ORIGINAL ARTICLE

A causal relationship model of factors influencing glycemic control among the elderly with type 2 Diabetes Mellitus in Sukhothai Province, Thailand

Pattama Suphunnakul[1], Suthichai Sirinual[2], Vimala Chayodom[3] and Orapin Singhadej[4]

[1] *Ph.D., Faculty of Public Health, Naresuan University, Thailand.*
[2] *Dr.P.H., School of Medicine, University of Phayao, Thailand.*
[3] *M.P.H., Faculty of Public Health, Naresuan University, Thailand*
[4] *Dr.P.H., Faculty of Public Health, Naresuan University, Thailand*

Corresponding Author: *Pattama Suphunnakul* ***Email:*** *Psk287@gmail.com*
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Abstract

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The purpose of this study was to investigate the causal relationships model of the factors influencing glycemic control among the elderly with type 2 diabetes mellitus (T2DM). A multi stage sampling was used to recruit 390 patients with type 2 diabetes from 9 primary care units in Sukhothai Province. Data were collected by questionnaire with reliability value of knowledge, social support and self-care behaviors were 0.81, 0.82 and 0.82, respectively. Data were analyzed using descriptive statistics and testing a causal relationship model by path analysis.

The results showed that 58.5% were females. Of 57.7% had duration of illness 1- 5 years with the mean of 5.48 years and S.D. of 2.42. Most of them (59.5%) aged 60-64 years with the mean age of 63.98 years and S.D. of = 2.29. Half of the sample had poorly controlled fasting blood glucose (FBG ≥ 126 mg/dl) with the mean of 135.19 mg/dl. The analysis of a causal relationship model illustrated by social support demonstrated direct effect on self- care behaviors (β = 0.81, *p-value* < 0.05), and explained the variance in self – care behaviors at 91%. On the other hand, diabetes knowledge had no direct effect on self-care behaviors (β = 0.15, *p-value* < 0.05). However, self- care behaviors had a negative direct effect on FBG (β = 0.82, *p-value* < 0.05), and explained the variance in FBG at 67% .

In conclusion, social support was the most important factor on diabetes self-management. Meanwhile, the knowledge cannot change their behavior. In order to control T2DM among the elderly, the focus should be on promoting social support rather than diabetes knowledge.

Keywords: self-care behavior, elderly, type 2 diabetes mellitus, glycemic control

วารสารสาธารณสุขและการพัฒนา
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โมเดลความสัมพันธ์เชิงสาเหตุของปัจจัยที่มีอิทธิพลต่อการควบคุมระดับน้ำตาลในเลือดของผู้สูงอายุที่ป่วยเป็นโรคเบาหวานชนิดที่ 2 จังหวัดสุโขทัย ประเทศไทย

ปัทมา สุพรรณกุล[1] สุทธิชัย ศิรินวล[2] วิมาลา ชโยดม[3] และ อรพินท์ สิงหเดช[4]

[1] *Ph.D., คณะสาธารณสุขศาสตร์ มหาวิทยาลัยนเรศวร ประเทศไทย*
[2] *Dr.P.H., คณะแพทยศาสตร์ มหาวิทยาลัยพะเยา ประเทศไทย*
[3] *M.P.H., คณะสาธารณสุขศาสตร์ มหาวิทยาลัยนเรศวร ประเทศไทย*
[4] *Dr.P.H., คณะสาธารณสุขศาสตร์ มหาวิทยาลัยนเรศวร ประเทศไทย*

บทคัดย่อ

ปัทมา สุพรรณกุล สุทธิชัย ศิรินวล วิมาลา ชโยดม และอรพินท์ สิงหเดช
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ว.สาธารณสุขและการพัฒนา 2560; 15(2):31-42

การวิจัยนี้มีวัตถุประสงค์เพื่อศึกษาโมเดลความสัมพันธ์เชิงสาเหตุของปัจจัยที่มีอิทธิพลต่อการควบคุมระดับน้ำตาลในเลือดของผู้สูงอายุที่ป่วยเป็นโรคเบาหวานชนิดที่ 2 กลุ่มตัวอย่าง ได้แก่ผู้สูงอายุที่ป่วยเป็นโรคเบาหวาน จำนวน 390 คน ที่สุ่มมาจาก 9 โรงพยาบาลส่งเสริมสุขภาพตำบล ในพื้นที่จังหวัดสุโขทัย ด้วยวิธีการสุ่มแบบหลายขั้นตอน เก็บรวบรวมข้อมูลด้วยแบบสอบถามที่มีค่าความเชื่อมั่นของความรู้ แรงสนับสนุนทางสังคม และพฤติกรรมการดูแลตนเอง เท่ากับ 0.81, 0.82 และ 0.82 ตามลำดับ วิเคราะห์ข้อมูลด้วยสถิติเชิงพรรณนาและทดสอบโมเดลด้วยการวิเคราะห์อิทธิพลเส้นทาง

ผลการวิจัย พบกลุ่มตัวอย่างเป็นเพศหญิง ร้อยละ 58.5 ส่วนใหญ่(ร้อยละ 57.7) เจ็บป่วยเป็นเบาหวานอยู่ในช่วง 1- 5 ปี มีระยะเวลาป่วยเฉลี่ยเท่ากับ 5.48 ปี ส่วนเบี่ยงเบนมาตรฐานเท่ากับ 2.42 มีอายุอยู่ระหว่าง 60-64 ปีมากที่สุดร้อยละ 59.5 อายุเฉลี่ยเท่ากับ 63.98 ปี ส่วนเบี่ยงเบนมาตรฐานเท่ากับ 2.29 ร้อยละ 50 ของกลุ่มตัวอย่างพบว่าไม่สามารถควบคุมระดับน้ำตาลในเลือดให้อยู่ในระดับปกติได้ (FBG ≥ 126 mg/dl) ซึ่งมีค่าเฉลี่ยของระดับน้ำตาลเท่ากับ 135.19 มิลลิกรัม / เดซิลิตร ผลการวิเคราะห์โมเดลพบว่า แรงสนับสนุนทางสังคมมีอิทธิพลทางตรง (เชิงบวก) กับพฤติกรรมการดูแลตนเองของผู้ป่วย (β = 0.81, *p-value* < 0.05) โดยพบว่าสามารถทำนายพฤติกรรมการดูแลตนเองได้ร้อยละ 91.0 ในขณะที่ความรู้เกี่ยวกับโรคเบาหวานไม่มีอิทธิพลทางตรงต่อพฤติกรรมการดูแลตนเองของผู้ป่วย (β = 0.15, *p-value* < 0.05) อย่างไรก็ตามพบว่าพฤติกรรมการดูแลตนเองของผู้ป่วยมีอิทธิพลทางตรง (เชิงลบ) กับระดับน้ำตาลในเลือด (β = 0.82, *p-value* < 0.05) โดยสามารถทำนายระดับน้ำตาลในเลือดได้ร้อยละ 67.0

ข้อสรุปการวิจัย พบว่า แรงสนับสนุนทางสังคมเป็นปัจจัยสำคัญที่ช่วยให้ผู้ป่วยเบาหวานปรับเปลี่ยนพฤติกรรมในการดูแลตนเอง ในขณะที่ความรู้ไม่สามารถทำให้ผู้ป่วยปรับเปลี่ยนพฤติกรรมได้ ดังนั้นในการควบคุมระดับน้ำตาลในเลือดของผู้สูงอายุที่ป่วยเป็นโรคเบาหวาน จึงควรให้การส่งเสริมสนับสนุนด้านแรงสนับสนุนทางสังคมมากกว่าการให้ความรู้กับผู้ป่วย

คำสำคัญ: พฤติกรรมการดูแลตนเอง ผู้สูงอายุ โรคเบาหวานชนิดที่ 2 การควบคุมระดับน้ำตาลในเลือด

Introduction

The prevalence of diabetes mellitus (DM) has been increasing overtime worldwide. Type 2 diabetes mellitus (T2DM) comprises 90% of the people with diabetes around the world.[1] It is a major cause of morbidity and mortality among the global population.[1] The cumulative number of patients with T2DM has increased in every country. Among those more than 80% live in developing countries. In 2014, there were 387 million people suffering from T2DM. Of these, 46.3% were undiagnosed and 77% of them live in low- and middle-income countries.[2] The greatest number of people with T2DM was found to be between 40 and 59 years of age. Furthermore, healthcare expenditure of patients with T2DM increaseding from 548 billion (USD) in 2013 to 612 billion (USD) in 2014.3 The health care expenditures for elderly (60-69 years old) care showed the highest proportion.[2-3] Moreover, the number of people with T2DM was expected to increase from 387 million in 2013 to 592 million in 2035.[3] The World Health Organization (WHO) predicted that diabetes will be the 7th leading cause of death in 2030.[1]

In Thailand, the finding of the health survey during 1971-2009 revealed that the prevalence rate of T2DM was more likely to increase significantly. The prevalence rate of T2DM was 2.5% in 1971 and it rose to 6.9 per 100 population in 2009.[4] The morbidity rate in T2DM patients during 2007– 2013 was 795.04, 844.90, 879.58, 954.18, 968.22, 1,050.05, and 1,081.25 per 100,000 population, respectively. In 2008, the mortality rate of T2DM patients 60 years and over was 73.3 per 100,000 population.[5] In 2013, 4.2 million people had T2DM and approximately 28% of them were undiagnosed. Moreover, 79.6% had uncontrolled blood sugar (HbA1C > 7.0%), 14.9% suffered from complications such as retinopathy, 2.1% had foot ulcers, and 1.1% had cardiovascular disease. Currently, healthcare expenditures due to T2DM in Thailand is 47.5 billion (THB).[6] The complications of T2DM not only damage the blood vessels, and nerves, but also result in a poor health-related quality of life.[7]

Sukhothai Province is located in the northern part of Thailand. In 2011, the morbidity rate in T2DM patients in Sukhothai Province was among the top ten in this region.[6] The morbidity rate was 8,703.02 per 100,000 population. The number of patients with T2DM between 2009 and 2013 was 13,916, 18,493, 19,635, 19,776, and 19,685, respectively.[8] In 2013, 19,688 patients with T2DM accessed health services at 118 primary care units in Sukhothai. The patients 60 years of age and over were the highest proportion followed by those 35-59 years of age and the lowest proportion was 15-34 years of age (10,243, 9,159 and 286, respectively). Additionally, 57.4 % of them had uncontrolled diabetes with complications.[9] To develop a model for controlling the fasting blood glucose among diabetic patients, the researcher reviewed related articles. The previous studies indicated that factors associated with self-care behaviors in patients with T2DM including age,[10] educational level,11-13 monthly income,10-11 marital status,[10] gender,[11,14] body mass index (BMI),[14-15] diabetes knowledge,[12-13] social support,[16-17] and self-care behaviors. However, some other studies found that self-care behaviors were associated with FBG in adults with T2DM.[18-19] The purpose of this study was to investigate a causal relationship model of factors influencing glycemic control among the elderly with

T2DM in Sukhothai Province. The research findings can be utilized to develop a model for patients with uncontrollable T2DM in the future.

Methods

Study Population

This causal research was studied in 9 primary care units (PCU) in Sukhothai Province. The data collection was conducted from January to March 2015.

The study population was 10,243 patients with type 2 diabetes diagnosed by a medical doctor at least one year before data collection was conducted.

The inclusion criteria were as follows: 1) diagnosed with diabetes by a medical doctor, 2) greater than 60 years of age, 3) able to communicate and understand Thai language, 4) have lived in the investigated community in the ensuing 6 months, and 5) willing to participate in this study.

The exclusion criteria: Participants had complications as hypertension and chronic kidney disease.

Sample size

In this study, there were 12 variables classified as 4 exogenous variables included social status (age, educational level, monthly income), marital status, gender, BMI, and 4 endogenous variables such as diabetes knowledge, social support (family support, friend support, VHVs support), self-care behaviors and FBG. The sample size of this research was calculated at 30 fold of the independent variables or predictor variables.[20] In this case, there are 11 predictor variables then the number of the participants were 330 persons. In order to obtain reliable data, the researcher increased the sample size to 390 persons. The samples were recruited using a multi-stage sampling. Sukhothai Province was the study area consisting of nine district. One PCU was selected from one district. A total of nine PCUs were recruited into the study. Then, the samples were selected using systematic random sampling for data collection.

Research Instrument

A standard questionnaire developed from previous studies[16,21] was used for data collection. Vadility and reliability tests were performed on 35 patients with T2DM. The questionnaire consisted of 5 parts as follows:

Part I: Personal characteristics: The demographic variables included gender, marital status, BMI, age, educational level, and monthly income.

Part II: Diabetes knowledge: This measure was defined as patients understanding of information about diabetes and its management including 12-items. Participants received a score of 1 for a correct answer and 0 for an incorrect or unknown answers. The score ranged from 0 to 12. The reliability value was 0.81.

Part: III Social support: The support was classified into 3 categories: family, friend, and village health volunteer consisting of 24-items. The scale for measuring was a 5-point Likert-type scale ranking from 0 = not at all to 4 = a great degree. The reliability value was 0.82.

Part IV: Self-care behaviors: There were seven essential self-care behaviors in T2DM patients which predicted good outcomes, namely healthy eating, being physically active, mornitoring of blood sugar, compliant with medications, good problem-solving skills, healthy coping skills and risk-reduction behaviors. This questionnaire included 16-items. The

scale for measuring was a 3-point Likert-type scale ranking from 0= never to 2 = regular.
The reliability value was 0.82.

Part V: Glycemic control: In this study, glycemic control was measured using fasting blood glucose (FBG) levels.

Data collection

The research team made and appointment with the samples at primary care unit to explain the objective of the study and to sign in the consent form for participation. Then, the samples were requested to complete the questionnaire. The study was carried out between January and March, 2015.

Data analysis

The data were collected using a questionnaire and analyzed by descriptive statistics, including percentage, frequency, mean, standard deviation, and minimum and maximum value. These statistics were used to explain socio-demographic characteristics of the sample. Then, path analysis was employed as a method for identifying the direct and indirect effects between social status, marital status, gender, BMI, social support, knowledge, self-care behavior and FBG. The maximum likelihood was obtained to check the parameter estimation method. The criteria to test the model included Chi-square test desired value of p-value > 0.05, χ^2/ df , the root mean square error of approximation (RMSEA), with a desired value of less than 0.05, and the comparative fit index (CFI) and goodness of fit index (GFI) with desired values of greater than 0.95. The adjusted goodness of fit index (AGFI) was close to 1.0 and standardized root mean square residual (SRMR) was close to 0.21

Ethical consideration

Ethical approval was obtained from the Human Research Ethics Committee, Naresuan University, Thailand (Ref No. 111/58; approved dated 2015/ May / 19).

Results

Personal characteristics of participants

The results showed that 58.5% were females. Most of them (79.7%) were married and, 59.5% were 60-64 years of age with the mean of 63.98 years and standard deviation (S.D.) of 2.29. The majority of them (91.2%) completed primary school level and 95.3% had a monthly income of 501-1,000 THB (Table 1).

Table 1 Distribution of participants personal characteristics

Personal characteristics	Number (percent)
Gender	
Male	162 (41.5)
Female	228 (58.5)
Age (year)	
60-64	232 (59.5)
65-70	158 (40.5)
$\bar{X}$ = 63.98, S.D.= 2.29, Min = 60, Max = 70	
Educational level	
No schooling	28 (7.2)
Primary school	356 (91.2)
Secondary school	3 (0.8)
Bachelor degree	3 (0.8)
Marital status	
Single	19 (4.9)
Married	311 (79.7)
Divorced	20 (5.1)
Widowed	40 (10.3)
Monthly income (baht)	
501-1,000	372 (95.3)
1,001-1,500	14 (3.6)
1,501-2,000	1 (0.3)
>2,001	3 (0.8)
Median = 700, Quartile *Deviation* = 50, Min= 700, Max = 20,200	
Duration of illness (year)	
1- 5	225 (57.7)
6-10	146 (37.4)
11-15	19 (4.9)
$\bar{X}$ = 5.48, S.D.= 2.42, Min = 1, Max = 14	
BMI (kg/m2)[a]	
18.51-22.99	145 (37.2)
23.00-24.99	169 (43.3)
25.00-29.99	75 (19.2)
>30.00	1 (0.3)
$\bar{X}$= 23.61, S.D. = 1.50, Min = 20.03, Mix = 32.09	
FBG level	
FBG ≤ 125 Mg/dl	195 (50.0)
FBG ≥ 126 Mg/dl	195 (50.0)
$\bar{X}$ = 135.19, S.D. = 29.63, Min = 89, Mix = 204	

[a] Body weight in kilograms divided by the square of the height in meters, the Asian cut-off point for overweight (WHO, 2000)[28] was ≥23 kg/m2

Most of the participants (57.7%), had their duration of illness was 1- 5 years with the mean of 5.48 years and S.D. of 2.42, 43.3 % had BMIs etween 23.0–24.99 with the mean of 23.61 and S.D. of 1.50. Half of the sample had poorly controlled fasting blood glucose (FBG ≥ 126 mg/dl) with the mean of 135.19 mg/dl and S.D. of 29.63 (Table 1).

Structural model

In the model (Figure 1), the estimated model demonstrated a good fit model (Chi-square value = 134.13, df = 109 (p-value = 0.051), χ^2 / df = 1.23, GFI = 0.99, AGFI = 0.99, SRMR = 0.045, and RMSEA = 0.024). The result showed that the significant positive direct pathways were found from marital status and gender to social support (β = 0.09 and β = 0.26, p-value < 0.05, respectively). Meanwhile, social status, and BMI had a negative direct effect on social support (β = -0.07 and β = -0.31, p-value <0.05, respectively). All of them explained the variance in social support at 18%. In addition, gender showed a negative direct effect on knowledge (β = -0.24, p-value < 0.05). Social support revealed a direct effect on knowledge (β = 1.00, p-value < 0.05). Both gender and social support explained the variance in knowledge at 100%.

Additionally, social support had a positive direct effect on self-care behaviors (β = 0.81, p-value < 0.05), and explained the variance in self – care behaviors at 91%. Furthermore, social support had an indirect effect on FBG through self-care behaviors ($\beta_{indirect}$ = 0.66 , p-value < 0.05). Finally, self- care behaviors showed a negative direct effect on FBG (β = 0.82, p-value < 0.05), and explained the variance in FBG at 67 %. In this model, there were four pathways which were shown to be insignificant to knowledge and knowledge to self-care behaviors, including social status, marital status, and BMI (Table 2).

Table 2 The direct effect (DE), indirect effect (IE) and total effect (TE) after adjusting the model

Cause variables	Effect variables											
	Social support (SS)			Knowledge (K)			Self-care behavior (SCB)			FBG		
	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE
Social status	-0.07*	-	-0.07*	0.01	-0.08*	-0.07*	-	-0.07*	-0.07*	-	0.06*	0.06*
Marital status	0.09*	-	0.09*	-0.01	0.10*	0.09*	-	0.09*	0.09*	-	-0.07*	-0.07*
Gender	0.26*	-	0.26*	-0.24*	0.29*	0.05*	-	0.22*	0.22*	-	-0.18*	-0.18*
BMI	-0.31*	-	-0.31*	0.01	-0.33*	-0.32*	-	-0.29*	-0.29*	-	0.24*	0.24*
SS	-	-	-	1.00*	-	1.00*	0.81*	0.16	0.97*	-	-0.79*	-0.79*
K	-	-	-	-	-	-	0.15	-	0.15	-	-0.12	-0.12
SCB	-	-	-	-	-	-	-	-	-	-0.82*	-	-0.82*

*p-value < 0.05

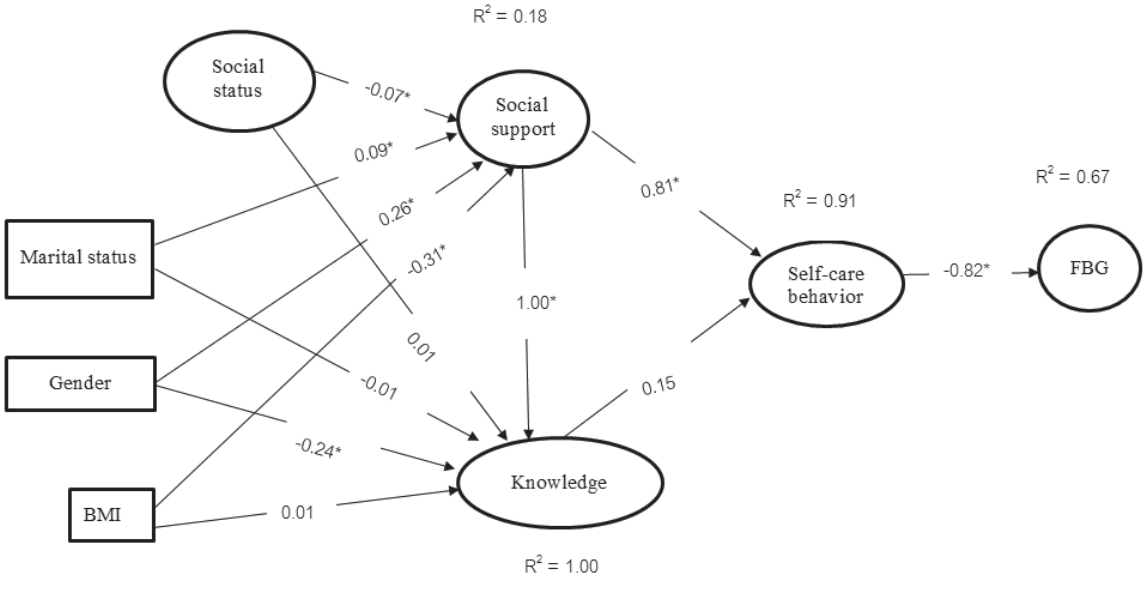

Figure 1 A Causal Relationship Model of Factors Influencing Glycemic Control among the Elderly with Type 2 Diabetes Mellitus, *p < 0.05

Discussion

This study indicated that social support showed a direct effect on self- care behaviors (β = 0.81, *p-value* < 0.05) and explained the variance in self-care behaviors at 91.0%. .Likewise, Fisher et al.[21] found that peer support could help T2DM patients to manage and reduce the risks effectively. Similarly, Wilson et al.[22] reported that social support was a significant predictor of adherence to dietary habits, physical activities, and blood glucose monitoring. In the same way, several studies of social support on chronic disease have found that social support affected self-management[11,23]. Additionally, Vaccaro et al.[24] demonstrated that family and friend social support (FSS) was associated with diabetes self-management(DSM). The studies conducted by Weeks[16] and Rad at el.[17] found a positive relationship between social support and self-care behaviors. On the other hand, knowledge indicated no direct effect on self-care behaviors. In other words, knowledge was unable to change behaviors to control blood glucose levels.

In contrast, Huang at el.[12] showed that the score of self-care behaviors among patients with T2DM related to diabetes knowledge (r=0.176, P<0.05). The findings in this study were not consistent with the study of Chlebowy and Garvin,[25] which did not identify the association between social support and self – care behaviors (e.g, diet and physical activities. Similarity, Phetarvut, Watthayu, and Suwonnaroop[26] showed that family support was not associated with self-care behaviors (p-value < 0.05).

However, self- care behaviors had a negative direct effect on FBG (β = 0.82, *p-value* < 0.05), and explained the variance in FBG at 67.0%. Namely, the patients with T2DM who have good self-care

behaviors are able to control the level of blood glucose. On the other hand, if the patients had bad self-care behaviors, they could not control blood glucose levels. As a result, blood glucose levels will be increased. Likewise, Gao at el.[27] showed that self-care behaviors negatively influenced the HbA1C values.

The result also indicated that the significant positive direct pathways were found from marital status, and gender to social support ((β = 0.09, β = 0.26, p-value < 0.05, respectively). Meanwhile, social status, and BMI had a negative direct effect on social support (β = -0.07 and β = 0.31, p-value <0.05, respectively). However, Prasertampisakul N, Sumpowthong K , Wattana C, (2008)[29] reported that age, high income level, education level had no direct effect on social support where as these factors had direct effect on self-care behavior in T2DM patients. On the other hand, gender indicated a negative direct effect on knowledge (β = 0.24, *p-value* < 0.05). In contrast, Salam MA, Siddiqui AF.(2013).[14] found that gender, income, and education level were not significantly affected to knowledge, however these factors had positive direct effect on self-care behavior. (P-value < 0.05).

In this study, the researcher measures glycemic control of patients with type 2 DM using FBG instead of HbA1C. Because primary care units able to check FBG of patients with type 2 DM every month, unlike HbA1C, it can be check once a year.

Recommendations

Social support is the most important factor on diabetes self-management. This study indicated that promoting social support rather than diabetes knowledge may be an effective method for self-management to control T2DM among the elderly.

Future study should be applying social support concept to develop behavior modification program to control blood sugar level for type 2 diabetic patients.

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