patient consent and evaluated every 6 months by a diabetes specialist. In addition, basic patient education regarding the pathophysiology of diabetes, nutritional guidance, drug administration guidance and exercise guidance was carried out every 6 months by healthcare providers such as diabetes specialists, nurses, pharmacists, nutritionists and other staff from the base hospital. The Diabetes Coordination Notebook and the Diabetes Regional Coordination Path were provided to patients by family physicians or diabetes specialists voluntarily.

Statistical analysis

Data were analyzed using IBM SPSS Statistics ver. 22 (IBM Japan Services Co., Ltd., Tokyo, Japan). Parametric variables were statistically compared by t test; nonparametric data were analyzed by the Mann–Whitney U test. Risk analyses were carried out by multivariate logistic regression analysis. Possible risk factors in multiple logistic regression analysis were identified by comparison of patient demographics by factor analysis, and items for which the p value was ≤ 0.300 were subsequently tested in logistic regression analysis.

Ethics statement

This study was carried out in accordance with the guidelines for human studies outlined by the Ethics Committee of the Gifu University Graduate School of Medicine (Institutional Review Board Approval No. 27-535, date of approval: March 16th, 2016), and ratified by the Ethics Committee of the Gifu Medical Association (Date of ratification: March 17th, 2016). All eligible patients gave written, informed consent prior to responding to the questionnaire.

Results

Demographics of patients with diabetes or prediabetes who replied to the questionnaire

The reply to the questionnaire was collected from 27,016 individuals, of whom 5,572 (21.1%) claimed to have diabetes or prediabetes. The demographics of these persons are shown in Table 1. Eighty and one-tenths percent of these individuals were over 60 years of age, 79.1% had not received diabetes education in a hospital, and 53.2% had more than a 5-year history of therapy for diabetes. The rate of regular visits to an ophthalmic clinic was 48.7% (2,712 patients) and the rate of patients with diabetic retinopathy was 9.4% (522 patients). The rate of regular visits to a dental clinic was 38.8% (2,161 patients) and the rate of patients with periodontal disease was 25.4% (1,419 patients). The percentage of use of the Diabetes Coordination Notebook and the Diabetic Eye Notebook were 40.6% (2,260) and 14.4% (803) individuals, respectively. The percentage of individuals using the Diabetes Regional Coordination Path was 7.1% (397).

Comparison of responses of individuals using and not using the Diabetes Coordination Notebook and those using the Diabetes Regional Coordination Path

As shown in Fig. 2a, individuals using the Diabetes Coordination Notebook showed a significantly higher rate of regular visits to an ophthalmic clinic ($p < 0.001$) but not to a dental clinic, period of diabetic therapy ($\geqq 5$ years) ($p < 0.001$), instruction regarding the Diabetes Coordination Notebook ($p < 0.001$), usage of the Diabetes Regional Coordination Path ($p < 0.001$), prevalence of retinopathy ($p < 0.001$) or diabetes education in a hospital ($p < 0.001$) in comparison with those not using the Diabetes Coordination Notebook. Patients using the Diabetes Regional Coordination Path showed a significantly higher rate of regular visits to both the ophthalmic clinic ($p < 0.001$) and the dental clinic ($p < 0.05$), period of diabetic therapy ($\geqq 5$ years) ($p < 0.001$), instruction regarding use of the Diabetes Coordination Notebook ($p < 0.001$), prevalence of retinopathy ($p < 0.001$), prevalence of periodontal disease ($p < 0.05$) and receipt of diabetes education in a hospital ($p < 0.001$) (Fig. 2B).

Risk factors for absence of regular visits to an ophthalmic and/or a dental clinic

We analyzed risk factors for the absence of regular visits to the ophthalmic and/or dental clinic by multivariate logistic regression analysis. As shown in Table 2a, logistic regression analyses indicated that there are several factors associated with regular visits to an ophthalmic clinic: receiving diabetes education in a hospital (OR = 0.579, 95% CI 0.484–0.693; $p < 0.001$), diabetes therapy for 5 years or more (OR = 0.479, 95% CI 0.412–0.557; $p < 0.001$), presently attending a hospital or clinic (hospital) (OR = 0.796, 95% CI 0.690–0.918; $p = 0.002$), regular visits to a dental clinic (OR = 0.365, 95% CI 0.316–0.422; $p < 0.001$) and use of the Diabetes Coordination Notebook(OR = 0.584, 95% CI 0.505–0.675; $p < 0.001$).

On the other hand, logistic regression analyses for the absence of regular visits to a dental clinic indicated that two factors are associated with regular visits to a dental clinic: regular visits to an ophthalmic clinic (OR = 0.370, 95% CI 0.320–0.427; $p < 0.001$) and usage of the Diabetes Regional Coordination Path (OR = 0.765, 95% CI 0.588–0.996; $p = 0.046$) (Table 2b).

Risk factors for the lack of control of HbA1c < 7.0%

Risks for glucose control HbA1c > 7.0% (53 mmol/mol) were analyzed by multivariate logistic regression analysis in all patients having diabetes or prediabetes (Table 3a) as well in patients who had had diabetes education in a hospital (Table 3b). As shown in Table 3a, receiving diabetes education (OR = 1.774, 95% CI 1.485–2.119; $p < 0.001$), period of therapy of 5 years or more (OR = 1.649, 95% CI 1.394–1.951; $p < 0.001$) and regular visits to an ophthalmic clinic (OR = 1.182 95% CI 1.012–1.381; $p = 0.035$) were associated with lack of control level of HbA1c < 7.0% (53 mmol/mol) in all patients. Furthermore, in patients who had received diabetes education in a hospital, period of therapy for 5 years or more (OR = 1.770, 95% CI 1.184–2.647; $p = 0.005$) and regular visit to an ophthalmic clinic (OR = 1.424, 95% CI 1.005–2.018; $p = 0.047$) were also significantly associated with lack of control level of HbA1c < 7.0% (53 mmol/mol) (Table 3b). Use of the Diabetes Regional Coordination Path (OR = 0.613, 95% CI 0.395–0.951; $p = 0.029$) was a factor associated with HbA1c < 7.0% (53 mmol/mol) only in patients who had received diabetes education in a hospital.

Discussion

The survey questionnaire revealed that 41.0% of the patients who answered the questionnaire (2,284/5,572) showed glucose level of HbA1c < 7.0% (53 mmol/mol) and that 17% ($n = 949$) of these patients had had no therapy for diabetes. These findings are similar to those reported in previous Japanese surveys [24–26]. Takahashi et al. [25] reported that in 7,180 Japanese patients who had received

Table 1 Demographics of patients with diabetes or prediabetes who replied to the questionnaire

	n	%
Gender		
Male	2,897	52
Female	2,548	46
No response	127	2
Age		
Younger than 40	93	2
40–49	312	6
50–59	603	11
60–69	1,668	30
70–79	1,869	34
Over 80	924	17
No response	103	2
Experience of receiving diabetes education		
Yes	960	17
No	4,405	79
No response	207	4
Periods of therapy		
Without therapy	949	17
Less than 1 year	332	6
1–4 years	998	18
5–9 years	1,102	20
10 years and more	1,864	33
No response	327	6
HbA1c		
<5.9	334	6
6.0–6.9	1,950	35
7.0–7.9	1,114	20
8.0–8.9	279	5
>9.0	111	2
Unknown	557	10
No response	1,226	22
Attending a hospital or clinic		
Hospital (internal medicine)	1,805	32
Hospital (other internal medicine)	83	1
Clinic (internal medicine)	2,313	42
Clinic (other internal medicine)	102	2
No response	1,269	23
Retinopathy		
Presence	522	9
Absence	4,816	86
No response	234	4
Regular visits to the ophthalmologist		
Yes	2,712	49
No	2,705	49
No response	155	3
Periodontal disease		
Presence	1,419	25
Absence	3,911	70
No response	242	4
Regular visits to the dentist		
Yes	2,161	39

Table 1 (continued)

	n	%
No	3,190	57
No response	221	4
Instruction regarding the use of the Diabetes Coordination Notebook		
Yes	1,950	35
No	3,148	56
No response	474	9
Usage of the Diabetes Coordination Notebook/Diabetic Eye Notebook		
Both	623	11
Only Diabetes Coordination Notebook	1,637	29
Only Diabetes Eye Notebook	180	3
Neither	2,764	50
No response	368	7
How to use the notebook		
Whenever leaving home	370	7
Whenever visiting internal medicine or ophthalmologic clinic	1,203	22
In case of visiting internal medicine or ophthalmologic clinic	496	9
Keeping at home	366	7
No response	3,137	56
Instruction regarding use of the Diabetes Regional Coordination Path		
Yes	397	7
No	4,785	86
No response	390	7

anti-diabetic therapy, the rate of HbA1c $< 7.0\%$ (53 mmol/mol) was 44.7%. Hu et al. [26] reported in a cross-sectional analysis of 3,070 patients with diabetes that 44.9% achieved HbA1c $< 7.0\%$ (53 mmol/mol). Similar values of HbA1c have been reported by other investigators from other countries [27, 28]. On the other hand, the U.S. National Health and Nutrition Examination Survey (NHANES) reported that a higher percentage (52.5%) of HbA1c $< 7.0\%$ (53 mmol/mol) was achieved [27]. With regard to anti-diabetic therapy, it was found to be generally insufficient in the prediabetic state by the Japanese National Diabetes Survey (2013) using HbA1c criteria [24]. The rates of implemented anti-diabetic therapy were approximately 65% in that survey [24], which are slightly lower than our present data of 77.1%.

In the present survey, the prevalence of retinopathy ($n = 552$, 9.9%) and periodontal disease ($n = 1,419$, 25.5%), were consistent with those reported in previous studies [29]. According to the Japanese National Diabetes Survey in 2008, the prevalence of retinopathy in patients over 20 years of age was 10.6% (91/857). Saito et al. [30]. found in the Hisayama Study that 28.1% (82/292) of individuals with impaired glucose tolerance or diabetes suffered from periodontal disease defined by high mean pocket depth (> 2.0 mm) and high attachment loss (> 2.5 mm).

Regarding regular screening for complications, the rates of regular visits to an ophthalmologist or a dentist were as low as in previous reports [31, 32]. These findings suggest that the implementation of optimal diabetes management remains a widespread challenge.

The Diabetes Coordination Notebook was originally developed by JADEC, and modified by Gifu University hospital, several base hospitals, the Gifu City Medical Association and the Gifu Prefecture Medical Association for the Gifu area. The examination schedule sheet (Fig. 1a) and the management evaluation sheet (Fig. 1b) were attached in addition to medical recordings regarding laboratory findings, treatment regimens, and findings regarding diabetic complications. This notebook is used for patient self-management and also as a tool for coordination between the base hospital and home-based care management as well as the nursing care office [23].

In the present study, patients using the Diabetes Coordination Notebook visited the ophthalmic clinic more frequently than those not using it. Moreover, in patients using the Diabetes Regional Coordination Path, the rate of regular visits to an ophthalmic clinic ($p < 0.001$) and a dental clinic ($p < 0.05$) were both significantly higher than in those who did not. More importantly, usage of the Diabetes Regional Coordination Path was found to be a factor associated with maintenance of a glucose level of HbA1c $< 7.0\%$ (53 mmol/mol), especially in patients with a history of diabetes education in a hospital (OR: 0.613, 95% CI: 0.395–0.951, $p = 0.029$). On the other hand, those who have experience of receiving diabetes education or regular visits to the
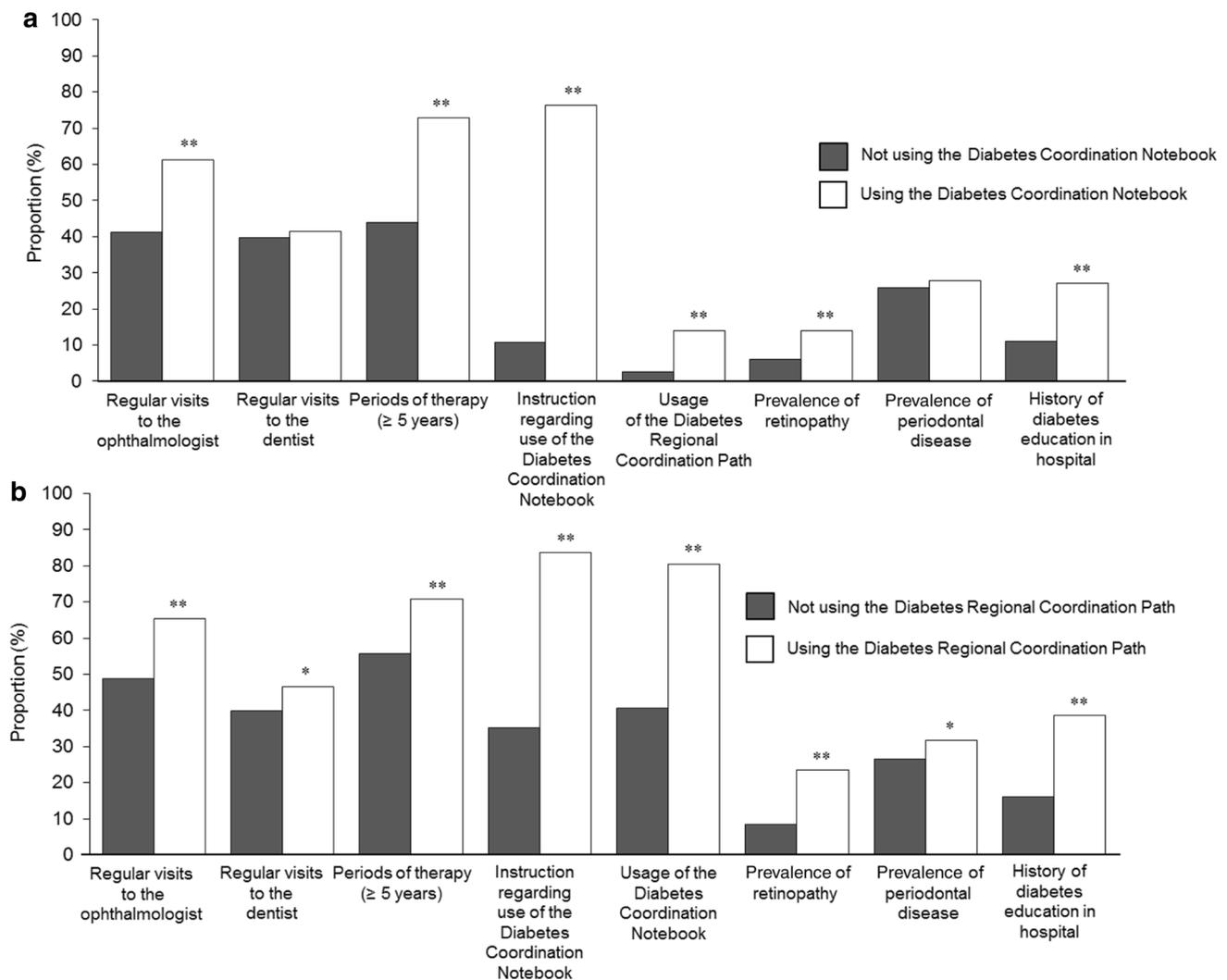
Fig. 2 Comparison of demographics of patients with or without the Diabetes Coordination Notebook (**a**) and with or without the Diabetes Regional Coordination Path (**b**). Data were statistically compared by Chi-square test. $*p < 0.05$, $**p < 0.001$

ophthalmologist showed a significant risk of HbA1c > 7%, possibly because those who had higher HbA1c were recommended to have diabetes education in hospitals teaching them to perform regular visits to the ophthalmologist (Table 3a). Furthermore, this is also derived from the fact that this study is a cross-sectional study, not a prospective study.

Diabetic retinopathy is one of the common microvascular complications in both type 1 and type 2 diabetes [33]. Regular screening for diabetic retinopathy by an ophthalmologist or optometrist is recommended to diabetes patients for prevention of the development of diabetic retinopathy [33]. The Organization for Economic Co-operation and Development (OECD) reported that the average rate of annual eye examination in 12 countries for diabetes patients is 57.3%, a rate much higher than that in Japan (37.0%) [31]. In the present study, the rate of regular visits to an ophthalmic clinic

was found to be 48.7% (2,712/5,572) in all patients, a value higher than that of Japanese in the OECD report. However, the rates increased to 60% and 65% in patients who used the Diabetes Coordination Notebook and in those using the Diabetes Regional Coordination Path, respectively.

In the present study, the prevalence of retinopathy was found to be higher in patients using the Diabetes Coordination Notebook than in those not using it (15% versus 5%, $p < 0.001$). In addition, the prevalence of retinopathy was higher in patients using the Diabetes Regional Coordination Path than in those not using it (25% versus 10%, $p < 0.001$). This may be related to the increased visits to an ophthalmic clinic, as well as to the patient's educated awareness of retinopathy. Allen et al. [34] reported that in outpatients with diabetes, a patient's awareness of increased risk is much higher for retinopathy (98%) than it is for periodontal disease (33%). Low awareness of general oral health in patients with

Table 2 Risk factors associated with the absence of regular visits to the ophthalmologist (A) or absence of regular visits to the dentist (B) in patients with diabetes or prediabetes

	OR	95% CI	p value
(A)			
Experience of receiving diabetes education (yes)	0.579	0.484–0.693	<0.001
Periods of therapy (≥5 years)	0.479	0.412–0.557	<0.001
Attending a hospital or clinic (hospital)	0.796	0.690–0.918	0.002
Regular visits to the dentist (yes)	0.365	0.316–0.422	<0.001
Usage of the Diabetes Coordination Notebook (yes)	0.584	0.505–0.675	<0.001
Usage of the Diabetes Regional Coordination Path (yes)	0.833	0.623–1.113	0.216
	OR	95% CI	p value
(B)			
Experience of receiving diabetes education (yes)	1.139	0.961–1.351	0.133
Periods of therapy (≥5 years)	0.901	0.773–1.050	0.182
Attending a hospital or clinic (hospital)	0.890	0.774–1.022	0.099
Regular visits to the ophthalmologist (yes)	0.37	0.320–0.427	<0.001
Usage of the Diabetes Coordination Notebook (yes)	1.055	0.914–1.219	0.463
Usage of the Diabetes Regional Coordination Path (yes)	0.765	0.588–0.996	0.046

p value by multiple logistic regression analysis

Table 3 Risk factors of HbA1c > 7% in all patients (A) or patients with a history of diabetes education in hospital (B)

	OR	95% CI	p value
(A)			
Experience of receiving diabetes education (yes)	1.774	1.485–2.119	<0.001
Periods of therapy (≥5 years)	1.649	1.394–1.951	<0.001
Attending a hospital or clinic (hospital)	1.043	0.898–1.210	0.583
Regular visits to the ophthalmologist (yes)	1.182	1.012–1.381	0.035
Regular visits to the dentist (yes)	0.961	0.826–1.117	0.604
Usage of the Diabetes Coordination Notebook (yes)	1.138	0.975–1.328	0.102
Usage of the Diabetes Regional Coordination Path (yes)	0.838	0.636–1.103	0.207
	OR	95% CI	p value
(B)			
Periods of therapy (≥5 years)	1.770	1.184–2.647	0.005
Attending a hospital or clinic (hospital)	1.103	0.810–1.501	0.534
Regular visits to the ophthalmologist (yes)	1.424	1.005–2.018	0.047
Regular visits to the dentist (yes)	0.935	0.679–1.286	0.678
Usage of the Diabetes Coordination Notebook (yes)	1.215	0.860–1.716	0.269
Usage of the Diabetes Regional Coordination Path (yes)	0.613	0.395–0.951	0.029

p value by multiple logistic regression analysis

diabetes has also been found by other investigators [32, 35]. In the present study, regular visits to a dental clinic was 38.8% in all patients, but the rate was not different in patients using and not using the Diabetes Coordination Notebook. However, the rate was significantly higher in those using the Diabetes Regional Coordination Path than in those not using it (47% versus 40%, $p < 0.05$). Early management of the oral disease is important to prevent or ameliorate diabetic complications. In this respect, our present findings indicate that use of the Diabetes Regional Coordination Path together with the Diabetes Coordination Notebook is useful in facilitating visits to a dental clinic.

There are several limitations in the present study. First, the study was conducted as a cross-sectional study by a questionnaire survey, and is not a prospective study. Thus, several confounding factors, including patients' motivation

regarding diabetes treatment, cannot be ruled out. Second, the HbA1c value and diabetic complications such as diabetic retinopathy and periodontal disease were based on the individual's testimony. Third, patient misunderstanding of questions and ambiguous answers cannot be excluded. Fourth, the number of patients using the Diabetes Coordination Notebook ($n = 1637$, 29.4%) and the Diabetes Regional Coordination Path ($n = 397$, 7.1%) was small, probably due to lack of family physicians' or diabetes specialists' knowledge of them. Furthermore, some of the patients were instructed regarding only the use of the Diabetes Regional Coordination Path (Question 14). We did not ask whether they actually used the Diabetes Regional Coordination Path or not in this survey. On the other hand, we did ask whether they actually used the Diabetes Coordination Notebook and/or the Diabetic Eye Book (Question 12) in addition to whether they received instruction regarding the use of these notebooks (Question 11). Further studies are, therefore, required to confirm our present findings.

We are presently undertaking two kinds of ICT (Information and Communication Technology) studies to share medical recordings without limitation of time and space: one is a Web-based electronic medical record for the Diabetes Regional Coordination Path using the REDcap® system [36], which is a secure web application for building and managing online surveys and databases; the other is an Electronic Diabetes Coordination Notebook using the MEDICA® card, which is issued as an emergency card to diabetes patients by Gifu University Hospital [37].

In conclusion, the rate of regular visits to both an ophthalmic and a dental clinic are significantly higher in patients using the Diabetes Regional Coordination Path together with the use of the Diabetes Coordination Notebook. Furthermore, the usage of the Diabetes Regional Coordination Path is a factor associated with a glucose level of HbA1c $< 7.0\%$ (53 mmol/mol) in patients with a history of diabetes education in a hospital. Thus, the present survey suggests the importance of the use of both the Diabetes Regional Coordination Path and the Diabetes Coordination Notebook for more effective treatment of diabetes through multidisciplinary collaboration.

Compliance with ethical standard

Conflict of interest All authors report no conflicts of interest relevant to this article.

Ethics approval This study was carried out in accordance with the guidelines for human studies outlined by the Ethics Committee of the Gifu University Graduate School of Medicine (Institutional Review Board Approval No. 27-535, date of approval: March 16th, 2016), and ratified by the Ethics Committee of the Gifu Medical Association (Date of ratification: March 17th, 2016).

Informed consent All eligible patients gave written, informed consent prior to responding to the questionnaire.

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