Analyzing the Association HbA1c control by Depression, social participation and Utilizing Self-management Questionnaire

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ABSTRACT

Aims: In Taiwan, 24.7% of the population aged ≥65 years has been diagnosed with type 2 diabetes. Only 23% of diabetes patients effectively conduct self-management. This study focused on the effects of self-management among type 2 diabetes patients aged ≥65 years on the effectiveness of their HbA1c control.

Methods: This cross-sectional study enrolled patients aged ≥65 years with type 2 diabetes who were admitted to a metabolic clinic at a medical center and treated over six months. 192 patients were recruited, and data were recorded using structured questionnaires. The HbA1c level of the recruited subjects was measured for statistical analysis.

Results: Older age, education, living alone, and an above-average level of self-management were associated with increased HbA1c control effectiveness; patients who used insulin had worse HbA1c control effectiveness.

Conclusion: That cohabitants living with diabetes patients affected the effectiveness of HbA1c control, suggesting that family members should also participate in self-management education programs. Given the advances in information networks, a lively and interactive mode of health education animation for uneducated diabetes patients should be developed, and medical teams should be encouraged to establish a two-way communication channel with patients improve the effectiveness of HbA1c control in diabetes patients aged >65 years.

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1. Introduction

Diabetes is a chronic, progressive, and long-term disease that affects body systems. Diabetes develops as a result of obesity, progressive reduction of beta-cell secretion of insulin, and insulin resistance and has the highest prevalence among the elderly population [1]. According to the International Diabetes Federation (IDF), the number of people with diabetes worldwide was 425 million in 2017 and is likely to increase to 629 million by 2045 [2], making diabetes care an issue of global concern. The medical cost of diabetes care is high. The cost of treating diabetes in the United States in 2017 was $327 billion [3]. In Taiwan, medical expenses related to diabetes care amount to NT 5.489 billion, accounting for 5.2% of the expenses of the National Health Insurance and ranking second in the top 10 diseases in outpatient clinics (including emergency departments) [4]. At present, 24.7% of the elderly people aged >65 years in Taiwan have been diagnosed with diabetes, accounting for 14% of the total number of diabetes patients [5,6], indicating that diabetes care may impose a heavy economic burden on society.

Diabetes control requires good self-management of diabetes. This self-management includes receiving relevant diabetes control education, gaining relevant knowledge, and having the support and skills to implement and maintain these behaviors [7]. Daily practice can reduce obstacles and solve problems in self-management of diabetes and help guide patients to make medical decisions [7]. Patients with better self-management are more effective at glycated hemoglobin (HbA1c) control [8,9]. Elderly with type 2 diabetes tend to develop depression due to their need to learn complex self-management skills and to change their lifestyles; thus, elderly individuals with diabetes have a higher risk of depression compared to the risk in those without [10]. Studies also revealed that diabetes patients with depression and more diabetes-related emotional problems have significantly less effective HbA1c control [11]; treatment hindrance and increased complications result in increased medical expenses and disability rates in daily life [10], underscoring the importance of preventing and treating depression due to self-management in diabetes patients. Elderly with type 2 diabetes need to complete complex self-management and change their lifestyles. To this end, they usually require help from social sectors such as friends, family members, health care providers, and community resources [12]; Spencer et al suggested that education and support from peer leadership and community involvement allow diabetes patients with limited resources to achieve self-management in the long term, leading to good effectiveness of HbA1c control and alleviation of psychological stress associated with diabetes [13].

The HbA1c level has always been the main indicator of the effectiveness of diabetes control and is currently recommended to be <7% so as to reduce the risk of microvascular disease long term [14,15], However, only 23% of diabetes patients comply with treatments and control their HbA1c levels to <7% [16]. Studies have shown that diabetes self-management leads to significant effectiveness of HbA1c control [1,15]. Diabetes control requires patients to comply with long-term treatments and conduct self-management, which may cause patients to feel tired and depressed, resulting in the gradual negligence of self-management [9]. However, few studies have explored the correlation between social participation and the effectiveness of HbA1c control. In clinics, social participation has been reported to potentially reduce depression and promote self-management in patients with type 2 diabetes. Therefore, the present study explored factors influencing the effectiveness of HbA1c control in type 2 diabetes patients aged >65 years.

2. Materials and methods

2.1. Design

The study population included type 2 diabetes patients who were admitted to a metabolic and endocrinology clinic at a medical center in the southern region between November 30, 2016, and June 30, 2017. Samples were obtained by convenience sampling. Using a structured questionnaire, diabetes patients who met the requirements for subject recruitment and who were willing to participate in this study were selected as subjects. After the required number of samples was achieved, data analysis was performed. The inclusion criteria were as follows: (1) patients aged ≥65 years who were diagnosed with type 2 diabetes by physicians and who had been treated for at least six months; (2) patients who were conscious and able care for themselves; and (3) patients who could clearly communicate in Mandarin and Taiwanese. The study program was reviewed and approved by Institutional Review Board of the Kaohsiung Veterans General Hospital (VGBKS16-CT12-22). Written informed consent was obtained from each participant before data collection.

2.2. Instruments

This study adopted a structured questionnaire for data collection. The questionnaires consisted of four parts, in the order of patients' basic information, Perceived Diabetes Self-Management Scale (PDSMS) with eight questions, the Taiwanese Depression Questionnaire (TDQ) with 18 questions, and the Social Participation Scale with 12 questions—thereby totaling 38 questions. The recruited subjects were divided into normal and abnormal groups according to HbA1c levels (tested after recruitment) retrieved through their medical record numbers. The questionnaires were subject to expert validity testing. The content validity index (CVI) values of the scales were between 0.88 and 1.0. The number of subjects required for this study was calculated using G-power 3.1.9.2. As described by Cohn (1988), with a statistical power of 0.8, an effect size (f^2) of 0.15, and α of 0.05, the number of required samples was 170 [17]. Assuming an estimated invalid questionnaire rate of 10%, at least 200 questionnaires were, thus, required. In this study, 200 questionnaires were distributed and 192 questionnaires were returned, corresponding to a recovery rate of 96%.

2.2.1. PDSMs
The PDSMS [18] was translated from the English edition described by Wallston et al. [19]. The scale consisted of a total

of eight questions scored using a five-point Likert scale, with each question's score ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Questions 5–8 contained negative words and were scored in a reverse manner; the total score range was 8–40, with a higher score indicating better diabetes self-management perceived by the patient. The Cronbach's α value was 0.695 in pre-testing of the questionnaires and 0.936 in the actual questionnaire survey.

2.2.2. TDq

The TDQ developed by Lee et al. [20] was adopted in this study to evaluate the degree of depression among the subjects. It consisted of a total of 18 question measured by a four-point Likert scale, with each question's score ranging from 0 ("none or very few (<1 day per week)") to 3 ("often or always (5-7 days per week)"), with the total score ranging from 0 to 54. Subjects were categorized as normal, slightly depressed, moderately depressed, and highly depressed for total scores below 8, 9–14, 15–18, and above 19, respectively. The Cronbach's α value was 0.892 in the pre-testing of the questionnaires and was 0.865 in the actual questionnaire survey.

2.2.3. Social participation scale

The social participation scale described by Tien and Chiou [21] was adopted in this study to measure the social participation of the subjects in their daily lives. This scale was based on the social participation scale proposed by Chang (2007) [22] and the Assessment of Life Habits (LIFE-H) of Fougeyrollas et al. (1998) [23]. The scale consisted of five sub-scales: personal and social responsibilities (questions 1–3), interpersonal interactions (questions 4–6), community life (questions 7–9), education and work (questions 10–11), and leisure and entertainment activities (question 12). Questions 1–10 and 12 were measured by four-point Likert scales, with each question's score ranging from 1 ("almost none") to 4 ("frequently"). Question 11 was scored as 1, 2, 3, and 4 points for the scenarios of "currently unemployed," "assisting family members in their job," "having a temporary and/or part-time paid job," and "having a long-term paid job and/or being self-employed," respectively. The total score ranged from 12 to 48, with a higher score indicating a higher degree of social participation. The Cronbach's α value in the pre-testing of the questionnaires was. 794 and was 0.780 in the actual questionnaire survey.

2.3. Statistical analysis

The variables analyzed in the study were as follows: age (continuous), sex (male or female), perceived economic condition (poor, average, wealthy), living condition (living alone, living with others), education level (uneducated, primary school, junior high school, senior high school and above), disease duration (≤10 years, 10.1–20, >20 years), current treatment method (no insulin use, insulin use), self-management (continuous values), degree of depression (continuous values), and social participation (continuous values). Eight individual scores from the PDSMS (points 1–5), 18 individual scores of the TDQ (points 0–3), and 12 individual scores of the Social Participation Scale (points 1–4) were used.

Percentages, maximum and minimum values, means, PDSMS, TDQ, and Social Participation Scale scores were calculated for descriptive statistical analysis and paired-samples t-tests, independent samples t-tests, and independent-samples one-way analysis of variance were used for inferential statistical analysis. Multivariate regression analysis was performed with the patients' demographic data, PDSMS, TDQ, and Social Participation Scale scores as independent variables to explore factors related to HbA1c. p-values <0.05 were considered statistically significant. The data were managed in Excel (Microsoft Corp, Redmond, Washington) and analyzed using IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, New York).

3. Results

As shown in Table 1, the average age of 192 subjects in this study was 74.1 years and 15.1% of the subjects were aged >85 years. The highest proportion of patients with abnormal HbA1c levels occurred in those aged 65–74 years (60.6%). The majority of the subjects were male (59.4%). Abnormal HbA1c levels were observed in 57.8% of male and 42.2% of female subjects. Higher proportions of abnormal HbA1c level were observed in the those with average economic condition (54.1%) and in subjects living with other people (79.8%) compared to those living alone (20.2%). Regarding education, the highest proportion of patients with abnormal HbA1c level occurred among those with senior high school education and above (42.2%) compared to the other three sub-groups (i.e., uneducated, with primary school education, and with junior high school education). Most of the subjects had a disease duration of ≤10 years (39.6%). The highest proportion of patients with abnormal HbA1c levels occurred in those with a disease duration of 10.1–20 years (39.4%) compared to those with disease duration of ≤10 and >20 years (39.4%). There were no statistically significant differences in the above-mentioned basic data. Among all subjects, 15.1% had insulin treatment, and the Pearson Chi-Square (p-value) was 0.001 (<0.05), indicating a statistically significant difference; 77.1% of patients not using insulin had HbA1c. The proportion of subjects with abnormal HbA1c level was higher in those not using insulin (77.1%) than that subject who used insulin (22.9%).

Table 2 shows the correlations of the degrees of diabetes self-management, depression, and social participation with the HbA1c level. In all subjects, 77.1% had an above-average degree of self-management (score above 31) ($p = 0.015$), indicating a significant correlation between the degree of self-management and normal HbA1c level. Among subjects with abnormal HbA1c levels, 70.6% had an above-average degree of self-management, while 29.4% had an average degree of self-management (score 20–30). In all subjects, the majority did not show depression (77.6%), while 79.8% and 20.2% of subjects with abnormal HbA1c level were depression-free and depressed, respectively. In all subjects, the majority (62%) had an above-average degree of social participation, while 60.6% and 39.4% subjects with abnormal HbA1c level had above-average and average degrees of social participation. There was no statistically significant difference in abnor-

Table 1 – Effect of sociodemographic characteristics on HbA1c level.

Characteristics	Total (N = 192) n (%)	Normal HbA1c (n = 83) n (%)	Abnormal HbA1c (n = 109) n (%)	p-value[a]
Age group				0.269
65–74 years	108 (56.3)	42 (50.6)	66 (60.6)	
75–84 years	55 (28.6)	25 (30.1)	30 (27.5)	
≥85 years	29 (15.1)	16 (19.3)	13 (11.9)	
Sex				
Male	114 (59.4)	51 (61.4)	63 (57.8)	0.610
Female	78 (40.6)	32 (38.6)	46 (42.2)	
Perceived economic condition				
Poor	49 (25.5)	23 (27.7)	26 (23.9)	0.171
Average	93 (48.4)	34 (41.0)	59 (54.1)	
Wealthy	50 (26.0)	26 (31.3)	24 (22.0)	
Living condition				
Living with other people	143 (74.5)	56 (67.5)	87 (79.8)	0.052
Living alone	49 (25.5)	27 (35.5)	22 (20.2)	
Education level				
Uneducated	24 (12.5)	6 (7.2)	18 (16.5)	0.162
Primary school	62 (32.3)	32 (38.6)	30 (27.5)	
Junior high school	25 (13.0)	10 (12.0)	15 (13.8)	
Senior high school and above	81 (42.2)	35 (42.2)	46 (42.2)	
Disease duration				
≤10 years	76 (39.6)	38 (45.8)	38 (34.9)	0.250
10.1–20 years	73 (38.0)	30 (36.1)	43 (39.4)	
>20 years	43 (22.4)	15 (18.1)	28 (25.7)	
Current treatment method				
No insulin use	163 (84.9)	79 (95.2)	84 (77.1)	0.001
Insulin use	29 (15.1)	4 (4.8)	25 (22.9)	
[a] chi-squared test.				

Table 2 – Effect of the degrees of self-management, depression, and social participation on HbA1c level.

Characteristics	Total (N = 192) n (%)	Normal HbA1c (n = 83) n (%)	Abnormal HbA1c (n = 109) n (%)	p-value[a]
Degree of self-management (score)				0.015
Average (20–30)	44 (22.9)	12 (14.5)	32 (29.4)	
Above-average (31+)	148 (77.1)	71 (85.5)	77 (70.6)	
Depression				0.399
No	149 (77.6)	62 (74.7)	87 (79.8)	
Yes	43 (22.4)	21 (25.3)	22 (20.2)	
Degree of social participation (score)				0.640
Average (24–35)	73 (38.0)	30 (36.1)	43 (39.4)	
Above-average (36+)	119 (62.0)	53 (63.9)	66 (60.6)	
[a] chi-squared test.				

mal HbA1c levels between the two degrees of depression and between the two degrees of social participation.

Table 3 presents the results of regression analysis, adjusted for the confounding effects of age, sex, perceived economic condition, living condition, education level, disease duration, current treatment method, self-management, degree of depression, and degree of social participation; the odds ratio (OR) per year of increasing age was 0.950, which was statistically significant ($p = 0.044$), indicating that for every year of age increase, the OR of abnormal HbA1c level decreased by 5%; that is, the older the patient, the better the effectiveness of HbA1c control.

After adjusting for the influence of other related variables, the OR of abnormal HbA1c level in the patients living alone was 0.368 compared to those living with others. The significant negative correlation ($p = 0.037$) indicated that those living alone had better effectiveness of HbA1c control than that in those living with others. The ORs of abnormal HbA1c level in the subjects with primary school education and with senior high school and above education were 0.197 and 0.221, respectively, compared to being uneducated. The significant negative correlation ($p = 0.009$; $p = 0.021$) indicated that the educated subjects had better effectiveness of HbA1c control. The OR of abnormal HbA1c level in those using insulin was

Table 3 – Multivariate logistic regression analysis of normal HbA1c level.

Variables	OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age	0.965	(0.928, 1.004)	0.075	0.950	(0.904, 0.999)	0.044
Disease duration	1.028	(0.994, 1.064)	0.106	1.037	(0.996, 1.078)	0.076
Sex						
Male		Ref			Ref	
Female	1.164	(0.650, 2.085)	0.610	1.043	(0.430, 2.531)	0.926
Perceived economic condition						
Poor (0)		Ref			Ref	
Average (1)	1.535	(0.761, 3.098)	0.232	1.732	(0.767, 3.910)	0.186
Wealthy (2)	0.817	(0.371, 1.797)	0.615	1.203	(0.490, 2.955)	0.687
Living condition						
Living with other people		Ref			Ref	
Living alone	0.524	(0.272, 1.010)	0.54	0.368	(0.144, 0.942)	0.037
Education level						
Uneducated (0)		Ref			Ref	
Primary school (1)	0.313		0.030	0.197	(0.058, 0.668)	0.009
Junior high school (2)	0.500		0.266	0.335	(0.081, 1.386)	0.131
Senior high school and above(3)			0.114	0.221	(0.061, 0.794)	0.021
Current treatment method						
No insulin use (0)		Ref			Ref	
Insulin use (1)	5.878	(1.958, 17.645)	0.002	6.543	(1.986, 21.557)	0.002
Degree of self-management						
Average (20–30) (0)		Ref			Ref	
Above-average (31−) (1)	0.407	(0.194, 0.850)	0.017	0.386	(0.169, 0.884)	0.024
Depression						
No		Ref			Ref	
Yes	0.747	(0.378, 1.475)	0.400	0.622	(0.265, 1.456)	0.274
Degree of social participation						
Average (24–35)		Ref			Ref	
Above-average (36+)	0.869	(0.482, 1.567)	0.640	0.790	(0.373, 1.676)	0.540

OR, odds ratio; CI, confidence interval.

6.543 times that in those with no insulin use. The significant positive correlation ($p = 0.002$) indicated that HbA1c control was less effective in the subjects using insulin. After adjusting for the influence of other related variables, the OR of abnormal HbA1c level in those with an above-average degree of self-management (score above 31) was 0.386 times that in those with an average degree (score 20–30). The significant negative correlation between self-management and HbA1c level ($p = 0.024$) indicated that patients with an above-average degree of self-management had better effectiveness of HbA1c control.

4. Discussion

This study investigated the association of factors such as patients' basic information, self-management, degree of depression, and degree of social participation with HbA1c level. After adjusting for the effects of the variables of age, sex, perceived economic condition, living condition, education level, disease duration, current treatment method, self-management, degree of depression, and degree of social participation, the present study revealed that the effectiveness of HbA1c control increased with age and was better among patients who received education, lived alone, and had an above-average degrees of self-management. Furthermore, patients using insulin had worse effectiveness of HbA1c control than those not using insulin.

The results of the present study found that for every one year increase in age, the chance of abnormal HbA1c level decreased, a finding similar to that of Maneze et al and which was attributed to the observation that older subjects may be more concerned about health problems and death and have time for self-management, thereby having better effectiveness of HbA1c control [24]. Maneze et al showed that younger patients with type 2 diabetes needed to spend more time at work and at home than their older counterparts and were more prone to neglect self-management, suggesting the need to further understand the reasons that prevent younger patients from conducting diabetes self-management [24]. Nanayakkara et al suggested that a deeper insight into the reasons for hindered self-management in younger diabetes patients is necessary in the clinic and that individualized self-management interventions should be designed to improve the effectiveness of HbA1c control [25].

HbA1c levels were more normal in patients living alone compared to those in patients living with other people, indicating that the people living with a patient affect the effectiveness of the patient's HbA1c control. Brown et al also found residency status (living with others or living alone) to be an important factor affecting the effectiveness of HbA1c control in patients with diabetes [26]. This finding may be attributed to patients failing to make their own decisions by accepting meals prepared by family members who do not understand diabetes control, thereby affecting the effective-

ness of HbA1c control [27]. Brown et al reported that family member participation in meeting on HbA1c level control for one year about significantly affect the patients' HbA1c level, indicating that encouraging the co-participation of the family members in self-management education courses may help to improve the effectiveness of HbA1c control [26].

Educated subjects had better effectiveness of HbA1c control than that in those who were uneducated. Uneducated patients lack knowledge about diabetes; therefore, it is impossible for them to set goals, increase self-confidence, and cultivate motivation for continuous self-management, thereby leading to poor effectiveness of HbA1c control [15,24]. Maneze et al suggested that it is possible to improve the effectiveness of HbA1c control in uneducated patients by focusing on the patient to connect them with family and cultural resources and allowing them to learn about diabetes self-management with their families [24]. With advancements in information networks, it is possible to develop a more lively and interactive mode of health education for uneducated people by providing problem-solving methods, setting appropriate goals, cultivating self-management motives, and implementing other lifestyle-changing interventions to improve the effectiveness of their health education.

HbA1c control was less effective in patients treated with insulin, consistent with the reports of a number of other studies [9,28–30]. Yigazu and Desse suggested that abnormal HbA1c levels may be due to decreased insulin secretion by β-cells in these patients [15]. Ramirez et al found that self-management in insulin-using individuals was significantly associated with diabetes-related knowledge, family factors, family lifestyles, and doctor-patient relationships [28]. Therefore, regular monitoring of self-management and treatment compliance in patients treated with insulin; good communication between the medical team and the patients, along with their family members; and regular screening and understanding of the lifestyle of patients and their family members will help to improve the effectiveness of HbA1c control in insulin-treated patients.

The degree of depression and social participation of the subjects did not have significant effects on the effectiveness of HbA1c control, contrary to findings reported by Houle et al. and Lima et al. [9,31]. The inconsistency was likely due to the fact that the subjects were followed-up for a long time in a medical center, where they received good health education, conducted self-management well, and had an above-average degree of social participation. Thus, most of the diabetes patients were free of depression and had good health, clear consciousness, and self-care ability. A cross-sectional study of social capital in Japan reported that, among patients with type 2 diabetes, participation in their favorite activities can alleviate diabetes-related emotional distress and benefit HbA1c control [27]. Another study of 300 patients with type 2 diabetes also noted that solidarity and trust are significantly and negatively correlated with HbA1c level [32]. Regarding self-management, the present study found that the HbA1c level was more normal among patients with an above-average degree of self-management compared to the level in those with an average degree of self-management. Yigazu and Desse also found that adherence to regular follow-up was an independent predictor of glycemic control in diabetes

patients, indicating that self-management can influence the effectiveness of HbA1c control [8,15]. The finding in the present study that people living with diabetes patients have an important influence on the effectiveness of their HbA1c control, future research should collect data on the family members of patients with type 2 diabetes. Furthermore, patients should be encouraged to co-participate in diabetes self-management training in clinics with the people they are living with so as to increase the participation of the cohabitants regarding the requirements for self-management in patients with diabetes.

5.   Conclusions

This study investigated the factors affecting the effectiveness of HbA1c control in diabetes patients aged >65 years, finding that the effectiveness increased with age and was better among those who received education, lived alone, and had an above-average degree of self-management compared to that in those who did not. Furthermore, the effectiveness of HbA1c control was worse in those treated with insulin.

The clinical recommendation is to strengthen the health education and follow-up of younger diabetes patients and to further characterize the factors hindering diabetes self-management; in the meantime, the results also revealed that the people living with the patients affected the effectiveness of HbA1c control in the patients; therefore, family members living with patients should co-participate in self-management education courses. With the advancement of the information network, we recommend the development of a livelier and more graphically-interactive mode of health education for uneducated patients and encourage medical teams to establish two-way communication with patients to assist self-management for improving the effectiveness of HbA1c control diabetes in patients aged >65 years.

Declaration of Competing Interest

The authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

Author contributions

Study concept and design (L-Y L, P-L T); acquisition of data (Y-T L); analysis and interpretation of data and statistical

analysis (Y-T L, C-W T); drafting of the manuscript (Y-T L, L-Y L, C-W T, C-Y Y); critical revision of the manuscript for important intellectual content (Y-T L, L-Y L, C-W T, C-Y Y, P-L T); study supervision (Y-T L, P-L T).

R E F E R E N C E S

[1] American Diabetes Association. J Clin Appl Res Educat 2018;41:S1–S159.

[2] International Diabetes Federation. Diabetes facts & figures. <https://idf.org/aboutdiabetes/what-is-diabetes/facts-figures.html; 2017> [accessed 22 April 2019].

[3] Shrestha SS, Honeycutt AA, Yang W, Zhang P, Khavjou OA, Poehler DC, et al. Economic costs attributable to diabetes in each U.S. state. Diabet Care 2018;41(12):2526–34. https://doi.org/10.2337/dc18-1179.

[4] Ministry of Health and Welfare. National health expenditure; 2017. <https://dep.mohw.gov.tw/DOS/np-4267-113.html; 2018> [accessed 22 April 2019].

[5] Ministry of Health and Welfare. Statistics of medical care, national health insurance 2014; 2015b. <https://dep.mohw.gov.tw/DOS/cp-1767-3586-113.html> [accessed 22 April 2019].

[6] Ministry of Health and Welfare. Report of the Senior Citizen Condition Survey 2013: 2015a. <https://dep.mohw.gov.tw/DOS/cp-1767-3586-113.html> [accessed 22 April 2019].

[7] Powers MA, Bardsley J, Cypress M, Duker P, Funnell MM, Fischl AH, et al. Diabetes self-management education and support in type 2 diabetes: a joint position statement of the American diabetes association, the American association of diabetes educators, and the academy of nutrition and dietetics. Clin Diabet 2016;34:70–80. https://doi.org/10.2337/dc15-0730.

[8] Schmitt A, Reimer A, Hermanns N, Huber J, Ehrmann D, Schall1 S, et al. Assessing diabetes self-management with the diabetes self-management questionnaire (DSMQ) can help analyse behavioural problems related to reduced glycemic control. PLoS One 2016;11(3):e0150774. https://doi.org/10.1371/journal.pone.0150774.

[9] Houle J, Beaulieu MD, Chiasson JL, Lesperance F, Cote J, Strychar I, et al. Glycaemic control and self-management behaviours in Type 2 diabetes: results from a 1-year longitudinal cohort study. Diabet Med 2015;32(9):1247–54. https://doi.org/10.1111/dme.12686.

[10] Park M, Reynolds CF. Depression among older adults with diabetes mellitus. Clin Geriatr Med 2015;31(1):117–37. https://doi.org/10.1016/j.cger.2014.08.022.

[11] Nanayakkara N, Pease A, Ranasinha S, Wischer N, Andrikopoulos S, Speight J, et al. Depression and diabetes distress in adults with type 2 diabetes: results from the Australian National Diabetes Audit (ANDA) 2016. Sci Rep 2018;8(1):7846. https://doi.org/10.1038/s41598-018-26138-5.

[12] Farajzadegan Z, Jafari N, Nazer S, Keyvanara M, Zamani A. Social capital - a neglected issue in diabetes control: a cross-sectional survey in Iran 2013. Health Soc Care Commun 2013;21(1):98–103. https://doi.org/10.1111/j.1365-2524.2012.01091.x.

[13] Spencer MS, Kieffer EC, Sinco B, Piatt G, Palmisano G, Hawkins J, et al. Outcomes at 18 months from a community health worker and peer leader diabetes self-management program for latino adults. Diabet Care 2018;41(7):1414–22. https://doi.org/10.2337/dc17-0978.

[14] Seferovic JP, Bentley-Lewis R, Claggett B, Diaz R, Gerstein HC, Kober LV, et al. Retinopathy, neuropathy, and subsequent cardiovascular events in patients with Type 2 diabetes and acute coronary syndrome in the ELIXA: the importance of disease duration. J Diabet Res 2018;2018:1631263. https://doi.org/10.1155/2018/1631263.

[15] Yigazu DM, Desse TA. Glycemic control and associated factors among type 2 diabetic patients at Shanan Gibe Hospital Southwest Ethiopia. BMC Res Notes 2017;10:597. https://doi.org/10.1186/s13104-017-2924-y.

[16] Raebel MA, Schmittdiel J, Karter AJ, Konieczny JL, Steiner JF. Standardizing terminology and definitions of medication adherence and persistence in research employing electronic databases. Med Care 2013;51:S11–21. https://doi.org/10.1097/MLR.0b013e31829b1d2a.

[17] Cohen J. Statistical power analysis for the behavioral sciences. Hillsdale, New Jersey: Lawrence Erlbaum Associates; 1988.

[18] Lin SM, Lin SL, Wu YC, Chang CM, Wu HL. Validity and reliability of a Chinese translation of a perceived diabetes self-management scale. Nursing Health Care Res 2011;7:198–206.

[19] Wallston KA, Rothman RL, Cherrington A. Psychometric properties of the perceived diabetes self-management scale (PDSMS). J Behav Med 2007;30(5):395–401. https://doi.org/10.1007/s10865-007-9110-y.

[20] Lee Y, Yang MJ, Lai YJ, Chiu NM, Chau TT. Development of the taiwanese depression questionnaire. Chang Gung Med J 2000;23(11):688–94.

[21] Tien HC, Chiou CJ. Study of social participation and related factors in persons with disabilities. J Nursing Healthcare Res 2013;9:182–91.

[22] Chang ML. A study of selfconcept, social engagement, and suicide ideation among the elderly Unpublished master's thesis [dissertation]. Taiwan: Asia University; 2007.

[23] Fougeyrollas P, Noreau L, Bergeron H, Cloutier R, Dion SA, St-Michel G. Social consequences of long term impairments and disabilities: Conceptual approach and assessment of handicap. Int J Rehabil Res 1998;21(2):127–41. https://doi.org/10.1097/00004356-199806000-00002.

[24] Maneze D, Everett B, Astorga C, Yogendran D, Salamonson Y. The influence of health literacy and depression on diabetes self-management: a cross-sectional study. J Diabetes Res 2016;2016:3458969. https://doi.org/10.1155/2016/3458969.

[25] Nanayakkara N, Ranasinha S, Gadowski AM, Davis WA, Flack JR, Wischer N, et al. Age related differences in glycaemic control, cardiovascular disease risk factors and treatment in patients with type 2 diabetes a cross sectional study from the Australian National diabetes audit. BMJ Open 2018;8:e020677. https://doi.org/10.1136/bmjopen-2017-020677.

[26] Brown SA, Garcia AA, Orlander PR, Hanis CL. A randomized clinical trial of diabetes self-management for Mexican Americans: are there serendipitous health benefits for supporters of study participants? SAGE Open Med 2017;5 (2050312116682125). https://doi.org/10.1177/2050312116682125.

[27] Yamada Y, Suematsu M, Takahashi N, Okazaki K, Yasui H, Hida T, et al. Identifying the social capital influencing diabetes control in Japan. Nagoya J Med Sci 2018;80(1):99–107. https://doi.org/10.18999/nagjms.80.1.99.

[28] Ramirez LDH, Soto AF, Valenzuela CLC, Ochoa MC, Gonzalez HR, Lopez MCM. Factors influencing glycemic control in patients with diabetes Type II in Mexican patients. J Fam Med 2016;3(2):1051.

[29] Ferwana M, Abdulmajeed I, Madani WA, AlDughaither A, Alrowaily MA, Bader BA, et al. Glycemic control and accompanying risk factors: 4-year primary care study. J Diabetes Metab 2015;06.

[30] Walker RJ, Smalls BL, Egede LE. Social determinants of health in adults with type 2 diabetes–contribution of mutable and immutable factors. Diabetes Res Clin Pract 2015;110 (2):193–201. https://doi.org/10.1016/j.diabres.2015.09.007.

[31] Lima RF, Fontbonne A, Carvalho EM, Montarroyos UR, Barreto MN, Cesse EA. Factors associated with glycemic control in people with diabetes at the family health strategy in pernambuco. Rev Esc Enferm USP 2016;50(6):937–45. https://doi.org/10.1590/S0080-623420160000700009.

[32] Moradi Y, Nasehi M, Asadi-Lari M, Khamseh ME, Baradaran HR. The relationship between social capital components and control of type 2 diabetes: a path analysis model. Med J Islam Repub Iran 2017;31(1):21. https://doi.org/10.18869/mjiri.31.21.