Effectiveness of a Self-regulation Program on Diet Control, Exercise, and Two-Hour Postprandial Blood Glucose Levels in Thais with Gestational Diabetes Mellitus

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Abstract: This study, using Bandura's Social Cognitive Theory as a framework, tested the effectiveness of a self-regulation program on diet control, exercise and two-hour postprandial blood glucose levels in Thais with gestational diabetes mellitus. Ninety participants were equally divided into an experimental (n = 45) and a control group (n = 45). Both groups were instructed in dietary control and exercise, and received routine care at their respective antenatal clinics. The experimental group members also were trained in self-regulation skills. Instruments for data collection included the: a) Personal Information Questionnaire, and b) Daily Diet Control, Exercise and Two-hour Postprandial Blood Glucose Record Sheet.

The Chi-square test revealed the rate at which the experimental group subjects controlled their diet, exercise and two-hour postprandial blood glucose levels, at weeks two, four and six of the program, to be significantly greater than in the control group. Moreover, relative risk analysis (risk ratio) showed the subjects, in the experimental group, could control their diet, exercise and two-hour postprandial blood glucose levels better than those in the control group at weeks two, four and six of the program. These findings illustrate the self-regulation program was effective in helping the experimental group subjects control their diets, exercise and blood glucose levels.

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Key words: Self-regulation; Diet, Exercise; Blood Glucose; Gestational diabetes mellitus

Introduction

Gestational diabetes mellitus (GDM), one of the most common complications of pregnancy: has been estimated to affect 1.4% to 14% of all pregnancies;[1] tends to occur most often among Asian, Hispanic/Latina and Native American women; and, is associated with significant maternal

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and fetal morbidity.[2] Among Thais, GDM affects 3.7% to 7% of all pregnancies.[3-5] Additionally, 40% to 60% of all women diagnosed with GDM are known to have reoccurrence of GDM during future pregnancies, as well as have an increased risk of developing type-2 diabetes within ten years.[6] Children of women with GDM also have been found to have an elevated risk of developing obesity and diabetes.[7,8] Thus, standard methods for management of GDM, including dietary, exercise and insulin regimens[9] have been developed to control elevated blood glucose levels and decrease adverse outcomes of GDM.

Although a number of Thai studies have shown educational programs significantly can affect blood glucose control, due to subjects failing to adhere to recommended dietary regimens, these studies have used posttest-only designs.[10-13] Results of a study that used a randomized control trail to investigate the effect of exercise on blood glucose levels revealed no significant differences between the blood glucose levels of the experimental and control groups.[14] Thus, it appears that women with GDM need knowledge and skills regarding self-regulation, so as to be better prepared to monitor their dietary intake, exercise and blood glucose levels.

Bandura recognizes self-regulation as a process in which individuals control and direct their behaviors toward desired goals, as well as develop functional patterns of thinking and behaving to attain new behaviors.[15] Self-regulation has been used to provide guidance for altering one's behavior and improving adherence to new behaviors among various populations, including: decreasing junk-food consumption in students;[16] reducing body weight and blood pressure in overweight women with elevated blood pressures;[17] promoting physical activity in adult patients and elders after knee replacement surgery;[18,19] and, promoting breastfeeding in primiparous mothers and mothers of preterm infants.[20] These self-regulation programs have tended to be conducted over six to ten weeks; consist of teaching, group discussion and telephone monitoring; and, demonstrate treatment adherence. Therefore, based upon the fact that most prior studies of pregnant, diabetic Thai women have used only post-test designs, rather than a self-regulation approach to education, the purpose of this study was to examine, using an experimental and control group design, the effect of a self-regulation program on diet control, exercise and two-hour postprandial blood glucose in Thais with GDM.

Literature Review and Conceptual Framework

Gestational Diabetes Mellitus (GDM): GDM has been defined as glucose intolerance that begins, or is first recognized, during pregnancy.[21] Risk factors for the condition are: advanced maternal age; obesity; high blood pressure; multiple pregnancies; previous delivery of a macrosomic infant; family history of type-2 diabetes; and, previous stillbirths or congenital malformations.[22,23] Normal pregnancy has been characterized as a "diabetogenic state" due to changes in the pattern of insulin secretion and sensitivity. In the late second and early third trimester, insulin sensitivity is reduced by human placental lactogen, leptin, prolactin and cortisol. During normal pregnancy, compensation for the marked reduction in insulin sensitivity takes place by way of an increase in β-cell secretion. If this compensation is not sufficient, abnormal glucose tolerance develops.[23,24]

The American College of Obstetricians and Gynecologists (ACOG)[24] recommends screening for GDM via a 50-g glucose challenge test (GCT) followed by a 100-g oral glucose tolerance test (OGTT). If the blood glucose level, secondary to the GCT, is more than 140 milligrams per deciliter (mg/dl) after one hour, the results are considered positive. The OGTT then is performed to determine

if the plasma glucose level, at fasting, is equal to or greater than the normal value of 105 mg/dl, or equal to or greater than the normal value of 190, 165 and 145 mg/dl at one, two and three hours, respectively, after consumption of 100 grams of glucose. If two or more of the plasma glucose values are equal to or greater than the normal criteria, a diagnosis of GDM can be made.[23]

When a woman is diagnosed with GDM, she is categorized as either having GDM class A_1 or A_2, based upon the level of glycemia determined from her fasting and two-hour postprandial blood glucose levels.[23] A pregnant woman is classified as having GDM class A_1 if her blood glucose is less than 105mg/dl and her two-hour postprandial blood glucose is less than 120mg/dl. On the other hand, a pregnant woman is classified as having GDM class A_2 when her fasting blood glucose is equal to or greater than 105mg/dl and/or the two-hour postprandial blood glucose is equal to or greater than 120mg/dl.

The presence of GDM impacts both the mother and her infant. The mother has a greater likelihood of contending with hydramnios, hypertension, pre-eclampsia and a caesarean section, while the infant is at an increased risk of being stillbirth and having congenital anomalies, macrosomia, hypoglycemia, hyperbilirubinemia, respiratory complications and birth trauma.[1,23,24] Standard methods for management of GDM (i.e. nutritional therapy, exercise and insulin regimens) have been developed to control elevated blood glucose levels and decrease adverse outcomes.[1,9,23] Nutritional therapy, the main aspect of GDM management, is based on women's ideal body weight of: (a) 30kcal/kg and a BMI (body mass index) of 22 - 25; (b) 24 kcal/kg and a BMI of 26 - 29; and, (c) 12 to15 kcal/kg and a BMI of 30 and greater. In addition, it is recommended that meals need to be composed of: 50-60% carbohydrates; 25-30% lipids; and, 10-20% proteins.[25] The American Diabetes Association (ADA)[1] recommends the initiation of insulin therapy when nutritional therapy alone fails to maintain a fasting blood glucose level of 105 mg/dl or a two-hour postprandial glucose level equal to or greater than 130 mg/dl. Since exercise has been shown to increase insulin sensitivity and enhance insulin action in extra-muscular tissue, resulting in lower blood glucose, the ACOG recommends that pregnant women perform moderate exercise 30 minutes or more, three days per week, while maintaining a heart rate at less than 140 beats per minute.[26]

Social Cognitive Theory: Bandura's Social Cognitive Theory (SCT)[15] was used as the guiding framework as it provides a framework for analyzing human motivation, thought and action. Human behavior, according to Bandura, can be explained in terms of the triadic, reciprocal, determinism model in which personal factors, behavior and environment influence each other. In addition, Bandura espouses that SCT emphasizes personal factors in which cognition plays an important role. From this perspective, self-regulation is seen as the process of acquisition of new behavior and as being composed of self-observation, judgment and self-reaction, wherein: self-observation is a way to motivate oneself; judgment is the way people judge the adequacy of their performances in relation to personal standards and referential standards; and, self-reaction involves reacting cognitively and emotionally to the results of the outcomes.[15]

The self-regulation process, according to the SCT, requires one to determine, through self-observation using strategically positioned mirrors (to provide visual feedback), how he/she is doing from a behavioral perspective.[15] The individual also has to judge the adequacy of his/her performance in relation to his/her personal and referential standards. One then can experience positive or negative cognitive and/or emotional reactions to his/her self-observation and self-regulation. If the person views his/her

reactions as positive, he/she has a feeling of confidence to grow and be capable of performing a behavior or take on the role associated with a behavior. On the other hand, if the person views the outcome as negative, he/she perseveres until his/her performance matches his/her expectation so as to avoid self-punishment.

Due to the fact that self-regulation focuses on the importance of the individual's ability to control his/her own behavior, and how change in the individual and/or the environment produces changes in behavior, self-regulation has been applied in the treatment of behaviors, such as: smoking,[27] obesity,[17,28] breast feeding,[20] sleep disturbances and depression.[27] Evaluation of various physiological (diet control,[16] weight loss,[17,28] physical activity,[18,19] heart rate and blood pressure[17]) and psychological[27, 29] (stress release, self-confidence and self-satisfaction) outcomes of various self-regulation interventions have revealed that programs that contain self-regulation are statistically more effective than programs that do not include self-regulation. Thus, self-regulation has been determined to be an effective component in treatment of various behavioral problems.

Thai studies consistently have found significant positive effects on transient ischemic attack (TIA) and minor stroke patients' physical fitness and satisfaction in exercise programs that include self-regulation components.[29] In addition, students in Bangkok have been found to decrease their consumption of junk food when involved in a self-regulation dietary program.[16] Therefore, the effectiveness of a self-regulation program on diet control, exercise and two-hour postprandial blood glucose levels was tested, in this study, in Thais with GDM.

Method

Design: A quasi-experimental design, using an experimental and control group, was used to determine the effects of a self-regulation program on diet control, exercise and two-hour postprandial blood glucose levels in Thais with GDM.

Ethical Considerations: The study was approved by the Institutional Review Boards of the primary investigator's (PI) university and the three hospitals used as study sites. All potential subjects were informed about: the purpose of the study; what participation in the study involved; confidentiality and anonymity issues; and, the right to withdraw without repercussions. All participating subjects were asked to sign a consent form prior to study inclusion.

Sample and Setting: A proportional, purposive, sampling technique was used to select 90 subjects from the antenatal units of three public hospitals, in Bangkok, that offered general health care services (46 from Hospital A, 28 from Hospital B, and 16 from Hospital C). Each of these units used the National Diabetes Data Group (NDDG) diagnostic criteria and standard of management for GDM.[30] Since subjects for both the experimental and control group were obtained from the same three hospitals, in order to prevent cross contamination of data, subjects for the control group were identified and took part in the study prior to identification of subjects for the experimental group.

Potential subjects were identified via a medical record review of women being seen in the antenatal clinics of the hospitals used as study sites. One hundred and eight women with GDM, who met the inclusion criteria, were approached. Eighteen potential subjects (16.6%) refused to participate, because they wanted to receive care from a hospital closer to their home, while others did not find the requirements of the research protocol to be convenient for them. Each potential subject was approached while waiting to be seen by the health care providers at the antenatal clinic she attended. The criteria for inclusion were: being a pregnant Thai with class A_1 or A_2 GDM; having a single fetus with a gestational age of 20 to 30 weeks at the time of data collection; having no other complications; and,

being able to read and understand Thai. Using information from the medical records, subjects were matched based on their pre-pregnancy BMI and classification of their GDM and randomly assigned to either the experimental (n = 45) or control (n = 45) group. However, upon completion of four weeks of the six-week study, two (4.4%) control group subjects dropped out, due to moving to their hometown and wanting to use the government's Universal Health Care Coverage Scheme. Therefore, 43 control group subjects participated in the six week research protocol. Using the Fisher's exact test, no significant differences ($p > .05$) were found between the demographic characteristics of the two who withdrew and the other 43 subjects in the control group. As shown in **Table1 and 2,** no significant differences were found between the experimental and the control group subjects with respect to their: demographics; health related characteristics; pre-program exercise activities; or, two-hour postprandial blood glucose levels.

Self-regulation Program for Subjects in the Experimental Group: The PI-designed, six week, self-regulation program, based upon Bandura's concept of self-regulation,[15] was implemented to the experimental group subjects. The subjects also received routine health care from the staff at their respective antenatal clinic. Routine care involved the provision, by a nutritionist or clinic nurse, of information about GDM, daily caloric needs and an exchange list for meal planning. In addition, the subjects were instructed regarding the need to control their diets, so as to maintain a fasting blood glucose level equal to or less than105 mg/dl and a two-hour postprandial glucose level less than120 mg/dl. Whenever it was determined a subject could not achieve these blood glucose levels, insulin therapy was used in addition to diet control.

Table 1 Demographic and Health Related Characteristics of Subjects

Characteristics	Experimental Group		Control Group		χ^2	*p*
	n	%	n	%		
Age (years)					.000	1.000
< 30	13	28.89	13	28.89		
≥ 30	32	71.11	32	71.11		
	Mean=31.86 (SD=5.45)		Mean=32.66 (SD=5.31)			
Educational level					1.390	.499
Primary education	10	22.22	15	33.33		
Secondary education	19	42.22	16	35.56		
Bachelor's degree or higher	16	35.56	14	31.11		
Occupation					4.482	.214
Homemaker	18	40.00	9	20.00		
Laborer	15	33.33	22	48.89		
Retailer and small business owner	7	15.56	8	17.78		
Government officer	5	11.11	6	13.33		

Table 1 Demographic and Health Related Characteristics of Subjects (cont.)

Characteristics	Experimental Group n	%	Control Group n	%	χ^2	*p*
Hours of daily work outside the home					.591	.442
≤ 8	17	62.96	18	50.00		
> 8	10	37.04	18	50.00		
Family income (baht)					.985	.611
< 15,000	12	26.67	16	35.56		
15,000-30,000	26	57.78	24	53.33		
> 30,000	7	15.55	5	11.11		
Type of family					1.182	.277
Nuclear family	25	55.60	31	68.90		
Extended family	20	44.40	14	31.10		
Food preparation					2.353	.308
Buying	11	24.44	13	28.89		
Cooking	22	48.89	15	33.33		
Buying and cooking	12	26.67	17	37.78		
Gravidity					1.212	.271
Primigravida	19	42.22	13	28.89		
Multigravida	26	57.78	32	71.11		
Gestational age at the beginning of the study					.452	.798
20-24 weeks	14	31.11	17	37.78		
25-28 weeks	17	37.78	15	33.33		
29-30 weeks	14	31.11	13	28.89		
Pre-pregnancy BMI (kg/m^2)					.000	1.000
<25	25	55.56	25	55.56		
25-29.9	14	31.11	14	31.11		
≥30	6	13.33	6	13.33		
	Mean=24.81 (SD=4.56)		Mean=24.99 (SD=4.89)			
Gestational diabetes mellitus classification					.000	1.000
A_1	37	82.22	37	82.22		
A_2	8	17.78	8	17.78		

Table 1 Demographic and Health Related Characteristics of Subjects (cont.)

Characteristics	Experimental Group		Control Group		χ^2	*p*
	n	%	n	%		
History of risk factors					.000	1.000
Family history of diabetes mellitus						
Yes	23	51.11	24	53.33		
No	22	48.89	21	46.67		
Previous gestational diabetes mellitus						.446*
Yes	5	19.23	3	9.38		
No	21	80.77	29	90.62		
Previous delivery of overweight infant						.120*
Yes	0	0.00	4	12.50		
No	26	100.00	28	87.50		
Previous infant with congenital anomalies						.448*
Yes	1	3.85	0	0.00		
No	25	96.15	32	100.00		
Hypertension during previous pregnancies						1.000*
Yes	2	7.69	3	9.37		
No	24	92.31	29	90.63		

*Fisher's Exact Test

Table 2 Comparison of Exercise and Two-hour Postprandial Blood Glucose before Initiation of the Self-regulation Program

Dependent Variables	Experimental Group		Control Group		χ^2	*p*
	n	%	n	%		
Exercise before pregnancy					**.93**	**.334**
Yes	14	31.11	9	20.00		
No	31	68.89	36	80.00		
Exercise during pregnancy					**1.44**	**.230**
Yes	9	20.00	4	8.89		
No	36	80.00	41	91.11		
Two-hour postprandial blood glucose levels					**.40**	**.527**
<120mg/dl	25	55.56	21	46.67		
≥120mg/dl	20	44.44	24	53.33		
	Mean=107.22 (SD=19.24)		Mean=122.27 (SD=23.61)			

During week one of the self-regulation program, 50 minutes of instruction were offered to the subjects, in a group setting, in a conference room at their respective antenatal clinic. Using lecture, discussion, written materials and demonstration, subjects were instructed regarding: symptoms, risk factors and types of GDM; effects GDM has on a pregnant woman and her fetus; daily caloric needs of a pregnant woman; and, yoga exercises for pregnant women.

The subjects also were instructed, via lecture, discussion and written materials, about self-regulation (self-observation, the judgment process and self-reaction). The self-observation instruction involved how to analyze daily dietary practices, exercise activities and two-hour postprandial blood glucose levels after breakfast, using a blood glucose meter provided by the respective antenatal clinic, and to list the results on the *Daily Diet, Exercise and Two-Hour Postprandial Blood Glucose Record Sheet* provided by the PI. In addition, subjects were instructed on how to: use these data for setting personal goals related to appropriate dietary intake, exercise and blood glucose control; create strategies to meet their personal goals; and, self-monitor their behavior to achieve their goals. Furthermore, the subjects were asked to identify things they thought would prove problematic for them in achieving their individual goals and share this with one another.

The judgment process involved instructing subjects on how to compare the information about their dietary control, exercise and two-hour postprandial blood glucose levels to their personal goals and referential standards. The referential standards was, for each of them, to: maintain a two-hour postprandial blood glucose level less than 120 mg/dl, and gain, on average, no more than one to two pounds per week during the second and third trimesters.

Self-reaction involved instructing the subjects on how to reward themselves for making positive achievements regarding dietary control, exercise and blood glucose levels. Since individuals reward themselves both with intrinsic and extrinsic incentives, they were told their rewards could include: a) feelings of self-satisfaction and enjoyment (intrinsic) or b) purchasing a new pair of shoes, reading or watching television (extrinsic). The subjects also were informed if they failed to obtain positive achievements, they likely would engage in negative self-evaluations (i.e. self-dissatisfaction and disappointment). After they had received the instructions, subjects were encouraged to implement, on a daily basis, what they had learned and the action plans they had developed, and to record their daily dietary practices, exercise activities and blood glucose levels on their personal record sheets.

At the beginning of week two, the PI telephoned each subject and reminded her to test and record her two-hour postprandial blood glucose level, after breakfast, on the date of her scheduled week two antenatal clinic appointment. The week two session of the program was held in the same location as the week one session and involved a repeat of the 50-minute instructional program offered during week one of the program. However, since they had engaged in a week of implementing what they had learned the first week of the program, they were encouraged to verbally share problems they had encountered and how they had worked to resolve them to be able to meet their personal goals. The PI and subjects complimented those who had been successful in achieving their goals and encouraged everyone to continue to implement what they had learned about dietary control, exercise, two-hour postprandial blood glucose testing and self-regulation skills, as well as to record, daily, the results of each activity on their personal record sheet. Upon completion of week two, subjects brought their personal record sheets to their respective antenatal clinics during their regular week two clinic visit for the PI to collect.

During weeks three through six, subjects continued to implement their self-regulation skills (self-observation, judgment process and self-reaction) with respect to the dietary control, exercise and two-hour postprandial blood glucose testing they had learned during the first two weeks of the program. In addition, during weeks three through six, the PI telephoned each subject and reminded her to monitor implementation of her self-regulation skills. During weeks four and six, the PI also telephonically reminded each subject to test and record her two-hour postprandial blood glucose level, after breakfast, on the day of her scheduled antenatal clinic appointment. The PI collected each subject's completed record sheets after they brought them to their respective antenatal clinics during their regular week four and week six clinic visits.

Program for Control Subjects: During week one, the control group members received the same instructions, as the experimental group subjects, regarding dietary control, exercise and two-hour postprandial blood glucose testing. In addition, like the experimental group, each member of the control group was provided personal record sheets on which to record her daily dietary control, exercise and blood glucose results. Since the control group did not receive information on self-regulation skills, their period of instruction lasted only 30 minutes. Throughout the program, like those in the experimental group, the control group members received routine care at their respective antenatal clinics.

During weeks two, four and six, the PI telephonically reminded each member of the control group to test her two-hour postprandial blood glucose, after breakfast, on the day of her scheduled antenatal clinic appointment. At the end of weeks two, four and six, the PI retrieved each subject's record sheets. The record sheets were brought, by the subjects, to their respective antenatal clinics when they were making their regular week two, week four and week six clinic visits.

Instruments: Data were obtained through use of two researcher-designed instruments: the *Personal Information Questionnaire (PIQ) and the Daily Diet, Exercise and Two-Hour Postprandial Blood Glucose Record (DDEAPPBGR).* Both instruments were examined by two obstetricians, two obstetrical nurses and one nutritionist who found the content to be appropriate and comprehensive.

The *Personal Information Questionnaire (PIQ)* was used to obtain demographic and pregnancy characteristics of each subject. The information requested included each subject's: age; educational level; occupation; hours of work outside the home; family income; type of family; food preparation involvement; gravidity; gestational age; GDM classification; exercise before and during pregnancy; history of risk factors of GDM; and pre-pregnancy BMI. It took approximately five minutes to complete the PIQ.

The *Daily Diet, Exercise and Two-Hour Postprandial Blood Glucose Record Sheet (DDEAPPBGR)* was divided into three sections to separately address each subject's daily diet, exercise and blood glucose levels. The diet section of the *DDEAPPBGR* requested subjects to record, any three days of the week during the entire six week program, all foods, including their respective amounts, consumed. The PI used this information to calculate the total calories each experimental and control group subject consumed. Their total calories then were compared to the calorie count standard of 30 to 35kcal/kg/day, for persons with an ideal body weight, and 25 kcal/kg/day, for individuals considered to be overweight/obese (BMI 30).[31,32] Subjects were categorized as "able to control" their dietary needs, if they consumed their dietary caloric count based on their body weight, or as "unable to control" their dietary needs, if they exceeded their dietary caloric count based on their body weight.

The exercise component of the *DDEAPPBGR* requested each subject to record the time, type,

duration and frequency of the exercises performed each day. The PI reviewed the calculations and categorized each subject as "able to adequately exercise," if she exercised at least 30 minutes per day, three days a week, or as "unable to adequately exercise," if she did not exercise at least 30 minutes per day, three days a week.[33]

The blood glucose section of the *DDEAPPBGR* requested each subject to measure her two-hour postprandial glucose level, after breakfast, on the day of her scheduled antenatal appointment during weeks two, four and six. The PI reviewed the calculations and categorized each subject as "able to control blood glucose level," if her blood glucose level was <120mg/dl, or as "unable to control glucose blood level," if her blood glucose levels was ≥120mg/dl.[30] It took subjects an average of 10-15 minutes to complete the *DDEAPPBGR*.

Procedure: The PI verbally administered the *PIQ* to all the experimental and control group subjects and told them when, where and at what time to participate in the instructional component of their respective program. The programs then were implemented as described.

Data Analysis: Descriptive statistics were used to describe the subjects' demographic and pregnancy characteristics. A chi-square test or Fisher's exact test was used to evaluate differences in demographic and pregnancy characteristics between the experimental and control groups. The Inmucal-N Program[34] was used to calculate dietary calories. A chi-square test and relative risk test (risk ratio) were used to examine, in both the experimental and control group, the effect of self-regulation on diet control, exercise and two-hour postprandial blood glucose levels.

Results

Diet control: As noted in **Table 3**, at weeks two, four and six of the program, the experimental group subjects were significantly better at controlling their diets than subjects in the control group. Control group subjects did manage, however, to increase their percentage of diet control at week six, compared to weeks two and four, but still not to the same level as the experimental group. In addition, assessment of relative risk showed subjects in the experimental group could control their diet better than those in the control group at weeks two, four and six (see **Table 4**). These findings suggest the self-regulation program was successful in improving diet control for subjects in the experimental group.

Exercise: At weeks two, four and six of the program, the percentage of subjects in the experimental group who exercised was significantly greater than those in the control group (See **Table 3**). The percentage of control group subjects who exercised increased only 3.26% over six weeks. Investigation of relative risk showed subjects in the experimental group exercised more regularly, at weeks two, four and six, compared to those in the control group (see **Table 4**). These findings suggest the self-regulation program had a positive influence on the experimental group subjects' exercise involvement.

Two-hour postprandial blood glucose levels: As shown in Table 3, subjects in the experimental group, at weeks two, four and six of the program, had significantly better two-hour postprandial blood glucose levels than those in the control group. Although the control group did demonstrate some improvement in the percentage of subjects who were able to control their blood glucose levels, they still failed to achieve the same level of improvement as the experimental group. Investigation of relative risk showed subjects in the experimental group controlled their two-hour postprandial blood glucose levels at weeks two, four and six of the program, better than those in the control group. These findings suggest the self-regulation program had a positive influence on the experimental group subjects' two-hour postprandial blood glucose levels.

Table 3 Comparison of the Dependent Variables between the Experimental and Control Groups

Dependent Variables	Experimental Group				Control Group				χ^2	*p*
	able		unable		able		unable			
	n	%	n	%	n	%	n	%		
Diet control										
Week two	32	71.11	13	28.89	20	44.44	25	55.56	5.51	.019
Week four	36	80.00	9	20.00	20	44.44	25	55.56	10.64	.001
Week six	36	80.00	9	20.00	23	53.49	20	46.51	5.85	.016
Exercise										
Week two	32	71.11	13	28.89	9	20.00	36	80.00	21.68	<.001
Week four	39	86.67	6	13.33	9	20.00	36	80.00	37.55	<.001
Week six	39	86.67	6	13.33	10	23.26	33	76.74	33.31	<.001
Two-hour postprandial blood glucose levels										
Week two	35	77.78	10	22.22	16	35.56	29	64.44	14.66	<.001
Week four	39	86.67	6	13.33	21	46.67	24	53.33	14.45	<.001
Week six	37	82.22	8	17.77	25	58.14	18	41.86	5.02	.025

Table 4 Relative Risk of the Dependent Variables in the Experimental and Control Groups after Program Completion

Dependent Variables	Relative Risk	95% Confidence Interval
Diet control		
Week two	1.80	1.10-2.94
Week four	2.43	1.34-4.40
Week six	1.97	1.10-3.51
Exercise		
Week two	2.94	1.80-4.82
Week four	5.69	2.68-12.08
Week six	5.17	2.44-10.95
Two-hour postprandial blood glucose levels		
Week two	2.68	1.52-4.71
Week four	3.25	1.55-6.81
Week six	1.94	1.05-3.58

Discussion

The self-regulation program was successful, at weeks two, four and six of the program, in controlling diet and exercise which, in turn, led to better control of the experimental group subjects' two-hour postprandial blood glucose levels. These findings are similar to those of previous studies on the effect of self-regulation programs. For example, a self-regulation program has been shown to significantly impact physical exercise in obese women,[28] as well as increase the walking distance of patients who have experienced a transient ischemic attack.[29] Using a self-regulation framework, Christensen and colleagues[35] found an increase in adherence to fluid-intake restrictions among hemodialysis patients, while Clark and associates[36] found an increase in weight loss among elderly female patients with heart disease.

Since self-regulation involves self-observation, judgment process and self-reaction,[15] the experimental group subjects' awareness of the importance of diet control, exercise and blood glucose levels, during pregnancy, most likely was raised as a result of information obtained about GDM and the impact it can have on both the mother and the fetus. In addition, the study's self-regulation program allowed for: observing one's behavior; recording those behaviors; analyzing problematic areas related to reaching one's goals; assessing the results of behaviors against acceptable standards; and, reacting to positive achievements. The fact that during the program self-monitoring was used that focused on proximal effects (i.e. two-hour postprandial blood glucose levels) rather than distal effects (i.e. occurrence of a congenital defect), no doubt, served as a motivator for subjects to continue self-regulatory behaviors.

Limitations

Like all studies, this study has limitations. For one, quasi-experimental designs, like the one used in this study, are susceptible to internal validity threats.[37] To contend with this concern, selection bias was minimized through the use of a balanced design. Attempts were made to ensure the two groups had proportional representation with regards to extraneous variables.[37] Pair matching was used to control the effects of GDM classification and pre-pregnancy BMI. Comparison of personal characteristics of both the experimental and the control groups, before initiation of the self-regulation program was executed, resulted in no significant differences. Attrition bias was addressed and the two control group subjects, who left the study after the fourth week of the program, were found to not be significantly different from those who remained. Therefore, the self-regulation program, rather than other factors, affected diet control, exercise behaviors and two-hour postprandial blood glucose of the experimental group subjects. However, the findings of this study can be generalized only to pregnant women with GDM who have characteristics similar to those used in the study.

Another study limitation is the fact the data relied on self-reports of food consumption, exercise and two-hour postprandial blood glucose levels. Thus, one has to assume the subjects' recordings were accurate. Self-reports are vulnerable to the risk of reporting biases, but tend to yield data of considerable richness that is useful in gaining an understanding of the phenomena under examination.

Finally, subjects were obtained from only one geographic area (Bangkok) in Thailand which was a major metropolitan area. Thus, the findings are applicable only to pregnant women with GDM who are from Bangkok and not to women from rural areas of Thailand.

Recommendations

Future studies, using a design similar to the one used in this study, are needed. However, those studies need to consider using both a larger sample size and subjects from multiple geographic areas (urban and rural) throughout Thailand. In addition, diet control and exercise behaviors are influenced not only by self-regulation, but also by family members, friends and peers. Therefore, it is recommended that the variable, social support, be added to future study designs. A qualitative study that addresses factors that contribute to maintaining self-regulation in pregnant women with GDM also might prove helpful.

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ประสิทธิผลของโปรแกรมการกำกับตนเองต่อพฤติกรรมการรับประทานอาหาร การออกกำลังกายและระดับน้ำตาลในเลือดหลังรับประทานอาหาร 2 ชั่วโมง ในสตรีไทยที่เป็นเบาหวานขณะตั้งครรภ์

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บทคัดย่อ: การศึกษานี้ใช้ทฤษฎีการเรียนรู้ทางสังคมเชิงพุทธิปัญญาของแบนดูรามาเป็นกรอบแนวคิดในการศึกษา เพื่อศึกษาประสิทธิผลของโปรแกรมการกำกับตนเองต่อพฤติกรรมการรับประทานอาหาร การออกกำลังกาย และระดับน้ำตาลในเลือดหลังรับประทานอาหาร 2 ชั่วโมง ในสตรีไทยที่เป็นเบาหวานขณะตั้งครรภ์ กลุ่มตัวอย่างจำนวน 90 ราย แบ่งเป็นกลุ่มทดลอง และกลุ่มควบคุม กลุ่มละ 45 ราย ทั้งสองกลุ่มได้รับการสอนเรื่องการควบคุมอาหาร, การออกกำลังกาย และได้รับการดูแลตามปกติจากโรงพยาบาลที่ไปฝากครรภ์ แต่กลุ่มทดลองได้รับโปรแกรมการกำกับตนเองร่วมด้วย เก็บรวบรวมข้อมูลด้วยเครื่องมือ แบบสอบถามข้อมูลส่วนบุคคล, แบบบันทึกการรับประทานอาหาร, แบบบันทึกการออกกำลังกาย และระดับน้ำตาลในเลือดหลังรับประทานอาหาร 2 ชั่วโมง

ผลการทดสอบไคสแควร์พบว่าอัตราส่วนของกลุ่มตัวอย่างในกลุ่มทดลองสามารถควบคุมอาหาร, ออกกำลังกาย และระดับน้ำตาลในเลือดหลังรับประทานอาหาร 2 ชั่วโมงมากกว่ากลุ่มควบคุม ภายหลังเข้าโปรแกรมในสัปดาห์ที่ 2, 4 และ 6 อย่างมีนัยสำคัญทางสถิติ นอกจากนี้จากการวิเคราะห์ด้วยความเสี่ยงสัมพัทธ์พบว่า กลุ่มทดลองสามารถควบคุมอาหาร ออกกำลังกาย และระดับน้ำตาลในเลือดหลังรับประทานอาหาร 2 ชั่วโมงได้ดีกว่ากลุ่มควบคุม ภายหลังเข้าโปรแกรมในสัปดาห์ที่ 2, 4 และ 6

การศึกษาครั้งนี้พบว่า โปรแกรมการกำกับตนเองช่วยสนับสนุนให้กลุ่มตัวอย่างในกลุ่มทดลองสามารถควบคุมอาหาร ออกกำลังกาย และระดับน้ำตาลในเลือดหลังรับประทานอาหาร 2 ชั่วโมงได้อย่างมีประสิทธิภาพ

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คำสำคัญ: การกำกับตนเอง, อาหาร, ออกกำลังกาย, ระดับน้ำตาลในเลือด, สตรีที่เป็นเบาหวานขณะตั้งครรภ์

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