

Self-perception of glycemic control among Japanese type 2 diabetic patients: accuracy of patient perception and characteristics of patients with misperception

Tomoko Suzuki-Saito^{1*}, Hirohide Yokokawa^{1,2}, Koichi Shimada³, Seiji Yasumura¹

ABSTRACT

Aims: Some diabetic patients, despite reporting a good perception of their glycemic control, actually show poor control and this misperception might well hinder successful diabetes management. This study aimed to assess patients' self-perception of glycemic control and to clarify factors associated with misperception of glycemic control status.

Methods: Baseline data from a hospital-based prospective cohort of 519 type 2 diabetic patients were analyzed. Self-perception of glycemic control and other items, including sociodemographic factors and blood test data, were determined from a self-administered questionnaire and medical records. Factors associated with misperception were examined by age group (elderly [aged \geq 65 years] vs non-elderly [aged < 65 years]) using multiple logistic regression analysis.

Results: Among poorly controlled patients, misperception was higher in the elderly (glycated hemoglobin [HbA_{1c}] 7.4–8.3, 55.1%; HbA_{1c} >8.4, 44.8%) than in the non-elderly (HbA_{1c} 7.4–8.3, 20.0%; HbA_{1c} >8.4, 18.9%). The factors significantly associated with misperception were as follows: high lifestyle regimen adherence in both age groups (non-elderly group odds ratio [OR] 5.23; elderly group OR 5.15, respectively); high family support (OR = 7.32), failure to achieve blood pressure control (OR = 6.94) and having diabetic complications (OR = 0.06) among the non-elderly; and long duration of diabetes (OR = 4.06) among the elderly.

Conclusions: For better management of diabetes, physicians should pay attention to the patient characteristics associated with misperception among uncontrolled diabetic patients, particularly among those who are elderly. (*J Diabetes Invest* doi: 10.1111/jdi.12002, 2013)

KEY WORDS: Glycemic control, Glycated hemoglobin, Perception

INTRODUCTION

The primary goal of diabetes treatment is prevention of micro- and macrovascular complications by maintaining satisfactory glycemic control¹. Despite the therapeutic advances in the treatment of diabetes, a large-scale survey carried out in Japan showed that 66% of patients failed to meet the glycated hemoglobin (HbA_{1c}) target of <6.9% set by the Japan Diabetes Society (JDS)², indicating that glycemic control is still not successfully achieved by most Japanese diabetic patients.

This low achievement rate shows that there might well be limits to achieving treatment goals with only a medication-oriented approach. Rather, comprehensive care that encourages patients to implement their diabetes self-management is

required. Diabetes self-management education that incorporates psychobehavioral strategies has been recommended in diabetes treatment guidelines^{3,4}. In actual clinical settings, however, physicians' interests in such an educational strategy, which require even more human resources and close coordination among healthcare professionals in their implementation, are limited and the implementation rate of these education programs remains low in Japan⁵. The health professionals might be required to pay more attention to patients' psychobehavioral aspects.

According to the Health Belief Model, perceiving how serious a condition and its sequelae are, in other words 'perceived susceptibility', is a crucial element of behavioral change⁶. For successful behavioral change in diabetes self-management, 'patients' accurate perception of glycemic control' seems to be important. There are some reports from Western countries focusing on patients' perception, which have shown that patients' accurate assessments of their last HbA_{1c} were related to better understanding of diabetes care and lower HbA_{1c} values^{7,8}. Taking these reports into consideration, in cases where

¹Department of Public Health, School of Medicine, Fukushima Medical University,

²Department of Diabetes and Metabolism, Hoshi General Hospital, Fukushima, Japan

and ³Department of General Medicine, School of Medicine, Juntendo University, Tokyo, Japan

*Corresponding author: Tomoko Suzuki-Saito Tel: +81-24-547-1179

Fax: +81-24-547-1183 E-mail address: saitemo8@fmu.ac.jp

Received 13 February 2012; revised 27 June 2012; accepted 14 August 2012

poorly controlled patients perceive their glycemic control as good, the misperception might well become an obstacle to patients' behavioral change for successful diabetes management.

In our previous study in Vietnam, 45–55% of poorly controlled patients misperceived their glycemic control status⁹. Japanese patients might also misperceive their glycemic control status, but as yet no studies have investigated their perception. Therefore, in the present study, we examined data obtained from diabetic patients at a general hospital in Japan in order to clarify the characteristics of diabetic patients by glycemic control status, especially focusing on accuracy of patient perception of glycemic control, and to determine factors associated with misperception of glycemic control status.

MATERIALS AND METHODS

Procedure

The present cross-sectional study used baseline data from a hospital-based prospective cohort study that was carried out at a general hospital located in Fukushima Prefecture, Japan, from June 2009 to August 2010. We recruited outpatients with diabetes who visited the general hospital between 1 June and 31 July 2009 to complete the baseline survey, and subsequently extracted follow-up data from their medical records between 5 August and 31 August 2010. The protocol of the present study was finalized based on the results of a pilot study carried out between 28 April and 21 May 2009.

In this general hospital, which serves as one of the main hospitals in a major urban area of the prefecture, two physicians specializing in treating diabetes work in the diabetes outpatient clinic. The physicians explain blood test results, including blood glucose levels and HbA_{1c} values, to all diabetic outpatients who visit the clinic, and provide them with a diabetes passport in which the blood test results, blood pressure results and body-weight are recorded. Among 649 patients who visited the diabetes clinic during the baseline survey period, 33 were inaccessible because of failure in the survey process; consequently, 616 received individual explanations of the study and were asked to participate in the study by a researcher while they were waiting for their clinical examination. A self-administered questionnaire was immediately provided to all 550 patients who agreed to participate (84.7% enrolment rate, 66 declined to participate) and was collected from them before they met with the physician.

Relevant medical and sociodemographic information was subsequently obtained from the patients' medical records, and those patients who met the following eligibility criteria were selected for the analysis: (i) diagnosis of type 2 diabetes; and (ii) had visited the clinic for more than 3 months for the purpose of diabetes treatment.

Medical Variables

The general medical information obtained from the medical records comprised age, sex, anthropometric measurement (height and weight) and blood pressure on the day of the visit,

past medical history, and records of medication for hypertension and dyslipidemia. Patients whose systolic blood pressure was >130 mmHg or diastolic blood pressure was >80 mmHg in the present study were categorized as having 'blood pressure control not achieved' according to the guideline for treatment of diabetes by the JDS. Data related to diabetes mellitus were also obtained: HbA_{1c} (JDS;%) and fasting or casual blood glucose concentration (mg/dL) measured on the day of the visit, type and duration of diabetes, therapeutic regimen for diabetes, and presence of complications (diabetic retinopathy, neuropathy and nephropathy). The HbA_{1c} (JDS;%) was converted to a National Glycohemoglobin Standardization Program (NGSP) equivalent value calculated using the following formula: HbA_{1c} (NGSP) (%) = 1.02 × HbA_{1c} (JDS) (%) + 0.25%¹⁰. High performance liquid chromatography (HPLC) was used to measure HbA_{1c}.

Patient-Completed Measures

Self-perception of glycemic control was assessed by asking a single-item question, 'To what extent do you feel your diabetes is in control?' with answers given on a Likert scale (1: poor to 4: excellent). Self-perception of lifestyle and medical regimen adherence were assessed by asking, 'How well do you follow the (dietary, exercise, appointment keeping, medication and self-monitoring of blood glucose) recommendations given by your physician or medical staff?' with answers provided on a Likert scale (1: not at all to 4: very well). Data regarding recommendation for self-monitoring of blood glucose were excluded from the analysis, because few patients were recommended to do this (157/550 patients) and hence data on patients' adherence to such self-monitoring was largely missing. Instead, adherence to their medical regimen was assessed through their self-evaluation of appointment keeping and medication. All question items were used in a previous study¹¹. The back-translation was carried out to develop the Japanese questionnaire from the original English questionnaire. The reliability of the questionnaire used in the present study was confirmed during the pilot study carried out in April–May 2009 (data not shown).

A two-question case-finding instrument that was developed as a concise measure for detecting depression^{12,13} was used to measure depressive mood. A diagnosis of depression was made if an affirmative answer was given to either of the following questions: (i) 'During the past month, have you often been bothered by feeling down, depressed, or hopeless?'; and (ii) 'During the past month, have you often been bothered by little interest or pleasure in doing things?'. Family support was assessed by the question, 'In order not to worsen your diabetes, to what degree do your family members cooperate with or give you advice regarding your medical care?' and answered on a Likert scale (1: substantially to 4: very little)¹⁴. Patients who assessed their family support as being substantial were categorized as having high family support¹⁴. Questions about family structure were also asked.

The questions regarding lifestyle collected information on physical activity, breakfast, snacks between meals, alcohol consumption, tobacco smoking and sleeping hours. A lifestyle score ranging from 0 to 7 was determined by assigning a score of 1 point to each of the following lifestyle factors and body mass index (BMI) status, and then summing them: physical activity (≥ 2 times a week), breakfast (every morning), snacks between meals (no), alcohol consumption (non-drinker), tobacco smoking (non-smoker), sleeping hours (7–8 h) and BMI (18.5–24.9). This scoring was decided with reference to Belloc and Breslow's seven health practices¹⁵ and the findings of our previous study¹⁶. Information was also obtained for occupation, family history and meal preparation (self/others).

Definition of Glycemic Control Status and Patients Misperception

The distribution of HbA_{1c} values was classified into the five levels used as clinical goals of diabetes therapy defined by JDS: ≤ 6.1 , 6.2–6.8, 6.9–7.3, 7.4–8.3 and ≥ 8.4 ³. The glycemic goal for adults set by JDS is $<6.9\%$; HbA_{1c} of 7.4–8.3 is referred to as 'not good' control status and HbA_{1c} of ≥ 8.4 is referred to as 'poor' control status. Although there are some opinions that a more relaxed glycemic goal can be considered in the elderly¹⁷, it is recommended that the goal in the elderly should be set at $<7.4\%$ at the most in the JDS clinical guideline³. Consequently, patients with a HbA_{1c} level $\geq 7.4\%$ were categorized into the 'poorly controlled group' and those with a HbA_{1c} level $<7.4\%$ were categorized into the 'well-controlled group' in the present study. In regard to self-perception of diabetic control, patients who rated 3 or 4 on a scale of 1–4 were defined as having 'good self-perception'. 'Misperception' was defined only for poorly controlled patients, as they perceived their own glycemic control to be good despite poor control status. A concept of misperception in the present study included a situation in which patients couldn't either recall or interpret their glycemic control correctly. Consequently, the poorly controlled patients were divided into two subgroups: those who perceived their control to be good when in fact they had poor glycemic control (with misperception group) and those who did not (without misperception group).

Statistical Analysis

All patient characteristics, including their self-perception of diabetic control, were compared between these two groups using the χ^2 -test and Mann–Whitney *U*-test. It is reported that age is a significant factor associated with the understanding of HbA_{1c} in diabetic patients⁸. Furthermore, age was considered to have a large impact on patient perception, as differences in diabetes care were found between the elderly and non-elderly^{3,18}. Therefore, to examine the factors associated with misperception, the odds ratio (OR) for each item was calculated for two age groups – the non-elderly (aged < 65 years) and the elderly (aged ≥ 65 years) – using multiple logistic regression analysis. Univariate factors with *P*-values < 0.10

were entered into the multiple logistic regression model. *P* < 0.05 was considered statistically significant. All analyses were carried out using SPSS Statistics 17.0 for Windows (SPSS, Chicago, IL, USA).

Ethical Consideration

The research protocol was approved by the Ethics Committees of Fukushima Medical University (approval date 2 April 2009; Application No. 817) and the survey site hospital (approval date 21 April 2009). All patients gave written informed consent to participate in the study.

RESULTS

Patient Characteristics

Among the 550 patients, 31 were excluded because of non-type 2 diabetes (*n* = 27) or being newly diagnosed (*n* = 4), leaving 519 who were enrolled in the study. Patient characteristics are shown by glycemic control status in Table 1. In the well-controlled group (HbA_{1c} $<7.4\%$), 44.3% were female and the median age was 66 years (range 31–90 years); in the poorly controlled group, 46.4% were female and the median age was 65 years (range 30–91 years). There were no significant differences in age or sex between the two groups. Median duration of diabetes in the poorly controlled group was 10 years (1–45 years), which was significantly longer than that of 6 years (0.5–39 years) in the well-controlled group. The proportions of patients treated with insulin, number of oral antidiabetic agents and number of diabetes complications in the poorly controlled group were also significantly higher than those in the well-controlled group. Although, the proportion of patients who perceived they had good glycemic control was significantly higher (71.1%) in the well-controlled group than in the poorly controlled group, nevertheless 36.3% of the poorly controlled patients also perceived incorrectly that they had good control (i.e. they were in the 'with misperception' group). Lifestyle regimen adherence was 3.0 (1.0–4.0) for the well-controlled group, which was significantly higher than that for the poorly controlled group (2.5, 1.0–4.0). There were no significant differences in lifestyle, social, or familial factors or depression scale scores between the two groups.

The median HbA_{1c} value of all participants was 7.1% (4.5–11.8). As shown in Figure 1, approximately 40% of patients achieved the goal of optimal glycemic control of 6.9% set by JDS.

Proportion of Patients Perceiving Their Glycemic Control to be Good

Table 2 shows the proportion of patients who perceived their control to be good for each HbA_{1c} level. Comparing the proportions between the elderly and the non-elderly, especially for each HbA_{1c} level over 7.4%, the proportion of patients with good perception was significantly higher in the elderly than in the non-elderly; approximately half of the elderly patients with HbA_{1c} $\geq 7.4\%$ rated their diabetic control as good.

Table 1 | Baseline characteristics of respondents

	Well controlled (<i>n</i> = 325)	Poorly controlled (<i>n</i> = 194)	<i>P</i> -value*
Age (years)	66 (31–90)	65 (30–91)	0.29
Sex (female)	144 (44.3)	90 (46.4)	0.64
Body mass index (kg/m ²)	24.1 (15.7–42.5)	24.1 (13.4–44.1)	0.91
Past history of atherosclerotic disease (present)	64 (19.7)	50 (25.8)	0.11
Family history (present)			
Diabetes mellitus	155 (47.8)	108 (55.7)	0.08
Atherosclerotic disease	136 (42.0)	78 (40.2)	0.69
Malignant neoplasm	116 (35.8)	65 (33.5)	0.60
Systolic blood pressure (mmHg)	128 (96–200)	130 (98–220)	0.58
Diastolic blood pressure (mmHg)	70 (46–100)	70 (54–100)	0.20
Medication for hypertension (yes)	190 (58.5)	109 (56.2)	0.61
Medication for dyslipidemia (yes)	127 (39.1)	77 (39.7)	0.89
Diabetes-related factors			
Fasting blood glucose (mg/dL)	124 (64–232)	149 (69–350)	<0.01
HbA _{1c} (NGSP;%) [†]	6.6 (4.5–7.3)	8.1 (7.4–11.8)	<0.01
Duration of diabetes (years)	6 (0.5–39)	10 (1–45)	<0.01
Treatment of diabetes			
Diet and exercise only	45 (13.8)	3 (1.5)	<0.01
Oral hypoglycemic agents	260 (80.0)	136 (70.1)	
Insulin only or combination	20 (6.2)	55 (28.4)	
No. oral antidiabetic agents	2 (1–4)	3 (1–5)	<0.01
Diabetes complication (present)			
Chronic kidney disease	55 (16.9)	42 (21.6)	0.18
Diabetic retinopathy	46 (14.2)	54 (29.0)	<0.01
Diabetic neuropathy	53 (16.4)	56 (29.5)	<0.01
No. diabetes complication	0 (0–4)	1 (0–4)	<0.01
Perceived diabetes control (good)	226 (71.1)	69 (36.3)	<0.01
Lifestyle regimen adherence	3.0 (1.0–4.0)	2.5 (1.0–4.0)	0.07
Medical regimen adherence	4.0 (1.0–4.0)	4.0 (1.5–4.0)	0.03
Lifestyle factors			
Breakfast (every morning)	307 (94.8)	184 (94.8)	0.96
Snack between meals (no)	176 (54.5)	104 (54.5)	0.99
Exercise frequency (≥ 2 times a week)	185 (57.3)	100 (51.8)	0.23
Sleeping hours (7–8 h/day)	145 (44.9)	100 (51.5)	0.14
Smoking behavior (never/ex-smoker)	256 (79.0)	148 (76.3)	0.47
Drinking behavior (non-drinker)	206 (63.8)	138 (71.1)	0.09
Lifestyle score (6–7)	64 (20.1)	49 (25.9)	0.13
Occupation (inoccupation)	195 (60.2)	114 (58.8)	0.75
Cohabitation (living with family)	283 (87.1)	175 (90.2)	0.28
Family support (high)	136 (42.0)	80 (41.2)	0.87
Food preparation (not self-performed)	195 (60.6)	103 (54.2)	0.16
Depression scale (positive)	84 (25.9)	59 (30.4)	0.27

Data presented as *n* (%) or median (range). Percentage of each item was calculated excluding missing data. Median (min–max) values are in italics.

* χ^2 -test and Mann–Whitney *U*-test.

[†]Glycated hemoglobin (HbA_{1c}; National Glycohemoglobin Standardization Program [NGSP]) value was calculated using the following formula: HbA_{1c} (NGSP) (%) = 1.02 × HbA_{1c} (JDS) (%) + 0.25%.

Factors Associated With Misperception in the Poorly Controlled Group

Results of the univariate analysis are shown in Table 3. After entering items, which were statistically significant or borderline significant (*P* < 0.1) in the univariate analysis, into multiple logistic regression analysis considering multicollinearity, the

items shown in Table 4 remained significant. Among the non-elderly, patients with misperception were more likely to have a high level of family support (OR = 7.32, 95% confidence interval [CI] = 1.28–42.01), not to have achieved blood pressure control (OR = 6.94, 95% CI = 1.25–38.69), to have a high lifestyle regimen adherence score (OR = 5.23, 95% CI = 1.30–21.10)

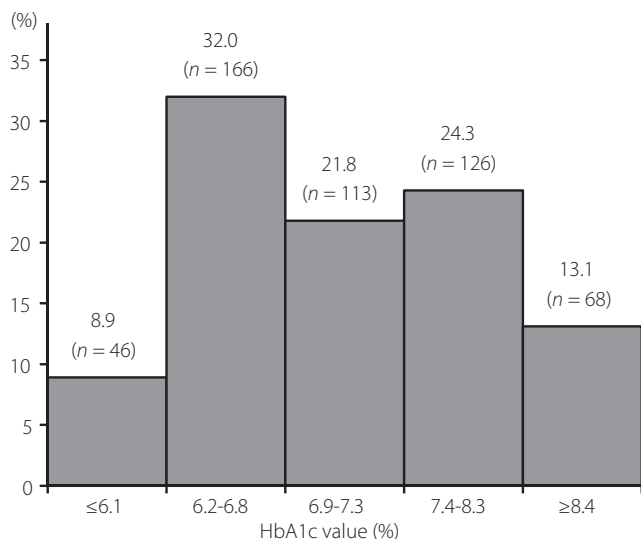


Figure 1 | The distribution of glycated hemoglobin (HbA_{1c}) level in all patients. The mean HbA_{1c} was $7.2 \pm 1.05\%$ (mean \pm SD).

and to be less likely to have diabetic complications (OR = 0.06, 95% CI = 0.01–0.43). Among the elderly, patients with long duration of diabetes (10 years or longer; OR = 4.06, 95% CI = 1.41–11.72) and with a high lifestyle regimen adherence score (OR = 5.15, 95% CI = 2.17–12.24) were more prone to misperception.

DISCUSSION

The present study is the first in Japan to report on the accuracy of patients' perception towards glycemic control and the factors associated with misperception of glycemic control status. It was found that 36.3% of the poorly controlled patients misperceived their glycemic control as good, and this proportion was higher among elderly patients aged ≥ 65 years. Furthermore, the factors associated with misperception were high lifestyle regimen adherence in both the non-elderly and elderly, number of complications, failure to achieve blood pressure control, and high

family support in the non-elderly, and duration of diabetes in the elderly.

The results of the present study showed that one out of three poorly controlled patients misperceived their glycemic control, which suggests that current strategies of diabetes care and education provided in Japanese diabetes clinics is not sufficient for diabetic patients to acquire appropriate self-perception and understanding of glycemic control. In particular, the elderly patients were more likely to misperceive their glycemic control than non-elderly patients. Despite the controversy around strict glycemic control among the elderly^{3,17}, it is a notable problem that approximately half of the elderly with HbA_{1c} $>7.4\%$ in the present study misperceived their control status. The Dual-Process Coping Model advocated by Brandtstädter *et al.* might help to explain this misperception among elderly patients¹⁹. According to the model, elderly people are unintentionally prone to coping with difficulties and losses by lowering their preferences and goals to meet situational constraints, a tendency that was reported in a previous study²⁰. As a result of coping, elderly patients, especially those with long-duration diabetes, were more likely to have lowered their desirable treatment status and to misperceive their glycemic control as good, despite having poor glycemic control in reality.

According to the associated factors of misperception among the poorly controlled patients, high lifestyle regimen adherence appeared a common factor in both age groups, although no lifestyle factor was significant in the final model. It is probable that patients with misperception tend to give higher evaluations of their lifestyle regimen adherence regardless of their actual adherence. This type of high self-evaluation might interfere in patients' self-care improvement. When healthcare practitioners identify a patient's misperception of glycemic control, they also should assess the patient's level of regimen adherence carefully, obtaining more detailed information from the patient on lifestyle.

Only non-elderly patients with misperception were less likely to have diabetes complications. This paradoxical result might show that patients become more aware of their glycemic

Table 2 | Proportion of patients who perceived their glycemic control was good by glycated hemoglobin level

HbA _{1c} level (%)‡	All (58.1% [295/508])	Non-elderly (45.5% [105/231])	Elderly (68.6% [190/277])	P-value†
Well controlled				
≤ 6.1	75.6% (34/45)	80.0% (16/20)	72.0% (18/25)	0.73
6.2–6.8	77.8% (126/162)	65.7% (44/67)	86.3% (82/95)	<0.01
6.9–7.3	59.5% (66/111)	51.9% (27/52)	66.1% (39/59)	0.13
Poorly controlled				
7.4–8.3	39.5% (49/124)	20.0% (11/55)	55.1% (38/69)	<0.01
≥ 8.4	30.3% (20/66)	18.9% (7/37)	44.8% (13/29)	0.02

Percentage of each item was calculated excluding missing data.

†P-value was calculated by χ^2 -test and Fisher's exact test between the non-elderly and the elderly.

‡Glycated hemoglobin (HbA_{1c}; National Glycohemoglobin Standardization Program [NGSP]) value was calculated by the following formula; HbA_{1c} (NGSP) (%) = $1.02 \times \text{HbA}_{1c}$ (JDS) (%) + 0.25%.

Table 3 | Factors associated with misperception of glycemic control among the poorly controlled patients by univariate analysis

	Non-elderly			Elderly		
	With misperception (n = 18)	Without misperception (n = 74)	P-value*	With misperception (n = 51)	Without misperception (n = 47)	P-value*
Sex (female)	5 (27.8)	27 (36.5)	0.49	29 (56.9)	27 (57.4)	0.95
Body mass index	25.0 (15.8–34.1)	25.2 (18.6–44.1)	0.48	23.1 (17.2–35.1)	23.7 (17.0–31.3)	0.32
Past history of arteriosclerotic disease (present)	1 (5.6)	14 (18.9)	0.20	22 (43.1)	13 (27.7)	0.11
Family history (present)						
Diabetes mellitus	12 (66.7)	44 (59.5)	0.58	25 (49.0)	26 (55.3)	0.53
Atherosclerotic disease	8 (44.4)	36 (48.6)	0.75	19 (37.3)	15 (31.9)	0.58
Malignant neoplasm	7 (38.9)	25 (33.8)	0.68	15 (29.4)	17 (36.2)	0.48
Occupation (inoccupation)	4 (22.2)	26 (35.1)	0.30	46 (90.2)	34 (72.3)	0.03
Cohabitation (living with family)	17 (94.4)	64 (86.5)	0.37	48 (94.1)	43 (91.5)	0.62
Family support (high)	10 (55.6)	18 (24.3)	0.01	30 (58.8)	20 (42.6)	0.11
Food preparation (not self-performed)	9 (52.9)	39 (53.4)	0.97	30 (58.8)	23 (51.1)	0.45
Depression scale (positive)	4 (22.2)	26 (35.1)	0.30	12 (23.5)	17 (36.2)	0.17
Hypertension related factors						
Blood pressure control (not achieved)	12 (66.7)	30 (41.1)	0.06	34 (68.0)	27 (60.0)	0.42
Taking blood pressure lowering agents (yes)	8 (44.4)	38 (51.4)	0.60	15 (29.4)	20 (42.6)	0.18
Dyslipidemia related factors						
Taking lipid lowering agents (yes)	5 (27.8)	34 (45.9)	0.17	21 (41.2)	16 (34.0)	0.47
Lifestyle factors						
Breakfast (every morning)	18 (100.0)	68 (91.9)	1.00	48 (94.1)	47 (100.0)	1.00
Snack between meals (no)	14 (77.8)	35 (48.6)	0.03	30 (60.0)	21 (44.7)	0.13
Exercise frequency (≥ 2 times a week)	9 (50.0)	29 (39.7)	0.43	36 (70.6)	25 (53.2)	0.08
Sleeping hours (7–8 h/day)	13 (72.2)	32 (43.2)	0.03	27 (52.9)	25 (53.2)	0.98
Smoking behavior (never/ex-smoker)	12 (66.7)	49 (66.2)	0.97	43 (84.3)	42 (89.4)	0.46
Drinking behavior (non-drinker)	10 (55.6)	51 (68.9)	0.29	42 (82.4)	33 (70.2)	0.16
Lifestyle score (6–7)	5 (27.8)	9 (12.7)	0.13	21 (42.9)	14 (29.8)	0.19
Diabetes-related factors						
Duration of diabetes (≥ 10 years)	7 (38.9)	29 (39.7)	0.95	40 (78.4)	26 (55.3)	0.02
Treatment of diabetes						
Diet and exercise only	1 (5.6)	0 (0.0)	0.34	0 (0.0)	2 (4.3)	0.11
Oral hypoglycemic agents	13 (72.2)	53 (71.6)		33 (64.7)	34 (72.3)	
Insulin only or combination	4 (22.2)	21 (28.4)		18 (35.3)	11 (23.4)	
Number of oral antidiabetic agents (≥ 2 drugs)	11 (84.6)	48 (90.6)	0.54	26 (78.8)	34 (100.0)	1.00
Number of diabetic complication (≥ 1)	4 (26.7)	41 (59.4)	0.03	36 (70.6)	31 (67.4)	0.73
Diabetic complication (present)						
Chronic kidney disease	2 (11.1)	19 (25.7)	0.20	13 (25.5)	7 (14.9)	0.20
Diabetic retinopathy	1 (6.7)	21 (30.0)	0.09	19 (37.3)	12 (26.1)	0.24
Diabetic neuropathy	1 (5.6)	24 (34.3)	0.04	15 (29.4)	16 (34.0)	0.62
Lifestyle regimen adherence	3.0 (1.5–4.0)	2.5 (1.0–3.5)	<0.01	3.0 (1.5–4.0)	2.5 (1.0–4.0)	<0.01
Medical regimen adherence	4.0 (3.0–4.0)	4.0 (2.0–4.0)	0.25	4.0 (2.5–4.0)	4.0 (1.5–4.0)	0.54

Data presented as *n* (%) or median (range). Percentage of each item was calculated excluding missing data. Median (min–max) values are in italics.

*Significance was determined by univariate analysis.

control once diabetic complications present. A similar association was observed in our previous study among patients with hypertension; the achievement rate toward blood pressure goals was significantly higher among those patients with a history of cardiovascular disease than those without complications²¹. Regardless, better management of diabetes is required before onset of complications. To prevent these complications, health-care practitioners should support diabetic patients in practicing

self-management by ensuring patients have accurate self-perception of glycemic control. In addition to aforementioned, not achieving blood pressure control and having high family support were significantly associated with misperception among the non-elderly. These results, however, were obtained from the analysis of limited sample size, and further studies are warranted to verify and discuss the association between these two factors and patients' perceived glycemic control.

Table 4 | Factors associated with misperception of glycemic control among the poorly controlled patients by multivariate analysis

Significant variable in final model	Odds ratio†	95% CI
Non-elderly		
Family support (high)	7.32	1.28–42.01*
Blood pressure control (not achieved)	6.94	1.25–38.69*
Number of diabetic complication (≥ 1)	0.06	0.01–0.43**
Lifestyle regimen adherence	5.23	1.30–21.10*
Elderly		
Duration of diabetes (≥ 10 years)	4.06	1.41–11.72*
Lifestyle regimen adherence	5.15	2.17–12.24***

CI, confidence interval.

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

†Odds ratio was calculated using 'without misperception' as a reference group and adjusted by multiple logistic regression analysis for six factors in the non-elderly: family support, number of diabetic complications, lifestyle regimen adherence, snacks between meals, sleeping hours and blood pressure control; and four factors in the elderly: occupation, duration of diabetes, lifestyle regimen adherence and exercise frequency.

In actual clinical settings, physicians and other healthcare practitioners should pay more attention to misperception of glycemic control, especially in poorly controlled elderly patients, as well as in the non-elderly without diabetic complications. As asking the single question about patients' perception of glycemic control in the present study requires little time, it is useful to assess patients' perception in time-limited settings, such as outpatient clinics. When patients are seen to misperceive their glycemic control status, appropriate support should be provided. Previous intervention studies have reported the effectiveness of methods to improve patients' knowledge and understanding of HbA_{1c} for better glycemic control and self-management^{22,23}. In Japan, a diabetes passport supervised by the JDS is widely used at almost all diabetes clinics to record patients' HbA_{1c} levels and other medical data, and it could be a useful tool not only for recording data, but also for providing information on glycemic control to the patients. Furthermore, we have developed an information card that can be attached to the diabetes passport to enable patients to check their glycemic control level based on their HbA_{1c} value. This would appear to be a feasible way to encourage patients' appropriate perception.

The present study had several limitations. First, the patients who participated in this study were limited to those who attended a diabetes clinic at one hospital and agreed to participate in this study. In addition, there were too few participants to carry out age-specific analyses. Thus, the obtained results cannot be considered representative of all diabetic patients in Japan. The mean HbA_{1c} value of the present study was relatively lower than that of another study carried out at Japanese diabetes clinics, the mean value of which was 7.5–7.7%^{24,25}, meaning that overall glycemic control among the patients in the present study was relatively good. A multicenter study with

a larger sample size would be required to determine the generalization of the present results. Second, as the two steps constituting perception (i.e. recalling own HbA_{1c} value and interpreting the value) were not assessed in the present study, we were not able to verify that all patients rated self-perception of glycemic control by recalling their HbA_{1c} value. Third, as some questions in the present study, especially for evaluation of depression status and patients' family support, were simplified self-answering questions, it might have been insufficient to evaluate these patients' characteristics precisely and objectively. To investigate characteristics of patients with misperception, focusing on depressive status and family support, a more detailed and objective evaluation should be carried out. Finally, this report was based on cross-sectional data and as such we cannot infer causal relationships between the independent variables and patient misperception. To verify the causal relationships, longitudinal analyses are required.

In conclusion, the present study found that approximately one in three poorly controlled patients who attended our diabetes clinic misperceived their glycemic control. Furthermore, several characteristics of these patients with misperception were clarified. These results present the challenges to be addressed for the more effective provision of diabetes education and care in actual clinical settings. As patients' misperception is thought to be associated with poor glycemic control, physicians and other healthcare practitioners must regard patient perception as a fundamental component of patients' ability to self-manage their diabetes. This means that diabetes education and care that is tailored to each patient's understanding and level of self-perception should be provided in diabetes outpatient clinics.

ACKNOWLEDGMENTS

We are grateful to the Health Promotion Foundation for funding support, and thank the staff of the Outpatient Department, Hoshi General Hospital, for cooperating with this survey. The authors have no conflicts of interest to declare.

REFERENCES

1. Kahn CR, Weir GC, King GL, *et al.* (editors). Joslin's Diabetes Mellitus, 14th edn. Lippincott Williams and Wilkins, Philadelphia, 2005; 587–596.
2. Kobayashi M, Yamazaki K, Hirao K, *et al.* The status of diabetes control and antidiabetic drug therapy in Japan—A cross-sectional survey of 17,000 patients with diabetes mellitus (JDDM 1). *Diabetes Res Clin Pract* 2006; 73: 198–204.
3. The Japan Diabetes Society. Evidence-based Practice Guideline for the Treatment of Diabetes in Japan 2010. Nankodo Co., Ltd., Tokyo, 2010 (Japanese).
4. Funnel MM, Brown TL, Childs BP, *et al.* National standards for diabetes self-management education. *Diabetes Care* 2011; 34: s89–s96.
5. Nakano M, Moriyama M, Sakamaki H. A survey on the care and education system geared towards standardization of

- patient education for diabetes. *Journal of Health Sciences Hiroshima University* 2007; 6: 118–125 (Japanese).
6. Glanz K, Rimer KB, Lewis FM (editors). *Health Behavior And Health Education; Theory, Research and Practice*, 3rd edn. Jossey-Bass, San Francisco, CA, 2002; 45–51.
 7. Heisler M, Piette J D, Spencer M, *et al.* The relationship between knowledge of recent HbA1c values and diabetes care understanding and self-management. *Diabetes Care* 2005; 28: 816–822.
 8. Beard E, Clark M, Hurel S, *et al.* Do people with diabetes understand their clinical marker of long-term glycemic control (HbA1c levels) and does this predict diabetes self-care behaviours and HbA1c? *Patient Educ Couns* 2010; 80: 227–232.
 9. Yokokawa H, Nguyen TK, Goto A, *et al.* Diabetes control among Vietnamese patients in Ho Chi Minh City: an observational cross-sectional study. *Int Electron J Health Educ* 2010; 13: 1–13.
 10. The Committee on the Standardization of Diabetes Mellitus-Related Laboratory Testing of the Japan Diabetes Society. International Clinical Harmonization of Hemoglobin A1c in Japan: From JDS to NGSP values. Available at: http://www.jds.or.jp/jds_or_jp0/uploads/photos/813.pdf (accessed January 23 2012).
 11. Rubin RR, Peyrot M, Siminerio LM. Health care and patient-reported outcomes-results of the cross-national Diabetes Attitudes, Wishes and Needs (DAWN) study. *Diabetes Care* 2006; 29: 1249–1255.
 12. Whooley MA, Avins AL, Miranda J, *et al.* Case-finding instrument for depression. Two question are as good as many. *J Gen Intern Med* 1997; 12: 439–445.
 13. Suzuki T, Nobata R, Kim N, *et al.* Evaluation of questionnaires (Two-question case-finding instrument & Beck depression inventory) as a tool for screening and intervention of depression in work place. *Clin Psyc* 2003; 45: 699–708 (Japanese).
 14. Takanashi K, Sugisawa H, Teshima K, *et al.* The relationship between compliance with diet therapy and exercise treatment, and belief in therapy and family support among elderly diabetic patients. *Japanese Journal of Gerontology* 1996; 18: 41–49 (Japanese).
 15. Belloc NB, Breslow L. Relationship of physical health status and health practices. *Prev Med* 1972; 1: 409–421.
 16. Yokokawa H, Goto A, Abe Y, *et al.* Lifestyle characteristics and 3-year total mortality of Japanese with self-reported diabetes. *Health Soc Care Community* 2008; 16: 614–620.
 17. Ismail-Beigi F, Moghissi E, Tiktin M, *et al.* Individualizing glycemic targets in type 2 diabetes mellitus: implications of recent clinical trials. *Ann Intern Med* 2011; 154: 554–559.
 18. Marchasson IB, Doucet J, Bauduceau B, *et al.* Key priorities in managing glucose control in older people with diabetes. *J Nutr Health Aging* 2009; 13: 685–691.
 19. Birren JE, Schaie KW (editors). *Handbook of the Psychology of Aging*, 6th edn. Academic Press, Burlington, MA, 2005; 289–313.
 20. Paul C, Ayis S, Ebrahim S. Disability and psychosocial outcomes in old age. *J Aging Health* 2007; 19: 723–741.
 21. Yokokawa H, Goto A, Sanada H, *et al.* Longitudinal community-based assessment of blood pressure control among Japanese hypertensive patients: Fukushima Research of Hypertension (FRESH). *J Clin Hypertens* 2010; 12: 166–173.
 22. Chapin RB, Williams DC, Adair RF. Diabetes control improved when inner-city patients received graphic feedback about glycosylated hemoglobin levels. *J Gen Intern Med* 2003; 18: 120–124.
 23. Iqbal N, Morgan C, Maksoud H, *et al.* Improving patients' knowledge on the relationship between HbA1c and mean plasma glucose improves glycaemic control among persons with poorly controlled diabetes. *Ann Clin Biochem* 2008; 45: 504–507.
 24. Watanabe Y, Fujii H, Aoki K, *et al.* A cross-sectional survey of chronic kidney disease and diabetic kidney disease in Japanese type 2 diabetic patients at four urban diabetes clinics. *Intern Med* 2009; 48: 411–414.
 25. Nozaki T, Morita C, Matsubayashi S, *et al.* Relation between psychosocial variables and the glycemic control of patients with type 2 diabetes: a cross-sectional and prospective study. *BiopsychoSoc Med* 2009; 3: 4.