Association between depression on diet and glycemic control in type 2 diabetic patients

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Background	:	*Diabetes mellitus is a chronic disease with high and rising prevalence worldwide. Diabetic patients have to control their levels of blood sugar to avoid complications. Diet control is one of the important factors that condition blood sugar level. Several studies showed that the prevalence of depression was high in chronic patients including diabetes, and depression affects the self-care behaviors.*
Objective	:	*To examine for the association between depression and diet control cooperation as well as glycemic control in patients with type 2 diabetes.*
Design	:	*This research is a cross-sectional study.*
Setting	:	*Diabetes Clinic, Outpatient Department, Phuthasothon Hospital, Chachoengsao Province.*
Materials and methods	:	*Type 2 diabetic patients without history of depression were evaluated for depression and diet control by questionnaires. Glycemic control was determined by HbA_{1C} and FBS. Nutrients and caloric intakes were also evaluated.*

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Results   :   *The result showed that depression is associated with diet control. It is also related with glycemic control.*

Conclusion   :   *Depression is related to diet and glycemic control in type 2 diabetic patients.*

Keywords   :   *Type 2 diabetes mellitus, depression, diet control, glycemic control.*

เหตุผลของการทำวิจัย : *โรคเบาหวานเป็นโรคเรื้อรังที่มีผู้ป่วยกระจายอยู่ทั่วโลกเป็นจำนวนมาก การควบคุมระดับน้ำตาลในเลือดให้อยู่ในระดับที่ดีมีความจำเป็นต่อผู้ป่วยเพื่อลดภาวะแทรกซ้อนที่อาจตามมา โดยการควบคุมอาหารเป็นปัจจัยสำคัญที่ส่งผลต่อการควบคุมระดับน้ำตาลในเลือด หลายการศึกษาพบความชุกของภาวะซึมเศร้าสูงในกลุ่มผู้ป่วยโรคเรื้อรัง รวมทั้งเบาหวาน และภาวะซึมเศร้ายังส่งผลต่อการดูแลตนเองของผู้ป่วย*

วัตถุประสงค์ : *เพื่อค้นหาความสัมพันธ์ระหว่างภาวะซึมเศร้ากับการควบคุมอาหารและการควบคุมระดับน้ำตาลในเลือด ในผู้ป่วยเบาหวานชนิดที่ 2*

รูปแบบการวิจัย : *การศึกษารูปแบบภาคตัดขวาง*

สถานที่ทำการศึกษา : *คลินิกเบาหวาน แผนกผู้ป่วยนอก โรงพยาบาลพุทธโสธร จังหวัดฉะเชิงเทรา*

ตัวอย่างและวิธีการศึกษา : *ผู้ป่วยโรคเบาหวานชนิดที่ 2 ที่ไม่มีประวัติภาวะซึมเศร้า ได้รับการประเมินภาวะซึมเศร้าและการควบคุมอาหาร โดยใช้แบบสอบถามประเมินการควบคุมระดับน้ำตาลในเลือดโดยใช้ระดับ Hemoglobin A_{1c} (HbA_{1c}) และ fasting plasma glucose (FPG) นอกจากนั้นผู้ป่วยได้รับการประเมินปริมาณอาหารและพลังงานที่ได้รับ*

ผลการศึกษา : *พบความสัมพันธ์ระหว่างภาวะซึมเศร้าและการไม่ร่วมมือในการควบคุมอาหารในผู้ป่วย และพบความสัมพันธ์ระหว่างภาวะซึมเศร้าและระดับของ HbA_{1c} ที่เพิ่มขึ้น*

สรุป : *ภาวะซึมเศร้ามีความสัมพันธ์กับการไม่ควบคุมอาหาร และ ระดับน้ำตาลในเลือดที่เพิ่มขึ้นในผู้ป่วยเบาหวานชนิดที่ 2*

คำสำคัญ : *โรคเบาหวานชนิดที่ 2, ภาวะซึมเศร้า, ควบคุมอาหารและระดับน้ำตาลในเลือด.*

Currently, diabetes mellitus (DM) is a serious problem in public health. In 2010, it is estimated that 171 million people worldwide had been sufferring from diabetes with the prevalence of 2.8%.[1] In Thailand, the prevalence of the diabetes reported in 2003 was 9.6% or equal to 2.4 million people.[2] According to the American Diabetes Association (ADA), the goal of blood sugar level control is to maintain the hemoglobin A1C (HbA$_{1c}$) level less than 7% that can reduce the microvascular and macrovascular complications.[3] Diet therapy is a cornerstone for controlling the level of blood glucose. Patients with a good diet control have a better control of blood glucose levels and can reduce the blood glucose levels by 31.8%. [4] The important factor that causes ineffectiveness in the glycemic control is failure to control dietary intake. [5] The reasons of noncompliance in diet control are poor eating habit, increased age and the progression of the disease that reduces the ability of the patient's self-care.[6] It is possible that the reduction of compliance in medication and diet control are associated with depression in diabetic patients.[7] These can lead to many other problems such as increased risk of blood vessel problems and other complications, higher medication costs, reducing the quality of life, and rising the amputation and death rates. Park et al. [8] studied the association of the depressive symptoms and self-care behavior of the patients with type 2 DM. The tools used in the study determined depression and some behaviors. The results provided information that the patients with depression were more likely to have poor self-care behaviors including medication use, dietary control, and self-monitoring of blood glucose.

In Thailand, the prevalence of depression in diabetic patients was 25% - 30.0%.[9,10] According to study of Lin et al. [11], patients with depression were significantly associated with decreased exercise, poor consumption, and noncompliance with glycemic control medication. Moreover, Al-Amer et al. [12] revealed that the prevalence of depression in diabetic patients was 19.7% and those were 1.49 times more likely to fail their diet controls when compared to diabetic patients without depression.

This study focuses on depression in the patients with type 2 DM that probably influences the diet control behavior.

Method
Participants

Participants were type 2 diabetic outpatients who received the treatment at the Endocrine Unit, Phuthasothon Hospital, Chachoengsao Province. The participants were selected by inclusion criteria that males or females aged above 18 years old, were diagnosed as type 2 diabetic patients and medication for lowering blood glucose levels. The patients who had severe mental disorders, or had been diagnosed and treated with anitdepressant were excluded.

Protocol

This observational study has been approved by the Ethics Committee of the Faculty of Pharmaceutical Sciences, Chulalongkorn University (protocol review number 11-33-021). The patients that had all the qualifications to participate in this study were chosen by convenient sampling. They were explained the procedure of the study and signed the research participation agreement form. They also

were interviewed before they visited the doctor. The patients' information including gender, age, duration of diabetes, HbA_{1C}, FPG were recorded from the patient chart. The participants were asked to do the Center for Epidemiologic Studies Depression Scale (CES-D) test, dietary control test, and the 24-hour dietary recall record form. Anthropometric measurement including body weight, height, waist circumference, and hip circumference were performed.

Measures

Depression

Depression was assessed by CES-D test in Thai version [9,10], a self-report questionnaire used for screening a depressive disorder in out-patients, but not for diagnosis the depression. CES-D test has high reliability and good validation. [9,10] It comprises of 20 questions with the total score of 60. If patient has the total score more than 16, he/she is considered depressed.

Diet control

Competency of dietary control was measured by dietary control test.[13] This test comprises of 20 questions, with 3-point scale rating from "always" to "not at all", to examine the adherence of diet control. The result was reported by averaged score of every question in the test. The patients would be classified into 3 groups as follows: poor diet control group (score 0-1.66), fair diet control (score 1.67 - 2.33), and good diet control (score 2.34 - 3.00).

Data analysis

The general characteristics of the patients (gender, age, weight, body mass index, waist circumference, healthcare information such as dietary control, medical treatment information such as time period of having diabetes, blood glucose level, and depression information were presented as number, percentage of frequency, mean and standard deviation. The 24-hour dietary recall record data were analyzed by Thai Nutrisurvey program (Division of Nutrition, Department of Tropical Medicine, Mahidol University). The results are shown as means and standard deviations, and the proportion of calories from carbohydrate, protein and fat. The differences in continuous data between the groups were tested by student t-test. The relationship between depression and glycemic control was determined by Chi-square test, and Person's correlation test. The relationship between depression and diet control was determined by Chi-square test. The difference was taken as statistically significant if the p-value was less than 0.05.

Results

Characteristics of participants

The total of 245 patients participated in this study. Twenty participants were excluded because of incomplete data. There were 41 participants (18.2%) had depression with average score of CES-D at 27 ± 6.5. Demographic characteristics of the participants are shown in Table 1. Most of the participants aged between 40 and 69 years. One hundred and twenty-four participants were female (67.3%). There were 22 females (53.7%) in the depression group. Most participants (76.5%) in the non-depression group had been diagnosed as diabetic for 1-15 years and average year of diabetes was 10.2 ± 3.2 years. In the depression group, more than half of the

participants (56.2%) had been diagnosed as diabetic for 6 - 15 years and average time of diabetes was 9.4 ± 3.2 years. However, there were no differences in these parameters between the two groups.

The anthropometric parameters are shown in Table 2. The results showed that most participants were overweight and obese, assessed by body mass index (BMI). In the non- depression group, 156 participants (84.8%) and 35 participants (85.7%) in the depression group had BMI > 22.9 kg/m^2. There were no differences in mean waist circumference, mean hip circumference, and mean waist-to-hip ratio between the two groups.

Biochemical data of participants.

Eighty-two participants in the non-depression group had HbA$_{1C}$ lower than 7% (45.5%), but only 4 participants (9.9%) with depression had HbA$_{1C}$ lower than 7%. It indicated that most participants in the depression group could not control their blood sugar levels. Moreover, mean HbA1c in the depression group was significantly higher than HbA$_{1C}$ in the non-depression group (8.25 ± 1.15 and 7.37 ± 1.03 respectively). Twenty-five participants (11.1%) had FPG lower than 90 mg/dl and the rest of the participants had FPG more than 90 mg/dl. There was no significant difference in FPG between both groups (Table 3).

Table 1. Characteristics of the participants (N = 225).

Variables	Non-depression group (n = 184) n (%)	Depression group (n = 41) n (%)	*p*-value
Gender			
Female	124 (67.3)	22 (53.6)	0.050
Male	79 (32.7)	19 (46.4)	
Age (year)			
< 30	1 (0.5)	-	0.090
30-39	15 (8.1)	2 (4.9)	
40-49	37 (20.1)	14 (34.1)	
50-59	54 (29.3)	10 (24.4)	
60-69	60 (32.6)	10 (10.0)	
>70	17 (9.2)	5 (12.2)	
Year of diabetes			
< 1 year	5 (0.2)	2 (4.9)	0.070
1-5 years	48 (26.0)	7 (17.1)	
6-10 years	54 (29.3)	11 (26.8)	
11-15 years	39 (21.2)	12 (29.2)	
16-20 years	21 (11.4)	9 (21.9)	
> 20 year	17 (9.2)	-	

Table 2. The anthropometric parameters of participants (N = 225).

Variables	Non-depression group (n = 184)	Depression group (n = 41)	*p*-value
Body mass index (BMI) (Kg/m^2)	25.7 ± 3.7	24.62 ± 4.75	0.120*
Nutritional status, n(%)			
Normal (BMI 18-22.9)	28 (15.2)	6 (14.6)	0.090**
Overweight (BMI 23-26.9)	73 (39.7)	17 (41.4)	
Obesity (BMI >27)	83 (45.1)	18 (44.3)	
Waist circumference (cm)			
Males	92.2 ± 4.4	91.1 ± 0.3	0.080*
Females	97.2 ± 3.7	94.3 ± 1.7	
Hip circumference (cm)			
Males	99.8 ± 0.5	100.2 ± 0.2	0.050*
Females	87.5 ± 5.2	90.4 ± 0.8	0.060*
Waist to hip ratio			
Males	0.92 ± 0.12	0.91 ± 0.5	0.070*
Females	1.10 ± 0.77	1.05 ± 1.2	0.090*

Data expressed as mean standard deviation, *Student T test, **Chi-square test

Table 3. Clinical biochemistry of participants.

Variables	Non-depression group (n = 184) n (%)	Depression group (n = 41) n (%)	*p*-value
HbA$_{1c}$ (%)			
< 7	82 (44.5)	4 (9.9)	
7 - 8	59 (32.0)	15 (36.5)	0.009*
> 8	43 (23.5)	22 (53.6)	
Mean ± SD	7.37 ± 1.03	8.25 ± 1.15	0.010**
Fasting plasma glucose;			
FPG (mg/dl)			
FPG < 90	21 (11.4)	4 (9.8)	0.200*
FPG 90 – 130	80 (43.5)	18 (43.5)	
FPG >130	83 (45.1)	19 (46.3)	
Mean ± SD	136.45 ± 52.6	136.9. ± 38.72	0.090**

*Chi-square test, **Student T-test

Dietary intake pattern

According to data from 24-hour dietary recall questionnaire, the result showed that participants in the non-depression group had average total daily energy intake at 1,220.5 ± 225.3 kcal, and in the depression group had 1,270.2 ± 314.7 kcal. The percentage of energy distribution of carbohydrate, protein and fat were 54.1%, 19.5%, and 28.3%, respectively in the non-depression group; and were 55.3%, 18.9%, and 29.8%, respectively in the depression group. There were no differences between the two groups in term of total energy intake and the percentage of energy distribution (Table 4).

Depression and diet control

The result in this study showed that the patients without depression had average score of diet control at 1.82 ± 0.11, and was significantly higher than that in the depression group ($p = 0.020$) (Table 5). All participants were classified into 3 groups by the results from diet control questionnaire. It was found that most diabetic patients without depression (67.3%) were defined in the fair level to good level of diet control. On the other hand, most diabetic patients with depression (85.3%) were defined as poor to fair diet control. By Chi-square test, the result showed that an increase in depression was correlated with a decrease in glycemic control ($Z = 9.014$, $p = 0.01$).

Table 4. Total energy intake and the percentage of energy distribution from carbohydrate, protein and fat.

Variables	Non-depression group (n = 184)	Depression group (n = 41)	*p*-value
Total daily energy (kcal)	1220.56 ± 225.30	1270.23 ± 314.74	0.220
Carbohydrate			
grams/day	150.35 ± 44.12	164.19 ± 56.87	0.092
% of total energy	54.17 ± 9.48	55.32 ± 14.22	0.120
Protein			
grams/day	55.85 ± 18.33	52.45 ± 19.20	0.300
% of total energy	19.55 ± 4.25	18.95 ± 5.77	0.070
Fat			
grams/day	39.17 ± 14.84	40.93 ± 12.76	0.060
% of total energy	28.32 ± 7.75	29.81 ± 8.32	0.550

Analyzed by Thai Nutrisurvey program, Division of Nutrition, Faculty of Tropical Medicine, Mahidol University.

Table 5. The mean score of diet control and the number of participants in three levels of diet control.

Variables	Non-depression group (n = 184)	Depression group (n = 41)	*p*-value
Diet control score (Mean ± SD)	1.82 ± 0.11	1.5 ± 0.07	0.020*
Level of diet control			
Poor (0-1.66)	60	21	0.010**
Fair (1.67-2.33)	77	14	
Good (2.34-3.00)	47	6	

*Student T-test, **Chi-square test

Depression and glycemic control.

The participants were separated by HbA1c level into 3 groups: HbA1c level lower than 7% (good control of blood sugar), HbA1c level were between 7-8% (poor control of blood sugar), and HbA1c level higher than 8% (uncontrolled blood sugar). Most of the participants without depression had HbA1c level lower than 8% (76.5%). However, more than half of the participants with depression showed HbA1c level higher than 8% (53.6%). When analyzing the relationship between depression and glycemic control by Chi-Square test, the result showed that an increase in depression was correlated with a decrease in glycemic control (Z = 9.322, *p* = 0.009). The relationship between HbA1c level and CES-D score was determined by Pearson's correlation. The result showed that depression was positively correlated with glycemic control (r = 0.37, *p* =0.01)

Discussion

Characteristics of participants

This study shows that more than half of the participants were woman (64.9%), most of them aged between 40 - 69 years old; their average age was 59.5 ± 7.6 years. These results were similar to the previous studies that most type 2 diabetic patients were women and elderly.[14,15] In type 2 diabetic patients with depression, the results in this study also show that the average age of the participants was quite high (60.3 ± 5.2 years old) and most of them aged between 40-69 years. In this study, the duration of diabetes in the both groups was not different and percentage of males in the depression group was more than that in the non-depression group. The percentage of the male in the depression group in this study was higher than in the previous studies. Some studies revealed that the female had more depressive symptoms than males.[16,17] However, the difference results may be due to difference in sample size.

According to the anthropometric parameters, it was found that most of the participants in both groups were obese. Their waist circumferences, hip circumferences, and waist to hip ratios were above the cut-off point for Asian population. [18] These results were similar to the previous studies which revealed

that most of the type 2 diabetic patients were obese, and had waist circumferences, hip circumferences, and waist to hip ratios above the cut-off point for Asian population.[19,20,21]

The prevalence of depression in this study was 18.2% which was lower than the previous studies in Thailand. However, this result was consistent with some previous studies which reported the prevalence of depression between 17.0 to 18.6%. [22, 23]

Dietary intake pattern

Both of diabetic patients with and without depression had average total energy intake lower than the recommendation. These values were lower than the results of a previous study in Thai population.[24] The difference results may be due to underestimation of dietary intake. Moreover, diabetic patients usually control their diet for a few days before they visit the doctor to have satisfactory levels of blood sugar. However, the percentages of energy distribution in both groups were similar to the recommendation. In patients with diabetes, the recommendations of energy distribution from carbohydrate, protein, and fat are 50 - 55%, 10 - 20%, 30% of total daily energy intake, respectively.[25]

Relationship between depression and diet control

This study revealed the relationship between depression and diet control. It was found that more than half of the participants with depression had low level of diet control (51.2%), but most diabetic patients without depression were defined as fair-good diet control (67.39%). In the contrary, if diabetic patients had depression, they would have had poor level of diet control. This was consistent with the previous

studies that diabetic patients with depression showed a decrease in self-care adherence. [11, 26, 27]

Relationship between depression and glycemic control

The results of this study show that diabetic patients with depression had higher HbA_{1C} level when compared to the participants in non-depression group. The relationship between depression and poor glycemic control was found. Moreover, this study showed that diabetic patients who had higher CES-D score probably had higher level of HbA_{1C}. This result was consistent with other studies. Eren *et al.* [28] studied the impact of depression on glycemic control and found the correlation between increased depression and higher level of HbA_{1C}. Some studies found that diabetic patients with depression had higher HbA_{1C} levels when compared to diabetic patients without depression. [29, 30]

However, the mechanism of the effect of depression on diet and glycemic control still remains unclear. There are hypotheses that could explain the effect of depression on diet and glycemic control. For example, diabetic patients with depression show lack of hope because they cannot expect the outcome of diabetic treatment and have defect in perception and cognition. These lead to non-adherence in treatment for diabetes and self-care behaviors. [31] Another mechanism is that diabetic patients with depression have elevated level of cortisol which leads to increased appetite, decreased diet control, and increased blood sugar level.(5) Moreover, depression has impacts on diabetes by stimulating the brain to increase the number and activities of counter-regulatory hormones, changing glucose transport system, and increasing immune-inflammatory

activation. Depression probably influences glycemic control in diabetic patients through some health behaviors. Several studies showed that depression was related to smoking. [32, 33] Some studies reveal that patients with depression show low levels of exercise, poor glucose self-monitoring, and medication non-adherence.[27,34] Moreover, some studies revealed the relationship between depression and alcohol consumption.[35,36] In addition, Snoek et al.. [37] showed that diabetic patients with depression who received the depression therapy with cognitive-behavior therapy resulted in reducing depressive symptoms and enhanced effectiveness of lowering HbA_{1C} level. Similarly, Petrak et al.. [38] stated that diabetic patients with depression who received the depression treatment showed good progress in glycemic control. However, there are many factors that influence depression such as disease complication, and medication adherence.[9]

There are many studies show relationship between depression and increasing in blood sugar level. In this study, it was found that depression was associated with diet and glycemic control in type 2 diabetic patients. However, this study has some limitations. First, the data of the nutrients and caloric intakes from the 24-hour dietary recall record form may not accurate. Second, there are many factors that were influenced by depression, for example, smoking, alcohol consumption, and medication adherence, which may effect blood glucose level. Thus, further study should collect more information about these related factors to determine the effect of depression on blood sugar levels.

Conclusion

Depression in type 2 diabetes was associated with diet and glycemic control. This study may be useful for healthcare professionals in order to help the diabetic patients with depressive symptoms to have a better control of the disease and quality of life.

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