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Original Article

Glycemic Control and Associated Factors among Elderly Patients with Type 2 Diabetes in a Tertiary Hospital in Saku, Japan

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SUMMARY

Background: Type 2 diabetes mellitus (T2DM) is a major disease among the elderly in Japan. This study aimed to estimate the prevalence of glycemic control and determine its associated factors among elderly patients with T2DM in Saku, Japan. The associated factors included diabetes self-management and social support.

Methods: 307 patients with T2DM, aged ≥ 60 years and using oral hypoglycemic drugs were enrolled into the study at a private tertiary hospital in Saku, Japan. Data were collected in March 2019. A validated questionnaire was used to collect diabetes self-management and social support data. HbA1c < 7.0% was considered to be glycemic control.

Results: The mean HbA1c was 7.3%. Prevalence of glycemic control was 40.7%. Patients had adequate adherence to medication and hospital visits (94.8%), adequate physical activity (54.4%) and adequate dietary control (29.0%). Only 26.1% received high social support related to diabetes care from their families, friends or neighbors. Multiple logistic regression analysis indicated that a duration of diabetes ≤ 10 years (adjusted odds ratio [AOR] = 1.87, 95% CI = 1.12–3.14) and having no diabetes complications (AOR = 1.68, 95% CI = 1.03–2.74) were significantly associated with glycemic control. However, diabetes self-management and social support were not significantly associated with glycemic control.

Conclusion: The prevalence of glycemic control, dietary control and high social support was low. Triggering factors of glycemic control should be taken into consideration by healthcare providers when targeting and designing interventions to achieve glycemic control. Further study using individualized glycemic targets based on patient-specific characteristics should be conducted.

1. Introduction

Diabetes mellitus (DM) is becoming an important health problem in older adults. Worldwide prevalence of DM among patients over 65 years was 136 million in 2019 and the number of patients is expected to double by 2045. About 90–95% of all diagnosed cases of diabetes were type 2 diabetes (T2DM).[1] The main reasons for high prevalence of DM may be found in the longer life expectancy, unhealthy lifestyle habits, obesity, stress and environmental pollution.[2] Older individuals with diabetes have higher risks of developing complications, premature death, accelerated muscle loss, functional disability, and coexisting illnesses such as ischemic heart diseases, hypertension, and stroke, than those without diabetes.[3] Because of these health conditions, American Diabetes Association[4] recommends that the HbA1c goal for DM should be individualized in consideration of their duration of disease, age, life, co-morbidities, complications and hypoglycemia unawareness. However a reasonable HbA1c goal which may prevent developing complications is HbA1c < 7.0%.[2–4] Japan adopted the goal of HbA1c < 7% in order to prevent complications.[5]

Japan is the most and fastest aging country in the world. 27.7% of population was 65 years or over in 2017, and the aging is still proceeding rapidly.[6] Japan has one of the highest rates of diabetes in the world as well.[7] The increasing number of people with diabetes in Japan has increased the cost of DM treatment.[7,8] Glycemic control is fundamental to DM management. If patients can retain better glycemic control, the probability of complications occurring can be reduced. However, only 50.7% of DM patients in Japan are attaining HbA1c < 7.0%.[9] In Saku Central Hospital, only 52.4% of DM outpatients are attaining this goal.[10]

The improvement of relevant diabetes self-management among patients is an essential part of reaching and maintaining an optimal blood glucose level, of an improved prognosis of diabetes and of decreased risks of long-term complications.[11–13] In this study, we used Schmitt's et al.[14] diabetes self-management questionnaire (DSMQ) to assess the important aspects of diabetes self-management: physical activity, dietary control and healthcare use. Social support of the patient, both general support and diabetes-related support, especially from spouses and family members, is a vital component of helping elderly patients with T2DM successfully attain better glycemic control.[15–18]

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Saku is a typical city in the countryside of Japan in that its aging is proceeding faster than in urban areas. Saku Central Hospital, the study site, is the biggest hospital in Saku. Several previous studies[11–18] have researched the association between diabetes self-management, social support and glycemic control for DM patients, however studies focusing on only elderly patients are still scarce. Furthermore, the prevalence of glycemic control among elderly patients with T2DM is not yet exactly determined. Therefore, this study aimed to assess the prevalence of glycemic control and its associated factors, including diabetes self-management and social support, among elderly patients with T2DM in Saku, Japan.

2. Methods

This study was conducted at the outpatient clinic of the Diabetes and Endocrinology Department of Saku Central Hospital, the biggest tertiary hospital in Saku, Japan. The hospital has 858 beds and 1,624 outpatients per day on average. There were 2,502 DM outpatients during the study period and 826 were aged ≥ 60 years.[10,19] Elderly was defined as aged ≥ 60 years.[20] The inclusion criteria were T2DM outpatients diagnosed by medical doctors; aged ≥ 60; who can read and write Japanese and are willing to participate in the study. Patients who were hospitalized; using insulin for treatment and too ill or cognitively impaired (determined by the research team) were excluded from the study.

Due to no previous information about the prevalence of glycemic control among elderly patients aged ≥ 60 years with T2DM being available, a prevalence of 50% was determined to obtain the maximum sample size.[21] The sample size was estimated using the single-proportion formula with finite population correction[21] and a 95% confidence interval (CI). Precision was set at 4.5%, and the sample size was calculated to be at least 302 to represent the population of 826 outpatients aged ≥ 60 years with T2DM.[19] A total of 307 elderly patients with T2DM were recruited into the study.

The research proposal was approved by the Human Research Review Committee of the Faculty of Public Health, Mahidol University per COA. No. MUPH 2019-035 and The Ethical Committee of Saku Central Hospital (Ref. Approval No. R201901-06). Data were collected during March 2019. The study was explained to elderly patients who met the inclusion and exclusion criteria during visits to the diabetes clinics. Patients were asked for their informed consent to participate in the study.

2.1. Research instruments

The questionnaire comprised three parts and was translated into Japanese by the first author.

Part 1 of the questionnaire looked at general characteristics and had nine questions: age, sex, marital status, living situation (living alone or with someone), education level, occupation, income, smoking and alcohol drinking. In addition, six clinical variables were collected from a review of patient electronic records: HbA1c, BMI, duration of disease, complications, co-morbidities and family history of DM.

Part 2 covered diabetes self-management by the patients. The questions were taken from the Diabetes Self-Management Questionnaire (DSMQ).[14] The original DSMQ has 16 questions about glucose management, physical activity, dietary control, adherence and overall rating of self-care. However, self-measurement of blood glucose is limited to patients using insulin. Therefore, the three questions about blood glucose measurement were removed. In addition, a question about overall rating and three similar questions were removed. The order of the questions was changed to be easier to understood and answered by elderly participants. Responses for the remaining nine questions ranged from 0: "does not apply to me to" 3: "applies to me very much". A reversed score (0 = 3, 1 = 2, 2 = 1, 3 = 0) was used for questions 2, 3, 5 and 7. The total score was transformed to scale ranging from 0 to 10 (total raw score / theoretical maximum score * 10). A higher score indicates a higher self-rating of the assessed behavior; a score from 0 to ≤ 6 was considered "suboptimal self-management"; while a score from > 6 to 10 was considered "adequate self-management". If 'not required as a part of my treatment' was marked on an item, it was not used.[14] The Cronbach's alpha was 0.619.

Part 3 measured social support using 12 questions based on House's theory,[22] including questions about emotional support, instrumental support, informational support and appraisal support from family, friends and neighbors. Responses for these 12 questions were scored from "1 = Not at all to 5 = Always". A total score ≥ 3 suggests "adequate social support". The Cronbach's alpha was 0.879.

2.2. Data analysis

The data were analyzed using SPSS program version 18.0 (licensed for Mahidol University). Descriptive statistics were used to described all study variables. All independent variables were tested for multi-collinearity before performing multiple logistic regression to obtain odds ratios and 95% CI to determine the association between the independent variables and glycemic control.

3. Results

Of the 307 patients, 46.3% were aged 65–74 years. 56.4% were male and 73% were married. 85.0% lived with somebody. 80.8% had finished high school or lower. 59.6% were unemployed or retired. 51.8% had a middle income. 51.8% had never smoked and 35.5% were ex-smokers. 43.0% drank alcohol (Table 1).

Roughly 59.9% were normal or underweight. 72.6% had duration of diabetes 11 years or over. 53.4% had complications. Of these, 53.1% had nephropathy and 34.1% had neuropathy. 92.2% had some co-morbidities. Of these, 65.4% had hypertension and 56.9% had hyperlipidemia. About 4.6% reported that they had family history of DM. About 40.7% were under glycemic control (HbA1c < 7.0%) (Table 2).

3.1. Prevalence of glycemic control

The overall prevalence of glycemic control was 40.7%. The proportion of glycemic control was higher among men than women (42.8 vs. 38.1%). The proportion of glycemic control was higher among patients aged 60–64 years than in other age groups (45.2 vs. 40.8, 40.0%). (Table 3).

3.2. Diabetes self-management and social support

Approximately 60.6% of patients had adequate overall diabetes self-management. When looking further into each component, only adherence to medication and hospital visits met the criteria for diabetes self-management (94.8%). A low proportion of patients had adequate diabetes self-management in terms of dietary control (29.0%). In relation to social support, only 26.1% received high overall social support for diabetes self-management from their family, friends or neighbors (Table 4).

Table 1
General characteristics of 307 T2DM patients.

General characteristics	n	%
Age (years)		
60–64	31	10.1
65–74	142	46.3
≥ 75	134	43.6
Mean ± SD = 73.8 ± 7.8, Range = 60–96		
Sex		
Male	173	56.4
Female	134	43.6
Marital status		
Married	224	73.0
Single/divorced/separated/widowed	83	27.0
Living situation		
Alone	46	15.0
Live with somebody (spouse/child/other relative etc.)	261	85.0
Education level		
≤ High school	248	80.8
College, university or higher	59	19.2
Occupation		
Unemployed/retired	183	59.6
Still working	124	40.4
Yearly household income (yen)[a] (n = 251)		
< 200 million (low income)	93	37.1
200–600 million (middle income)	130	51.8
600 million or more (high income)	28	11.1
Smoking status		
Never smoked	159	51.8
Ex-smoker	109	35.5
Current smoker	39	12.7
Alcohol drinking		
Never drink/ex-drinker	175	57.0
Current drinker	132	43.0

[a] 1 USD = 108 yen.

3.3. Factors associated with glycemic control

In multiple logistic regression analysis, age, sex, diabetes self-management, social support and two variables associated with glycemic control at $p < 0.05$ in univariate analysis and with no multicollinearity problems, were simultaneously entered for multiple logistic regression analysis with enter method. Two variables re-

Table 3
Prevalence of glycemic control among 307 elderly patients with T2DM.

Age (years)/sex	Male		Female		Total	
	n	%	n	%	n	%
60–64	9/17	52.9	5/14	35.7	14/31	45.2
65–74	38/86	44.2	20/56	35.7	58/142	40.8
≥ 75	27/70	38.6	26/64	40.6	53/134	40.0
Total	74/173	42.8	51/134	38.1	125/307	40.7

Table 4
Summary of adequate diabetes self-management and high social support of 307 patients with T2DM.

Variables	n	%
Adequate diabetes self-management		
Overall diabetes self-management	186	60.6
Physical activity	167	54.4
Dietary control	89	29.0
Adherence to medication and hospital visits	291	94.8
High social support		
Overall social support	80	26.1
Emotional support	105	34.2
Instrumental support	94	30.6
Informational support	102	33.2
Appraisal support	83	27.0

Table 2
Clinical factors of 307 T2DM patients.

Clinical factors	n	%
Body mass index (BMI, kg/m^2)		
< 25.0	184	59.9
≥ 25.0	123	40.1
Duration of diabetes (years)		
≤ 10	84	27.4
> 10	223	72.6
Mean ± SD = 14.8 ± 7.4, Range = 0–41		
Complications		
No complications	143	46.6
With complications [a]	164	53.4
Nephropathy	87	53.1
Neuropathy	56	34.1
Retinopathy	54	32.9
Arteriosclerosis (angina pectoris, myocardial infarction, cerebral infarction)	67	40.9
Co-morbidities		
No co-morbidities	24	7.8
With co-morbidities [a]	283	92.2
Hypertension	185	65.4
Hyperlipidemia	161	56.9
Other disease e.g. asthma, heart failure, depression	115	40.6
Family history of diabetes		
Yes	14	4.6
No	293	95.4
HbA1c (%)		
Controlled (< 7.0)	125	40.7
Uncontrolled (≥ 7.0)	182	59.3
7.0–7.9	127	41.4
≥ 8.0	55	17.9
Mean ± SD = 7.3 ± 1.0, Range = 5.2–12.4		

[a] Multiple response.

mained significantly associated with glycemic control: duration of diabetes ≤ 10 years (AOR = 1.87, 95% CI = 1.12–3.14) and no complications (AOR = 1.68, 95% CI = 1.03–2.74) (Table 5).

Table 5
Adjusted odds ratios (AORs) for glycemic control by multiple logistic regression (n = 307).

Variables	AOR	95% CI	p-value
Age (years)			
< 75	1.09	0.67–1.79	0.726
≥ 75	1.00		
Sex			
Male	1.33	0.82–2.15	0.247
Female	1.00		
Duration of diabetes (years)			
≤ 10	1.87	1.12–3.14	0.017
> 10	1.00		
Complications			
No	1.68	1.03–2.74	0.038
Yes	1.00		
Diabetes self-management			
Adequate	1.15	0.71–1.87	0.572
Suboptimal	1.00		
Social support			
High	1.23	0.73–2.09	0.440
Low	1.00		

Adjusted for: age, sex, duration of diabetes, complications, diabetes self-management and social support.

4. Discussion

The findings of this study indicate that the prevalence of glycemic control in elderly patients aged ≥ 60 years with T2DM was rather low (40.7%). This result was lower than the 50.7% found in a report of 349 hospitals in Japan[9] and the 52.4% found in another study at Saku Central Hospital.[10] A possible reason to explain the lower result is that the elderly patients had a high proportion of complications (53.4%) and had a high proportion of co-morbidity (92.2%). The target HbA1c of elderly patients tend to be higher because the potential risk of hypoglycemia increases with age.[5] Another explanation might be due to the seasonal variation. The study data were mainly collected in March, which is the end of the cold and snow season in Japan. Patients tend not to walk or exercise outside in winter in Saku because of the low temperatures and snow, therefore glycemic control at this time might be worse than in other seasons.

However, the prevalence of glycemic control is higher than in the other studies in China (34.4%).[23] This might be due to the participating patients in Japan having better access to healthcare services.

Regarding diabetes self-management, 45.6% of patients did not exercise regularly. This might be they did not know how to do in house exercise. In addition, all kinds of physical performance decrease with aging.[24] The patients might not be able to do sufficient physical activity because of their physical condition. Another reason might be the cold weather during data collection period.

For dietary control, only 29.0% had adequate dietary control. The possible explanations include a lack of guidance and information given by health personnel/nutritionists, and a lack of recognition of dietary control by patients. Also, some patients told the researchers that they want to eat what they like because the rest of their life is not so long.

For adherence to medication and hospital visits, more than 90% had adequate diabetes self-management. This might be due to the medication management system in Japan where medicines are normally dispensed by drug stores outside of the hospital and leftover medicines are managed by not only doctors but also the drug store pharmacists using a medicine notebook and electronic medical records. This system makes it easier to find which patients have leftover medicines and give instructions to patients and their family about taking the prescribed medicines. Hospital appointments are also managed through the electronic medical records and medical staff phone patients if they do not show up for their hospital visit.

For social support. The overall availability of social support was not high as a whole (26.1%). The possible explanations might be due to Japanese culture. Japanese people take care of their own family but tend not to get involved in others' lives, meaning support from friends or neighbors would be limited or infrequent. Additionally, it is not common in Japan to ask family or friends for instrumental support, such as money and transportation. Free bus transportation run by the hospital is available for Saku Central Hospital, therefore patients can visit the hospital without asking friends or neighbors. Japanese people find it much easier to get information from various media, including TV, radio and internet, than from friends or neighbors.

A Japanese national report suggests that more than 60% of elderly people do not have friends or neighbors to talk with intimately.[25] It might be flection of the decreased social engagement of elderly people. Many patients in the study told researchers they did not have friends or neighbors to talk with frequently and when they did talk, they did not talk much about their private issues, such as their health or diabetes.

In this study, two variables of duration of diabetes and complications were significantly associated with glycemic control. Patients whose duration was ≤ 10 years were 1.87 times better at glycemic control than those whose duration was ≥ 11 years. A previous study also suggested that longer duration of DM is associated with poor glycemic control.[26] It might be too long time becomes more difficult to modify their behavior and keep motivation for glycemic control over time.

Patients with no complications were 1.68 times better at glycemic control than those patients with complications. The typical complications of DM were: neuropathy, retinopathy, nephropathy and arteriosclerosis. This might reflect the fact that complications occur in the result of bad glycemic control.[2–4]

We found that only patients with adequate diabetes self-management (OR = 1.15, 95% CI = 0.71–1.87), and high overall social support (OR = 1.23, 95% CI = 0.73–2.09) tended to have better glycemic control. But no significant association was found. These results are not in line with the findings of several previous studies[11–18] where adequate diabetes self-management and high diabetes-related support were significantly associated with good glycemic control. The reason for the discrepancy might be that previous studies[11–18] did not focus on elderly patients with T2DM. However, the results of this study are similar to the findings of Howteerakul et al.[27] who reported that social support tended to be associated with glycemic control, but did not find a significant association.

HbA1c < 7.0% is the general criteria for glycemic control for patients with DM. However, in Japan there are different criteria for elderly patients based on the kind of medications taken, the activities of daily living (ADL) and cognitive function.[27] We recommended healthcare providers to set a target value of HbA1c for each elderly patient. Although patients whose ADL was weakened or had obviously declined cognitive function were excluded from this study, individualized HbA1c targets for each patient were not considered. In addition, some parts of the questionnaire might be not appropriate due to the natural decline of physical and cognitive function due to aging.

4.1. Limitations

There are four limitations in this study which should be considered in any further studies: 1) Data were collected in a private hospital. It is unlikely to be representative of all hospitals in Japan; 2) The study had a cross-sectional study design, and it determined association rather than causal relationships between significant factors and glycemic control; 3) We could not analyze the prevalence of good glycemic control according to individualized target or patients aged > 75 years with major co-morbidities aiming at HbA1c < 7.5%. This was because it was too complicated to determine the target HbA1c set for each patient by their doctor; 4) In this study, the proportion of patients with reported family history of DM (4.6%) was lower than the proportion in the general population. This discrepancy is likely because the figure is based on the incomplete family history records held by the hospital.

4.2. Recommendations

Based on the findings, healthcare providers should provide more social support, such as nutrition and exercise guidance, for patients with longer duration DM or complications, if their glycemic control is not good. Providers should explain more about how to adjust the agreed diet plan when patients eat outside the house. Providers should not only provide diabetes self-management for elderly patients but also confirm their understanding the significant of glycemic control as well.

Further studies should be conducted with more representative samples and cover all year round. Patient-centered targets for each patient should be based on the health conditions of individual elderly patient.

Conflict of interest

None.

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