ผลของกระบวนการบริบาลภายใต้การประยุกต์ใช้ทฤษฎีการรับรู้สมรรถนะแห่งตนต่อผลลัพธ์ด้านคลินิกในผู้ป่วยเบาหวานชนิดที่ 2 ที่ควบคุมระดับน้ำตาลไม่ได้
Effects of Self-efficacy-based Program in Type 2 Diabetes Mellitus Patients with Poor Glycemic Control

นิพนธ์ต้นฉบับ

Original Article

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วารสารไทยเภสัชศาสตร์และวิทยาการสุขภาพ 2566;18(4):354-360.

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บทคัดย่อ

วัตถุประสงค์: เพื่อเปรียบเทียบผลการเปลี่ยนแปลงระดับน้ำตาล การปรับเปลี่ยนพฤติกรรมและความร่วมมือในการใช้ยาของผู้ป่วยเบาหวาน โดยโปรแกรมที่ประยุกต์ทฤษฎีการรับรู้สมรรถนะแห่งตนเพื่อปรับเปลี่ยนพฤติกรรมสุขภาพ **วิธีการศึกษา:** การศึกษาวิจัยแบบกึ่งทดลองแบบกลุ่มเดียววัดผลเปรียบเทียบก่อนและหลังในผู้ป่วยนอกโรคเบาหวานชนิดที่ 2 ที่ควบคุมระดับน้ำตาลไม่ได้ ที่รับบริการที่โรงพยาบาลน้ำหนาว จ.เพชรบูรณ์ 32 คน ระยะเวลาศึกษา 12 สัปดาห์ กลุ่มตัวอย่างได้รับโปรแกรมปรับเปลี่ยนพฤติกรรมที่ประยุกต์ทฤษฎีการรับรู้สมรรถนะแห่งตนโดยทีมสหวิชาชีพ เก็บข้อมูลระดับน้ำตาล (FPG และ HbA1c) การบริโภค (BMI, น้ำหนักตัว และ calorie intake) และความร่วมมือในการใช้ยา (ร้อยละเม็ดยาที่กิน) แล้วทดสอบความแตกต่างโดยใช้การวิเคราะห์ความแปรปรวนแบบมีการวัดซ้ำทางเดียว **ผลการศึกษา:** ค่าเฉลี่ยระดับน้ำตาลในเลือดหลังอดอาหารที่สัปดาห์ที่ 12 ต่ำกว่าก่อนการได้รับโปรแกรมอย่างมีนัยสำคัญทางสถิติ (147.25 ลดลงเป็น 139.59 มก./มล., P-value < 0.05) ไม่พบความแตกต่างของระดับน้ำตาลสะสมในเลือด (8.00% เพิ่มเป็น 8.08%, P-value = 0.53) ค่าเฉลี่ยของพลังงานที่ได้รับในแต่ละวันลดลงอย่างมีนัยสำคัญทางสถิติที่สัปดาห์ที่ 6 และ 12 (1690.50 ลดลงเป็น 1571.63 และ 1566.21 kcal ตามลำดับ, P-value < 0.01) ความร่วมมือในการใช้ยาเพิ่มขึ้นอย่างมีนัยสำคัญจากร้อยละ 87.70 เป็น 94.33 ในสัปดาห์ที่ 6 (P-value = 0.01) และ 95.75 ในสัปดาห์ที่ 12 (P-value < 0.01) **สรุป:** โปรแกรมที่ประยุกต์ทฤษฎีการรับรู้สมรรถนะแห่งตนช่วยให้ผู้ป่วยเบาหวานชนิดที่ 2 ที่ควบคุมระดับน้ำตาลไม่ได้สามารถลดระดับน้ำตาลในเลือดหลังอดอาหาร ลดการบริโภคในแต่ละวัน และเพิ่มความร่วมมือในการใช้ยา

คำสำคัญ: การรับรู้สมรรถนะแห่งตน, ผู้ป่วยเบาหวานชนิดที่ 2, น้ำตาลในเลือดหลังอดอาหาร, น้ำตาลในเลือดสะสม, ความร่วมมือในการใช้ยา

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Abstract

Objectives: To compare changes in blood glucose levels, results of modified health behaviors, and medication adherence in diabetic patients with uncontrolled glycemia with a self-efficacy-based health behavior modifying program. **Method:** This quasi-experimental research compared outcomes before and after the 12-week program in 32 diabetic patients at Nam Nao Hospital, Phetchabun, Thailand. The program was carried out by a multidisciplinary team. Outcomes of glycemic control (FPG and HbA1c), health behavior (BMI, body weight, and calorie intake), and medication adherence (% pills taken) and compared for differences using repeated measure ANOVA. **Results:** At week 12, FPG level was significantly lower than that before the program (147.25 to 139.59 mg/dl, P-value < 0.05). However, HbA1c level was not different (8.00 to 8.08%, P-value = 0.53). Calorie intake from before the program decreased at week 6 and week 12 (1,690.50 to 1,571.63 and 1,566.21 kcal, respectively, P-value < 0.01). Medication adherence increased from 87.70% at baseline to 94.33% at week 6 (P-value = 0.01) and 95.75% at week 12 (P-value < 0.01). **Conclusion:** Self-efficacy-based program improved FPG, calorie intake, and medication adherence among type 2 diabetic patients with uncontrolled blood sugar.

Keywords: self-efficacy, type 2 diabetes mellitus, fasting plasma glucose, HbA1c, medication adherence

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Introduction

Diabetes is of major global concern having a direct impact on health, as well as being a leading cause of death worldwide, according to the WHO's 2017 release[1] and more particularly in Thailand, according to the Division of Non-Communicable Diseases of the Thai Government.[2]

Cases of diabetes presenting at Namnao Hospital, Phetchabun, Thailand, were 328.28, 309.08, 404.88, and 566.85 per 100,000 persons in 2014 - 2017, respectively, indicating a worsening public health situation. Over the same period, the rate of well-controlled patients declined year-over-year, by 29.52%, 27.14%, 19.61%, and 23.1% in 2014 to 2017, respectively.[3] In 2017, according to Namnao Hospital's database by the HosXP program, diabetes cases represented the third-highest number of OPD visits. The cost of treating diabetes patients in the OPD was the second highest for all categories of cases treated, at 2.7 million baht.

Several factors have been identified as having beneficial effects on the management of diabetic patients' blood glucose levels. These factors include the severity of the condition as perceived by the patient and perceived susceptibility to complications and future difficulties, and the mitigating factor of education and the application of the Self-efficacy Theory.[4,5] Diabetic patients with well-established control over their condition are better able to choose their appropriate dietary intake and exercise regimen to regulate their blood glucose levels[7]. The results of the modification and limitation of dietary behavior could reduce HbA1c by 0.2 - 2%[8-11] and suitable exercise could reduce HbA1c by 0.14%.[9]

The establishment of self-efficacy in people with diabetes is to increase their confidence in their ability to embrace healthy behaviors following Bandura's Social Learning Theory.[12] People who have self-confidence in their abilities are better able to focus on achieving their goals after developing those skills. Self-efficacy can be developed in 4 different ways namely performance accomplishments, vicarious experience, verbal persuasion, and emotional arousal.[12-14] The self-efficacy theory has been applied in some research projects[4,5,13,14], such as investigations into sexual behavior[15] and the results of a campaign to increase diabetics' self-efficacy in changing health behaviors.[5]

In our research, we applied self-efficacy theory in a 12-week intervention program with behavior-modifying activities and medication adherence education to achieve beneficial outcomes of improved dietary and exercise behavior, and medication adherence. We conducted our intervention program and evaluated these clinical outcomes in Namnao Hospital by observing FBS and HbA1c levels of persons with diabetes. Medical adherence by the patients was evaluated by the pill count technique. The success of recommended dietary modification behavior was evaluated by the measurement of the patient's body mass index (BMI), body weight, and daily calorie intake. Results from the study could be useful in promoting diabetic patients to self-manage their conditions and achieve their glycemic control objectives and better understand and manage necessary treatments for complications arising from their condition.

Specifically, for primary objective, we aimed to compare HbA1c and fasting plasma glucose (FPG) levels before and after the 12-week intervention program in diabetes patients with uncontrolled glycemia. For secondary objectives, we aimed to compare 1) the results of modified health behaviors including BMI, body weight and calorie intake, and 2) medication adherence (i.e., % pill intake) before, and at week 6 and week 12. Accordingly, it was hypothesized that 1) HbA1c and FPG levels after the program were lower than those before the program, 2) BMI, body weight and calorie intake at week 6 and week 12 were lower than those before the program, and 3) % pills taken at week 6 and week 12 were lower than that before the program.

Methods

In this quasi-experimental research with one-group pre-test post-test design, the outcomes before and 6-week and 12-week after the 12-week intervention program were compared. The study took place in Namnao Hospital from November 2019 to July 2020. The study population was type 2 diabetic patients receiving care at Diabetes Clinic in the Outpatient Department of Namnao Hospital in Phetchabun province.

Sample size estimation

Purposive sampling was used to select the 32 diabetic patients who conformed to the eligibility criteria stated below. The n4Studies program was used to calculate the appropriate size of the study sample. This calculated value was 26 subjects which represented one mean hypothesis test with a type I error of 5% and a power of 80%. By using data from prior research, the average HbA1c was identified with an effect size of 1.81[17]. To compensate for an expected 20% dropout rate usually found in experimental studies[18], 6 additional participants were added.

To be eligible, individuals had to be 20 – 65 years old, be diagnosed with type 2 diabetes over 1 year, have HbA1c between 7 and 9 mg% within the previous 2 months, be able to communicate competently in Thai, and consent to participate in the 12-week study. Those who were currently suffering from severe liver damage or extreme anemia, with alcoholic diseases, and participating in any other programs to change their health-related behaviors were excluded.

Participant ethical protection

This research was approved by Naresuan University Institutional Review Board (NU-IRB) at NU – IRB 0232/62 on 20 September 2019. On voluntary basis, participants could refuse participation or withdraw from the study at any time with no negative consequences on healthcare services. All participants had provided written informed consent. Their information was kept secret and presented as a summary not individual persons' data.

Research instrument

The instruments consisted of the health behavior modifying program and data collection questionnaire.

Health behavior modifying program

The program was carried out by the multidisciplinary team of Nam Nao Hospital. The intervention provided information on and support for care processes to diabetic patients with uncontrolled glycemia by utilizing the self-efficacy theory to address each person's particular problems. This led to the participants changing their healthy habits and managing their blood glucose control. In this study, three different components of self-efficacy were used including master experience, verbal persuasion, and emotional arousal, which were addressed by six activities for the intervention. The experiential learning aspect encompassed the participant's personal experience of achievement. Verbal persuasion was helping service providers in establishing a rapport with diabetic patients to support the process of persuading patients that they could carry out an activity effectively. Emotional arousal was the effect of cognitive feelings on confidence and being able to control arousal using stress management techniques. In a positive mood, for example, by accomplishment of life and well-being, people were empowered to accomplish their goals, whereas in a negative mood, for example, disease caused by unhealthy behaviors, which patients should avoid at such activities. Six activities for increasing self-efficacy were proposed during home visits to the participants. Activities 5 and 6 were carried out consistently each week to follow up and encourage the participants to alter their routines, while activities 1, 2, 3, and 4 were carried out only in week 1 and week 6 as follows (Table 1).

Activity 1 involved learning about appropriate food selection and diabetes nutritional requirements with suggestions for the best diet. The purpose of this activity was to increase the participants' knowledge of food requirements to enable them to decide on the appropriate diet for themselves. For instance, cutting back on a sticky rice dinner one day a week or reducing daily amounts of calories to 10 – 30 % of their usual meals, and skipping afternoon snacks.

Activity 2 offers an appropriate fitness regimen, which was delivered to the participants in two customized programs based on their circumstances. Some participants were employed in jobs that required high levels of physical performance, such as farming or jobs requiring significant physical effort. These participants were instructed on how to relax and reduce tension. Others were employed in less vigorous jobs, such as housekeeper, or sedentary work that required little physical exertion, such as merchant. Participants in the low-activity group were instructed to boost their routine physical activity by 30 - 60 minutes of walking three times per week. Furthermore, all the participants were given sufficient relaxation and stress management.

Activity 3 included the provision of information to the participants on how to handle complications arising from abnormal glycemia levels, such as nausea and vomiting, diarrhea, and fainting. People with diabetes should be able to monitor and control their conditions. For example, patients should be able to recognize the onset of hypoglycemia and immediately consume sweet food, juice, or sweets, as well as taking a rest.

Activity 4 entailed evaluating medication use and resolving each person's specific medication problems. The pill count technique was used to evaluate adherence when leftover pills were discovered at patient appointments. This technique could precisely demonstrate the details of medication adherence.

Activity 5 included the process of developing relationships between physicians and patients that made

it easier to persuade patients to alter their diabetes control habits for a better outcome. It also included idea sharing and brainstorming on diabetes management.

Activity 6 included processes of planning and establishing treatment goals between healthcare providers and patients. Patients who were presently ill and their susceptibility prognosis with uncontrolled glycemia were demonstrated with clinical outcomes. These processes of encouraging patients' emotions resulted in a shift in healthy habit plans. Plans included goal setting and identifying future outcomes in both the short and long term. For example, if the participants were unable to accomplish their goal or alter their habits appropriately, their modifying behavior program would need to be adjusted.

Table 1 Schedule of self-efficacy-based health behavior modifying program.

Activities	Week												self-efficacy technique
	1	2	3	4	5	6	7	8	9	10	11	12	
Activity 1: dietary for diabetic patients	/					/							master experience
Activity 2: exercise	/					/							master experience
Activity 3: management of complications in diabetics	/					/							master experience
Activity 4: evaluation o patient's compliance	/					/							master experience
Activity 5: empowerment of diabetic patients	/	/	/	/	/	/	/	/	/	/	/	/	verbal persuasion
Activity 6: planning an treatment targets	/	/	/	/	/	/	/	/	/	/	/	/	emotional arousal

Data collection instruments and procedure

Demographic characteristics were collected before the experiment (baseline or week 0). Based on data from Namnao Hospital's database with the HosXP program, blood glucose levels (both FBS and HbA1c) were collected for baseline and week 12. Body weight, BMI, and calorie intake were collected at baseline, week 6 and week 12. Medication taking adherence behavior, i.e., % pills taken, based on pill count interview were evaluated at baseline, week 6 and week 12.

Data analysis

Descriptive statistics including mean with standard deviation and frequency with percentage were used to summary demographic and clinical characteristics and study outcomes. Repeated measure ANOVA were used to compare means of study outcomes at different time points. Bonferroni's adjustment was used for pairwise comparisons. Statistical significance was set at a type I error of 5% (i.e., P-value < 0.05). All statistical analyses were performed using IBM SPSS statistics software version 21.

Results

During the 12-week study, one participant experienced complications from hyperglycemic status. The physician discussed changing their therapy regimen, which might have an impact on the results of the study.

Of the 32 participants with uncontrolled blood glucose, most were women (84.38%). By average, they were 51.53 ± 6.85 years old and weighed 63.34 ± 9.63 kg with BMI of 25.0 – 29.9 in 13 people (40.60%). Most had elementary school education (78.13%). The majority were married 27 (84.38%), farmer (78.13%), with relatives with a history of diabetes (53.13%). Mean duration of diabetes was 6.13 ± 3.52 years. Most had complications (90.63%) (Table 2).

Table 2 Demographic and clinical characteristics of the participants (N = 32).

Characteristics	N (%)
Gender	
Men	5(15.62)
Women	27(84.38)
Age (years) (mean ± SD)	51 ± 6.85
Body weight (kg), mean = 63.34 ± 9.630 kg	
< 60	14 (43.80)
60 – 69.9	10 (31.20)
70 – 79.9	5 (15.60)
> 80	3 (9.40)
Body mass index (kg/m^2), mean = 25.47 ± 3.572	
18.5 – 22.9 (normal)	8 (25.00)
23.0 – 24.9 (obesity level1)	8 (25.00)
25.0 – 29.9 (obesity level1)	13 (40.60)
≥ 30.0 (obesity level 1)	3 (9.40)
Marital status	
Single	1 (3.12)
Married	27 (84.38)
Widowed/divorced/separated	4 (12.50)
Occupation	
Farmer	25 (78.13)
Employee	3 (9.38)
Merchant	2 (6.25)

Housekeeper	1 (3.12)
Government officer /state enterprise employee	1 (3.12)
Education level	
Primary school	25 (78.13)
Secondary school	7 (21.87)
History of a family suffering from diabetes	
Relatives with diabetes	17 (53.13)
Relatives with no diabetes	15 (46.87)
Duration of diagnosis with diabetes (years) (mean ± SD)	6.13 ± 3.53
Complications	
Hypertension	22
Dyslipidemia	20
Hypothyroidism/hyperthyroidism	2
Gout	1
No complication	3
Number of medications (mean ± SD)	3.66 ± 1.54

HbA1C level slightly increased from 8.00 ± 0.50% at baseline to 8.08 ± 0.80% at week 12 with no statistical significance (P-value 0.53). FBS level slightly decreased from 147.25 ± 24.52 mg/dl at baseline to 139.59 ± 26.04 mg/dl at week 12 with statistical significance (P-value 0.04).

There were no significant differences in lowering BMI and body weight at week 6 and week 12 compared with that at baseline.

For calorie intake, there was a downward trend from baseline to week 6 and week 12 with a statistical significance (P-value < 0.001). Specifically, significant differences were found among those at week 6 and week 12 compared with that at baseline with mean differences of 118.87 and 124.29 kcal, respectively (P-value < 0.001 and < 0.001, respectively).

Medication adherence increased from baseline to week 6 and week 12 with a statistical significance (87.70%, 94.33% and 95.75%, respectively) (P-value = 0.02 and < 0.001, respectively). Specifically, significant differences were found among those at week 6 and week 12 compared with that at baseline with mean differences of 6.63 and 8.05 %, respectively (P-value = 0.01 and < 0.001, respectively).

Table 4 Comparisons of study outcomes at different time points.

Variables	Mean (SD)			P-value*
	Week 0	Week 6	Week 12	
HbA1c (%)	8.00 (0.50)		8.08 (0.80)	0.53
FBS (mg/DL)	147.25 (24.52)		139.59 (26.04)	0.04
BMI (kg/m^2)	25.47 (3.57)	25.46 (3.60)	25.44 (3.60)	0.61
Body weight (mg)	63.34 (9.63)	63.31 (9.63)	63.26 (9.26)	0.59
Calorie intake (kcal)	1,690.50 (120.55)	1,571.63 (92.11)†	1566.21 (80.16)§	< 0.001
Medication adherence (%)	87.70 (10.06)	94.33 (4.11)#	95.75 (3.33)$	< 0.001

* Repeated measure ANOVA.

† P-value < 0.001, compared with baseline, based on Bonferronis's adjustment.

§ P-value < 0.001, compared with baseline, based on Bonferronis's adjustment.

P-value = 0.01, compared with baseline, based on Bonferronis's adjustment.

$ P-value < 0.001, compared with baseline, based on Bonferronis's adjustment.

Discussions and Conclusion

Thirty-two diabetic patients with HbA1c levels ranging from 7 to 9% were considered appropriate by Namnao Hospital's providers for monitoring over three to four months. The concept corresponded to withdrawal criteria. During the study's 12 weeks, the participants who discussed changing their therapy regimen with their doctor were asked to withdraw from the research.

The study's participant ratio was 5 times female over male concerning the prevalence of diabetes in Thailand, which was discovered in most females.[19] The research emphasized the importance of changing dietary habits and medication use. The effect of exercise in the program could not be appropriately assessed. This was because the primary occupation of most participants was agriculture, which required workers to participate in physical activity such as exercise regularly. Consequently, the study did not clearly assess the effects of exercise.

According to the previous research, changes in FBS levels were noted within 4 weeks, and changes in HbA1c levels took 8 to 12 weeks after health-modifying habits were implemented.[5,16,20,21] The results of this present study indicated that FBS levels significantly decreased at week 12, which corresponded to the experiment of a health education program using self-efficacy to manage diabetes in elderly patients[5] and empowerment on the self-efficacy, adherence, and glycemic control in patients with type 2 diabetes.[21] However, average FBS levels remained higher than the desired goals (80 - 130 mg/dl).

There was no significant difference in HbA1c levels at week 12 compared with baseline. This is consistent with a study using self-efficacy-based program to manage diabetes conditions in persons with type 2 diabetes.[22]

According to this experimental study, the participants usually adopted more behavioral change by reducing daily calorie intake, the result decreased significantly at weeks 6 and 12. However, this study's methodologies were designed to restrict and lower amounts of their dietary energy intake, but there was still enough that did not result in exhaustion from insufficient daily energy. There was a 12-week short course with activities aiming at flexible changes from the patients' general behaviors to reduce the probability of resistance to the intervention. Finally, there were no

statistically significant changes in BMI or body weight from baseline.

Unchanged blood glucose in our study could be from the diet. High glucose levels in regional fruits, particularly sweet mangoes, and tamarinds might be one factor that contributed to unregulated glycemia in diabetic patients as shown in other studies.[22,23] These high-sugar fruits are seasonally available. A seasonal factor was a limitation of this research, which resulted in different results of changes in blood glucose levels in different seasons. For example, our research was conducted at a high season for regional fruits, which may result in higher blood sugar levels than at other times. Extending duration and adjusting the methodologies by measuring the amount of fruits consumed before and after the intervention to observe consumption behaviors with more dietary specifics were required to get the intended outcomes. To obtain a more reliable results, an extended period of study such as six-month follow-up period could be established to observe sustainable behavior adjustment in persons with diabetes, or a twelve-month monitoring period could be established for seasonal factor evaluation.

In this present study, the pill count technique was used to evaluate medication adherence with over 80% of pills taken as a success. Participants' compliance increased considerably by over 90% after 6 weeks and 12 weeks. This could be because the health-modifying behavior program promoted knowledge and awareness of diabetic people resulting in appropriate medication use among participants, such as managing the missed dose and medication storage. Previous research showed that greater levels of medication adherence were linked to lower HbA1c and could significantly regulate the participants' blood glucose levels.[24] The pill count technique was developed for this study to measure the results conveniently. This method, however, could not explain the quality dimension of detailed medication use. The medication adherence measurement technique should be adjusted if the research desires the additional assessment to encompass both quantitative and qualitative dimensions.

Three components of self-efficacy were used to build participants' confidence in managing their diabetes conditions including proper dietary, exercise, and medication use. Master experience included assisting participants in promoting knowledge and awareness of diabetic people to establish positive health behaviors and control their diabetes conditions. Verbal persuasion was communication between the physician, diabetic patients, and caregivers to establish a positive relationship that would lead to an acceptable commitment. As a result, they shared their thoughts and discovered the barriers to diabetes management regulation, as well as devised solutions to the problems. Emotional arousal was the process of planning and setting treatment objectives for making health-modifying behavior in the short and long term, which resulted in significantly lower FBS levels in the participant. Their FBS levels, however, stayed higher than the desired goals. Finally, changes in the treatment regimen, such as additional medication adjustments, may be needed to control diabetes conditions successfully. The researcher suggested that activities based on self-efficacy be implemented in health-adjusting habits in diabetes patients, resulting in positive habits and lower blood glucose levels.

The present study has certain limitations. Since the experiment was intended to be completed in a short amount of time, we were unable to control the various seasonal variables, particularly seasonal fruits. As a result, the outcomes of changes of HbA1C and FPG could not be found. Qualitative information of medication adherence could not be obtained since we use pill count method which was a quantitative method. Since this research included only diabetic patients with HbA1c levels ranging from 7 to 9%, generalization diabetic patients with different HbA1c levels should be cautioned.

Based on the results, study conducts and limitations, certain recommendations were as follows. Future studies should extend to diabetic patients with HbA1c levels higher than 9% required in the study to prove efficacy of this kind of intervention. Future studies should extend the study period to cover seasonal changes that affect glycemic control especially fruits which are mostly seasonal. Qualitative methods to capture medication adherence should be used in future studies.

In conclusion, this present 12-week one-group pre-test post-test research on the efficacy of self-efficacy-based health behavior promoting program significantly improved fasting plasma glucose levels but not HbA1c levels among type 2 diabetic patients with uncontrolled blood glucose. The program significantly improved body mass index, body weight, calorie intake, and medication adherence.

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References

1. World Health Organization. Global report on diabetes. 2016. (Accessed Oct. 20, 2018, at https://iris.who.int/bitstream/handle/10665/204871/9789241565257_eng.pdf?sequence=1)
2. Sawatdimongkol S. Annual report 2015. Control department of disease; 2016:14. (in Thai).
3. Ministry of Public Health. Percent of well-controlled diabetes. (Accessed Oct 23, 2017. https://hdcservice.moph.go.th/hdc/reports/page.php?cat_id=b2b59e64c4e6c92d4b1ec16a599d882b)
4. Jaisit J, Meetam R, Kamkan P. Effect of self-management supporting program on self-management behaviors and hemoglobin A1c level among persons with type 2 diabetes. J Nurs Sci Health 2017;40(2):65-73. (in Thai)
5. Suksawat N, Pranprawit A, Phechmanee S. Effect of health education program using appling self-efficacy theory together with social support for self-care of diabetes elder patients of Thasathon health promoting hospital, Phunphin district, Surat Thani province. Commun Health Dev Quart Khon Kaen Univ 2016;4(1):49-65. (in Thai)
6. Beckerle CM, Lavin MA. Association of self-efficacy and self-care with glycemic control in diabetes. Diabetes Spectrum 2013;26(3):172-178.
7. Evert AB, Boucher JL, Cypress M, et al. Nutrition therapy recommendations for the management of adults with diabetes. Diabetes Care 2013;36(11):3821-3842.
8. American Diabetes Association. Standard of medical care in diabetes 2018. Diabetes Care 2018;41(suppl 1):13-72.
9. Boniol M, Dragomir M, Autier P, Boyle P. Physical activity and change in fasting glucose and HbA1c: a quantitative meta-analysis of randomized trials. Acta Diabetologica 2017;54(11):983-991.
10. Mottalib A, Salsberg V, Mohd-Yusof BN, et al. Effects of nutrition therapy on HbA1c and cardiovascular disease risk factors in overweight and obese patients with type 2 diabetes. Nutr J 2018;17(1):42. (doi: 10.1186/s12937-018-0351-0)
11. Post RE, Mainous AG, King DE, Simpson KN. Dietary fiber for the treatment of type 2 diabetes mellitus: a meta-analysis. J Am Board Fam Med 2012;25(1):16-23.
12. Bandura A. Self-efficacy: toword a unifying theory of behavioiral change. psychological. Psychol Rev 1977;84(2):191-215.
13. Prada J, Kullawong N, Promwung P, Phuchan B. Effect of family program on the parent perceived self-efficacy, family caring behaviors and development of intellectual and developmental disabilities persons. Rajanukul Institute 2010:22-29. (in Thai).
14. Tussanawin U. The effects of diabetic day camp participation on perceived self-efficacy, self-care behaviors and blood Sugar Level among patients with diabetes mellitus, type 2. Bangkok. Thammasart University, 2007. (in Thai)
15. Chudjuajeen S, Singhasame P, Wuttisukpaisan S. Effects of a perceived self-efficacy promoting program for life skill enhancement on sexual health behavior of students. The Southern College Network J Nurs Public Health 2017;4(2):258-280. (in Thai)
16. Saivaew P, Boonyamalik P, Chongchitpaisan W, Kaewboonchoo O. The effectiveness of promoting self-efficacy with organization support programs on health behaviors and HbA1C among workers with diabetes mellitus. J Med Health Sci 2022;29(1):67-82. (in Thai)
17. Jaisit J, Meetam R, Kamkan P. Effect of self-management supporting program on self-management behaviors and hemoglobin A1C level among persons with type 2 diabetes. J Nurs Sci Health 2017;40(2):65-73. (in Thai)
18. Bell ML, Kenward MG, Fairclough DL, Horton NJ. Differential dropout and bias in randomized controlled trials: when it matters and when it may not. Br Med J 2013;346:e8668. (doi: 10.1136/bmj.e8668)
19. Karnjanapiboonwong A, Khumwangsa-nga P, Keawtha S. Situation of NCDs 2019 Report. Bangkok. Aksorn Grphic And Design Publishing Limited Parnership, 2019. (Accessed on Jan. 12, 2020, at http://www.thaincd.com/2016/media-detail.php?id=13865&tid=&gid=1-015-005) (in Thai).
20. Hamwong S, Bunchonhattakit P. Effect of health education program using applying self-efficacy theory and social support for type 2 diabetic patients at Nhongkungpueak health promoting hospital, Nhongkungsri district, Kalasin province. Srinagarind Med J 2013;28(4):451-460.
21. Muangkum A, Suttajit S. Effects of patient empowerment on self-efficacy, adherence and glycemic control in patients with type 2 diabetes. Thai Pharm Health Sci J 2013;8(3):104-111. (in Thai)
22. Chaichumporn R. Plasma Glucose, Serum lipid and blood viscosity response in hyperlipidemic NIDDM patients after Ingestion mangoes (Mangifera indica L.cv.) Keaw Sawoey: effect of doses and degree of ripeness. Master's degree thesis. (Nutrition). Bangkok. Mahidol University, 2000. (in Thai)
23. Somnok S. Glycemic index of durian, mango, longan, pineapple, guava and dragon fruit and acute responses of plasma glucose, serum lipids and blood viscosity after ingestion of different amounts of fruits in hyperlipidemic type 2 DM patients. Master's degree thesis. (Nutrition). Bangkok. Mahidol University, 2004. (in Thai)
24. Alkhoshaiban A, Shoiab A. The impact of patient medication adherence on HbA1c level among type 2 diabetes mellitus patients. Presented at: Joint Event on 4th International Conference on Gastroenterology and Hepatology & 9th World Clinical Pharmacy and Pharmacy Practice. 2019. Amsterdam, Netherlands.