Effects of Traditional and Modified Arm Swing Exercise Programs on Blood Glucose and Nutritional Status among People with Type 2 Diabetes: A Secondary Data Analysis

Sangthong Terathongkum, Ratchanok Phonyiam, Pattaraporn Koonmee*

Abstract: People with type 2 diabetes are at high risk of diabetes complications. Optimal glycemic control is required and could be achieved by lifestyle modification, particularly through regular exercise. This quasi-experimental study used secondary data analysis to compare the effects of Traditional and Modified Arm Swing Exercise programs on blood glucose level and nutritional status among people with type 2 diabetes. Seventy-six people with type 2 diabetes were from two previous datasets and divided into three groups: 26 for the Traditional Arm Swing Exercise, 24 for the Modified Arm Swing Exercise, and 26 for the control group. Data were gathered using a demographic questionnaire and measurements of fasting capillary blood glucose, hemoglobin A1c, and for nutritional status, we measured body mass index, waist circumference, visceral fat and skeletal muscle using measuring tape, body composition monitor and blood glucose monitor at baseline and after the Programs. Data were also analyzed using t-test, one-way ANOVA, and ANCOVA.

The results revealed that after the Programs both Traditional and Modified Arm Swing Exercise groups had statistically lower fasting capillary blood glucose, hemoglobin A1c, body mass index, waist circumference, and visceral fat, but higher skeletal muscle than before the Program. The Traditional Arm Swing Exercise group had a statistically lower average hemoglobin A1c when compared with the control group and also had statistically lower average waist circumference than the Modified Arm Swing Exercise and control groups. Average hemoglobin A1c and waist circumference were not different between the Modified Arm Swing Exercise and control groups. Results suggest that the Traditional Arm Swing Exercise is the most effective. Nurses can apply the Traditional Arm Swing Exercise Program to improve blood glucose and nutritional status in people with type 2 diabetes.

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Introduction

Type 2 diabetes mellitus (T2DM) is a global health problem experienced by around 463 million

people in 2019 and its prevalence is expected to increase to 700 million by 2045.[1] In Thailand, the total case of diabetes in adults was almost 4.3 million, with a prevalence rate equal to 8.3%.[2] Of these, approximately 79% were unable to control their blood glucose levels to within normal range and were at high risk of T2DM complications, including chronic kidney failure and cardiovascular disease.[3-5] To achieve glycemic control and prevent these complications, the American Diabetes Association recommends people with T2DM modify lifestyle activities, especially healthy diet and adequate exercise.[4] However, previous studies have shown that Thai people consume high-calorie food,[5] sugar-sweetened beverages,[6] and high carbohydrates,[7-8] and are less physically active.[9] An imbalanced caloric intake contributes to beta-cell dysfunction and insulin resistance,[10] hence, efforts to improve insulin regulation may benefit from regular exercise.

In Thailand, the majority of individuals living with T2DM have a low family income (89.57%), low educational achievement (53.27%), and work in either agricultural or laboring jobs (54.59%).[3] Lower socioeconomic status (SES) has been positively associated with T2DM and poor glycemic control and is found to be higher among people with lower educational achievement.[3] People with T2DM living in lower SES environments may have limited access to exercise infrastructure and may need to pay for gym membership.[7] Hence, feasible and straightforward exercise alternatives with practical outcomes are needed.

Traditional Arm Swing Exercise (TASE) is a traditional Chinese exercise, a mind-body intervention recommended by the Thai government to promote home-based exercise.[11,12] Previous studies report that the TASE significantly improved lipid profiles, regulated blood glucose level, and promoted stress management in people with T2DM.[11,13,14] However, TASE focuses on the upper part of the body by moving the arm back approximately 60 degrees and forth lightly rather than using whole-body movement that cannot stimulate more lymph nodes. Nevertheless, there has been limited studies using a Modified Arm Swing Exercise (MASE) to enhance both abdominal and quadriceps muscle contraction, and to promote hip and knee joint movement by a little bending of the knees at the third arm swing performance that may be appropriate for people with T2DM.[15]

Although the effectiveness of arm swing exercise has been well-documented,[11,13-15] little is known about the comparison effects between the TASE and MASE in people with diabetes. Therefore, this study aimed to compare the effects of the TASE and MASE on blood glucose levels and nutritional status among them. This will provide preliminary data to inform tailored home-based exercise training to enhance glycemic control and improve nutritional status, which in turn can promote the quality of life of people with diabetes in Thailand and elsewhere.

Review of Literature and Conceptual Framework

Self-Efficacy Theory originated in 1997 from the Social Cognitive Theory of Albert Bandura, who stated that perceived self-efficacy influences a person's belief in his or her capability to succeed in a particular circumstance or goals.[16] His theory also determined that accomplishing outcome expectations leads to better health outcomes. Accordingly, Bandura delineated four principal sources to increase self-efficacy for health behavior modification: 1) mastery experience, which is the most powerful resource arising from successful performance outcomes or past experiences; 2) vicarious experience, which is derived from observing social modeling to perform similar activities without adverse consequences being able to generate expectations developing perceived self-efficacy for change in health behavior; 3) verbal persuasion which indicates that persons have more skills and capabilities to succeed, affecting their behavior to achieve their goals; and 4) physiological and affective states which are the last

resource being essential to relaxation and readiness, leading people to feel more confidence in completing tasks.[16] Thus, integration of the Self-Efficacy Theory in this study was considered essential to enhance the exercise behavior of the participants.[17-19]

Among people with diabetes, several studies have confirmed the effectiveness of interventions integrating self-efficacy in adults[18] and older adults[20] with diabetes. A recent systematic review and meta-analysis also reported that people with diabetes receiving a self-efficacy-focused intervention have better self-management behaviors, diabetes knowledge, psychological states, and quality of life.[21] Another review on the bio-behavioral determinants of glycemic control also synthesized that self-efficacy was the utmost consistent predictor of all adherence behaviors.[16] Further, exercise adherence and perceived self-efficacy were the major predictive factors of body mass index and glycemic control among people with diabetes.[22]

Previous studies in people with T2DM using TASE or MASE intervention to control blood glucose and nutritional status are limited but found significant differences when comparing hemoglobin A1c (HbA1c) before the program or in the control group[13,14,23,24] as well as body mass index (BMI),[14] waist circumference (WC),[13,14,24] and skeletal muscle.[24] Unfortunately, a previous study had no significant difference in visceral fat.[24] No studies in Thailand have compared the TASE and MASE Programs in people with T2DM.

Study Aim

The purpose of this secondary data analysis study was to compare the effects of TASE and MASE on blood glucose levels and nutritional status among people with T2DM in Thailand. We hypothesized that the MASE Program could decrease capillary blood glucose (CBG), HbA1C, BMI, WC, and visceral fat, and increase skeletal muscle in people with T2DM more than the TASE Program and the control group having only routine nursing care.

Methods

Design, Sample, and Settings: This quasi-experimental research design was secondary data analysis. We used the two quasi-experimental previous datasets published in 2017-2018.[13,14,24] The participants in these were people with T2DM from sub-district health promoting hospitals in two provinces in the central part of Thailand with the following inclusion criteria: diagnosed with T2DM, aged ≥20 years, no severe diabetic complications such as blindness, prescribed oral hypoglycemic medications, able to perform exercise, and willing to participate in this study.

We excluded people with T2DM who practiced the TASE or MASE <90 minutes per week and were admitted in the hospitals during this study. Thus, the TASE study[13,14] had 87 participants (43 in the experimental group and 44 in the control group) and the MASE study had 60 participants (30 in the experimental group and 30 in the control group).[24] In this study, the eligibility criteria were similar except HbA1C was ≥7.0%.

We calculated the sample size using G*Power software[25] with a statistical power at 0.80, p-value at .05, and effect size at 0.75 according to a similar study[26] being 21 participants in each group. Approximately 20% more participants were added for possible attrition and we calculated the final sample of 26 participants per group. We used a computer program to randomly select participants from the two datasets passing the inclusion criteria with HbA1C ≥7.0%. There were 26 participants from one province in the TASE, and 26 participants from two provinces in the control group. Unfortunately, the MASE group from another province had only 24 participants passing the inclusion criteria and being enough for sample size calculation. Thus, we had 76 participants in this analysis.

Research instruments: These consisted of research interventions, instruments for data collection, and a research control instrument.

Research interventions: The Traditional Arm Swing Exercise (TASE) and The Modified Arm Swing Exercise (MASE) Program integrating Self-efficacy Theory for 12 weeks and developed by Terathongkum et al,[27] included diabetic knowledge, demonstration and return demonstration of TASE and MASE (**Figure 1**). The MASE intervention differs from the TASE only adding slight bending of the knees at every third arm swing performance. Concerning the physiological rationale for MASE, knee bending and whole-body movement can increase muscle oxidative capacity and glucose uptake.[15] The participants in TASE or MASE groups performed the exercise at least 30 minutes a day, 5 days a week, for 12 weeks at home with telephone follow-up for approximately 20 minutes/time and focus group discussions. By integrating self-efficacy theory and the physiological benefits of TASE and MASE, people with diabetes would expect to have the motivation and confidence to perform TASE or MASE at home with the potential advantages of better glucose uptake to enhance glycemic control. The three diabetic experts, an endocrinologist and two registered nurses reviewed and approved the content of the intervention. In addition, both TASE and MASE groups still received routine care providing at the outpatient clinic.

Routine care was the care provided for everyone with DM at the outpatient diabetic clinics depending on their blood glucose level and to control diabetes and its complications using "Seven Color Life Traffic Ping-Pong". This routine care is composed of: 1) Normal group (white color) having FBS ≤ 100 mg/dl receives lifestyle modification; 2) Pre-diabetes/risk group (mildly green) having FBS 100-125 mg/dl obtains as normal group plus blood glucose checked every 1-3 months; 3) Diabetes group (green, yellow, orange, or red) obtains lifestyle modification, takes diabetic medicine, has complication assessment, including retinopathy, nephropathy, and neuropathy as well as cardiovascular risk assessment, follows up with physician every 4 weeks, and receives home visits; and 4) Diabetes group with complications (black) considers referral to the provincial hospital for proper management and home visits.

Instruments for data collection: The *Demographic Questionnaire* included gender, age, level of education, marital status, occupation, income, duration of diabetes, co-morbidities, and exercise behavior. The *blood glucose level* (HbA1c) was analyzed by a technician in the laboratory of the hospital. *Medical equipment* included blood glucose monitor, measuring tape, and body composition monitor.

Research control instruments: Four forms were used: 1) a form for monitoring the TASE or MASE including date, time, and duration, 2) a form for recording telephone follow-ups including date, time, duration, problems, and problem-solving, 3) a form for recording food consumption including date, time, duration, and type and amount of food intake per day (breakfast, lunch, dinner, and between meal-snacks), and 4) a document for recording CBG, HbA1c, weight, height, BMI, WC, visceral fat, and skeletal muscle for people with type 2 diabetes. In each group, research assistants (RAs) measured the participants' blood glucose levels and nutritional status, using blood glucose monitor, measuring tape, and body composition before and after the Programs, and then recorded the results.

Ethical considerations: Approval was given by the Institutional Review Board, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Thailand (MURA 2019/421) before this secondary data analysis began. After participants willingly signed the informed consent form, data was gathered by the researchers in the following procedures. Data was kept confidential throughout and will be destroyed 5 years after data collection.

Data collection: This study used data from two previous studies including the TASE study entitled "Effects of Arm Swing Exercise Program on Blood Sugar and Nutritional Status of Persons with Diabetes Type 2 in Community (ID 08-58-33)"[13,14] and the MASE study titled "Effects of Arm Swing Exercise

Program on Blood Sugar Level, Nutritional status and Perceived Self-Efficacy for Exercise in Persons with Uncontrolled Type 2 Diabetes Mellitus (ID 10-59-26)."[24] Studies used the TASE in one province and the MASE in another province in the central part of Thailand. Data before and after the Programs was collected by the RAs using a single-blind process, including information of demographic characteristics, CBG, HbA1c, BMI, WC, visceral fat, and skeletal muscle, and the interventions were carried out by the researchers (**Figure 2**).

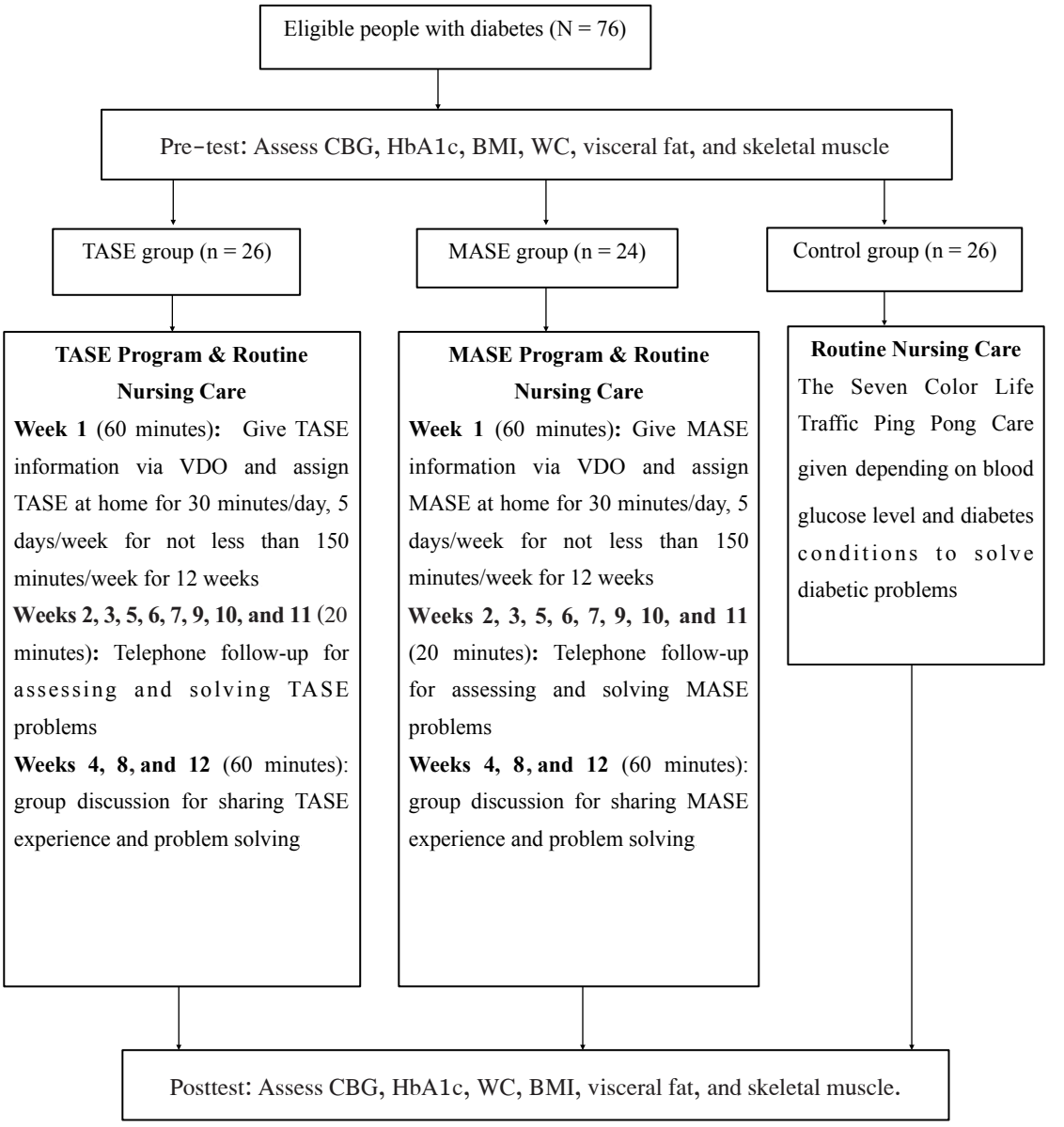

Figure 2 Data collection process

Data analysis: Analysis was performed using IBM SPSS, version 21. Descriptive statistics, including means ± standard deviation (SD), frequency (n), and per cent (%), were used to explain the demographic data and all dependent variables. The baseline of demographic data was analyzed using the chi-square or Fisher's exact test for comparison of categorical variables, while the one-way analysis of variance (ANOVA) was used for continuous variables after all assumptions were achieved. Then, comparisons of the average CBG, HbA1c, BMI, WC, visceral fat, and skeletal muscle within the group was examined using paired t-test; and comparison among three groups was achieved using the ANOVA and the analysis of covariance (ANCOVA) at a significance level of α=0.05.

Results

The findings revealed that the most participants in TASE, MASE, and control groups were females (84.6%, 79.2%, and 83.5%, respectively) with the average age being mostly older adults (58.85±10.34 years, 59.29 ± 9.77 years, and 59.50 ±10.86 years, respectively). The highest education was primary school (73.1%, 87.5%, and 76.9%), and married (69.2%, 75.0%, and 57.7%). Most participants in the TASE group and control group were employed in a company or factory (80.8% and 61.5%, respectively) whereas approximately one-third of participants in the MASE group worked as merchants (37.5%). Diabetic duration of TASE, MASE, and control groups were 7.96 ± 6.86, 7.08 ± 4.83, and 7.17 ± 3.76 years with comorbidity of 96.2%, 62.5% and 88.5%, respectively. Most participants in the TASE group undertook an exercise (80.8%), such as walking, bicycle, being different from the MASE and the control group (20.8% and 42.3%, respectively). There were no significant differences among three groups ($p > .05$), except occupation, income, comorbidity, and exercise behavior ($p < .001$, $p < .05$, $p < .01$, and $p < .001$, respectively) as shown in **Table 1.**

Table 1 Comparison of participants' characteristics among TASE, MASE, and control groups

Variable	Frequency (%)			p-value
	TASE (n=26)	MASE (n=24)	Control (n=26)	
Gender				
Male	4 (15.4)	5 (20.8)	3 (11.5)	.678[b]
Female	22 (84.6)	19 (79.2)	23 (83.5)	
Age (years), mean ± SD	58.85±10.34	59.29 ± 9.77	59.50 ±10.86	.973[c]
range	45-83	41-78	37-78	
Education				
Primary school	19 (73.1)	21 (87.5)	20 (76.9)	.222[b]
Secondary school	6 (23.1)	1 (4.2)	3 (11.5)	
Diploma	1 (3.8)	-	2 (7.7)	
No education	-	2 (8.3)	1 (3.8)	
Marital status				
Single	1 (3.8)	2 (8.3)	3 (11.5)	.626[b]
Married	18 (69.2)	18 (75.0)	15 (57.7)	
Divorced	7 (26.9)	4 (16.7)	8 (30.8)	
Occupation				
Farmer	2 (7.7)	8 (33.3)	2 (7.7)	**.000**[b]
Merchant	3 (11.5)	9 (37.5)	6 (23.1)	
Employee	21 (80.8)	3 (12.5)	16 (61.5)	
Unemployed	-	4 (16.7)	2 (7.7)	

Table 1 Comparison of participants' characteristics among TASE, MASE, and control groups (Cont.)

Variable	Frequency (%)			p-value
	TASE (n=26)	MASE (n=24)	Control (n=26)	
Income (baht), mean ± SD	11,865.38 ± 8,999.51	6,483.33 ± 5,233.31	11,688.46 ± 9,012.63	.033[c]
range	1,500-30,000	500-20,000	600-30,000	
Duration of DM (year),				
mean ± SD	7.96 ± 6.86	7.08 ± 4.83	7.17 ± 3.76	.811[c]
range	1-30	1-16	1-14	
Comorbidity				
No	1 (3.8)	9 (37.5)	3 (11.5)	.007[b]
Yes	25 (96.2)	15 (62.5)	23 (88.5)	
Ever exercise				
No	5 (19.2)	19 (79.2)	15 (57.7)	.000[a]
Yes	21 (80.8)	5 (20.8)	11 (42.3)	

Note: a = Chi-Square Test; b = Fisher's Exact Test; c = one-way ANOVA

After completion of the Program, participants in the TASE group had a statistically lower average HbA1c level, BMI, WC, and visceral fat than before the Program ($t= 3.17, p<.01$; $t=2.76, p<.05$; $t=7.16, p<.001$; $t=2.31, p<.05$, respectively). Participants in the MASE group also had statistically lower CBG and HbA1c level than before the Program ($t=2.21, p<.05$; $t=3.61, p<.01$, respectively); and higher average skeletal muscle ($t=-2.38, p<.05$) as shown in **Table 2.**

Table 2 Comparisons of blood glucose level and nutritional status before and after receiving the Programs within each group using paired t-test

Variables	Group	Before		After		*t*	p-value
		Range	mean ± SD	Range	mean ± SD		
CBG	TASE (n=26)	96-355	164.38±60.90	95-276	155.35±47.60	.62	.541
	MASE (n=24)	108-258	164.41±43.34	108-248	149.45±32.40	2.21	**.038**
	Control (n=26)	99-267	151.96±47.25	109-364	166.62±59.64	-1.02	.318
HbA1c	TASE (n=26)	7-13.8	8.40±1.48	5.9-10.0	7.48±1.11	3.17	**.004**
	MASE (n=24)	7.1-12.1	8.99±1.19	6.9-11.9	8.47±1.28	3.61	**.001**
	Control (n=26)	7-12.3	8.45±1.47	6.2-12.2	8.36±1.56	.26	.799
BMI	TASE (n=26)	20.2-36.2	27.30±4.04	20.6-35.4	26.97±3.99	2.76	**.011**
	MASE (n=24)	17.39-37.83	27.90±5.66	17.44-35.94	27.68±5.12	.62	.541
	Control (n=26)	17.5-45.8	26.95±6.02	18.5-45.7	27.01±6.06	-.37	.715
WC	TASE (n=26)	76-114	91.27±8.75	74-107	86.71±8.35	7.16	**.000**
	MASE (n=24)	77-120	92.25±11.26	68-121	91.58±13.40	.64	.527
	Control (n=26)	67-129	88.77±12.20	76-126	90.88±12.22	-1.83	.079
Visceral fat	TASE (n=26)	4-28.5	11.85±5.93	4-25.0	11.33±5.39	2.31	**.029**
	MASE (n=24)	2.5-29.0	12.48±7.12	3-28.0	12.50±6.46	-.30	.977
	Control (n=26)	1-30	11.69±7.22	2-30	11.87±6.72	-.44	.662
Skeletal	TASE (n=26)	18.2-29.4	23.48±2.69	17.9-30.6	23.72±3.13	-.84	.409
muscle	MASE (n=24)	15-30.4	23.04±3.45	19.1-32.7	23.92±3.37	-2.38	**.026**
	Control (n=26)	18.4-28.7	23.59±2.70	20.1-29.9	23.72±2.90	-.38	.710

Note: CBG = Capillary Blood Glucose; HbA1c = Hemoglobin A1c; BMI = Body Mass Index; WC = Waist Circumference

Before receiving the Program, all study variables among the three groups were not significantly different, as shown in **Table 3.** Using pretest as a covariate in ANCOVA, we found no significant differences among three groups in CBG, BMI, visceral fat, and skeletal muscle after adjusted for a covariate ($p > .05$). However, the TASE group had a statistically lower average HbA1c ($F = 3.94$, $p < .05$) and WC ($F = 11.90$, $p < .001$) when compared with the MASE group and the control group, as shown in **Table 4.** The TASE group also had a statistically lower average HbA1c when compared with the control group ($p < .05$); and also a statistically lower average WC than the MASE and the control group ($p < .05$). Nonetheless, average HbA1c and waist circumference between the MASE and control groups were not different.

Table 3 Comparisons of blood glucose level and nutritional status before receiving the Program among three groups of people with T2DM using one-way ANOVA

Variance resource	SS	df	MS	F	p-value
CBG					
Between group	2,646.46	2	1,323.23	.50	.606
Within group	191,748.95	73	2,626.70		
Total	194,395.41	75			
HbA1C					
Between group	5.28	2	2.63	1.35	.264
Within group	142.14	73	1.96		
Total	147.42	75			
BMI					
Between group	11.56	2	5.78	.21	.815
Within group	2,051.96	73	28.11		
Total	2,063.52	75			
WC					
Between group	162.97	2	81.48	.70	.502
Within group	8,552.23	73	117.15		
Total	8,715.20	75			
Visceral fat					
Between group	8.7	2	4.38	.095	.909
Within group	3,346.55	73	45.84		
Total	3,355.30	75			
Skeletal muscle					
Between group	4.18	2	2.09	.23	.798
Within group	674.88	73	9.25		
Total	679.06	75			

Note: CBG = Capillary Blood Glucose; HbA1c = Hemoglobin A1c; BMI = Body Mass Index; WC = Waist Circumference

Table 4 Comparisons of blood glucose level and nutritional status after receiving the programs among three groups of people with T2DM using ANCOVA

Variance resource	TASE (n=26) M (SE)	MASE (n=24) M (SE)	Control (n=26) M (SE)	SS	df	MS	F	p-value
CBG								
Programs	154.65(9.38)	148.75(9.77)	167.97(9.42)	4,835.77	2	2,417.88	1.06	.352
Pretest				5,248.12	1	5,248.12	2.30	.134
Error				164,457.88	72	2,284.14		
Total				2,055,034.00	76			
HbA1c								
Programs	7.5 (.23)	8.30 (.24)	8.43 ± .23	10.98	2	5.49	3.94	.024
Pretest				29.26	1	29.26	21.00	.000
Error				100.32	72	1.39		
Total				5,127.88	76			
BMI								
Programs	27.03 (.22)	27.18 (.23)	27.41 ± .22	1.84	2	.92	.72	.488
Pretest				1,828.95	1	1,828.95	1,440.87	.000
Error				91.39	72	1.27		
Total				58,186.58	76			
WC								
Programs	86.19 (.96)	90.12 (.99)	92.76 ± .96	564.82	2	282.41	11.90	.000
Pretest				7,903.23	1	7903.23	333.09	.000
Error				1,708.35	72	23.73		
Total				621,163.25	76			
Visceral fat								
Programs	11.46 (.32)	12.07 (.33)	12.14 ± .32	7.17	2	3.58	1.37	.261
Pretest				2630.94	1	2630.94	1,005.92	.000
Error				188.31	72	2.62		
Total				13,565.50	76			
Skeletal muscle								
Programs	23.63 (.32)	24.22 (.33)	23.53 ± .32	6.80	2	3.40	1.29	.282
Pretest				526.58	1	526.58	199.63	.000
Error				189.92	72	2.64		
Total				43,704.75	76			

Note: CBG = Capillary Blood Glucose; HbA1c = Hemoglobin A1c; BMI = Body Mass Index; WC = Waist Circumference

Discussion

This study found that the TASE was effective in reducing the HbA1c, BMI, WC, and visceral fat levels; and MASE was effective in decreasing CPG, HbA1c, and increasing skeletal muscle. The TASE or MASE acts as an insulin-like effect helping to reduce insulin resistance and to increase insulin activity.[23] After the 12-week training, the participants in TASE and MASE groups had significantly lower HbA1c levels than their baseline and the control group. The results are similar to previous studies in people with diabetes.[13,14]

Several investigators indicated that BMI and WC are associated with insulin resistance[28,29] and a higher risk of diabetes complications.[30] The results in this study are incongruent with a previous study of 8-weeks duration in people with diabetes given the TASE group who had less BMI and WC.[23] Thus, this may suggest that the effectiveness of the TASE in

improving nutritional status requires at least 12 weeks to yield changes.

TASE was not only effective for improving body weight, but also achieved a significant decrease in fat accumulation. It has been well-documented that visceral fat contributes to chronic systemic inflammation, such as cytokines, which is the key factor to increase insulin resistance and cardiovascular risks.[31-33] Our study showed the treatment effect of the TASE on reducing BMI, WC, and visceral fat. The result is dissimilar to a previous study on older adults with hypertension, indicating that the exercise training, merely 3 days a week for 12 consecutive weeks in that study, did not significantly lower visceral fat.[34] The mechanisms put forward to explain that the TASE training for at least 150 minutes per week for 12 weeks is sufficient to reduce the visceral fat in people with type 2 diabetes. Consequently, a regular 12-week period of the TASE is effective, and further improves glycemic control in people with diabetes.

The knee bend and whole-body movement in the MASE can increase skeletal muscle in people with diabetes. Exercise training is a potent way to promote increased muscle oxidative capacity[35] resulting in better muscle insulin sensitivity[36] and glucose uptake.[37] Our finding is supported by a meta-analysis on the effects of resistance training in the elderly with diabetes and suggests that the lower body movement has a greater space for glucose disposal than the upper body.[38] Therefore, further research needs to examine the effectiveness of the MASE home-based training on glycemic control specifically in older adults with diabetes.

The findings in this study indicate that a 12-week TASE and MASE programs can improve glycemic control in people with diabetes. However, the findings of this study did not support our hypothesis that the MASE Program could decrease CBG, HbA1C, BMI, WC, visceral fat and increase skeletal muscle in people with T2DM more than the TASE Program and the control group. This might result from the MASE group performing exercise 20.8% less than the TASE group (80.8%) who used more energy than the MASE group. Besides, the occupation of the MASE group used more physical activities than the TASE group resulting in better health outcomes. Hence, health care providers may apply our findings and the exercise interventions needed for specific people with diabetes. For those who experience muscular atrophy they are recommended to perform MASE to increase muscle.[38] In contrast, TASE may be used for people with diabetes who are overweight and obese, and require immediate attention to reduce their body weight.[31-33] More importantly, our study encourages people with diabetes to train in any type of low-intensity exercise for at least 30 minutes a day, 5 days a week continuously for better health outcomes.

Limitations

Limitations of the study include that the data do not reflect a representative sample of all people with T2DM due to specific eligible criteria. Interventionists and researcher assistants were not also blinded to the intervention allocation in both previous studies. Thus, there may be an unknown performance bias. Moreover, the important limitations were both external and internal validity because this study did not randomly assign the participants into the TASE, MASE and control groups as well as not controlling for other additional exercise in the TASE group. Future research needs to involve a randomized controlled trial to assure the internal validity. Despite these limitations, the study offers notable strengths. This is a large sample of people with T2DM providing important information on the comparison effects of the TASE and MASE in blood glucose levels and nutritional status in Thailand. The study also demonstrated the importance of home-based exercise interventions for people with T2DM to achieve glycemic control, improve nutritional status, prevent diabetes complications, and enhance their quality of life.

Conclusion and Implications for Nursing Practice

The TASE is the most effective for lower HbA1c and WC while the MASE can decrease HbA1c. Nurses could apply this TASE program for people with diabetes at least 30 minutes a day, 5 days a week using vicarious experience to generate expectations cultivating perceived self-efficacy for change in health behavior. This results in mastery experience being the most powerful resources to inspire them from their successful performance outcomes emerging continuously performance of TASE for controlling blood glucose, improving nutritional status, and minimizing diabetes complications. Future research studies should focus on the TASE for people with T2DM having metabolic syndrome or obesity and performing exercise at least 80% to reduce BMI, WC, and visceral fat, and increase skeletal muscle resulting in better health outcomes.

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ผลของการออกกำลังกายแบบแกว่งแขนดั้งเดิมและการออกกำลังกายแบบแกว่งแขนประยุกต์ต่อค่าน้ำตาลในเลือด และภาวะโภชนาการในผู้ที่เป็นเบาหวานชนิดที่ 2: การวิเคราะห์ข้อมูลทุติยภูมิ

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บทคัดย่อ: ผู้ที่เป็นเบาหวานชนิดที่ 2 มักมีภาวะแทรกซ้อน จึงจำเป็นต้องมีกลวิธีที่ควบคุมระดับน้ำตาล ซึ่งจะประสบความสำเร็จได้ด้วยการปรับเปลี่ยนพฤติกรรมสุขภาพ โดยเฉพาะการออกกำลังกายด้วยวิธีที่มีประสิทธิภาพ จึงจำเป็นต้องออกกำลังกายด้วยวิธีที่มีประสิทธิภาพ การศึกษากึ่งทดลองโดยวิเคราะห์ข้อมูลทุติยภูมิครั้งนี้มีวัตถุประสงค์เพื่อเปรียบเทียบผลของการออกกำลังกายแบบแกว่งแขนดั้งเดิมและการออกกำลังกายแบบแกว่งแขนประยุกต์ต่อค่าน้ำตาลในเลือดและภาวะโภชนาการของผู้ที่เป็นเบาหวานชนิดที่ 2 โดยสุ่มคัดเลือกกลุ่มตัวอย่างจากข้อมูลในงานวิจัยสองเรื่อง จำนวน 76 คน ตามเกณฑ์คัดเข้า แบ่งเป็น 3 กลุ่ม ได้แก่ กลุ่มออกกำลังกายแบบแกว่งแขนดั้งเดิม 26 คน กลุ่มออกกำลังกายแบบแกว่งแขนประยุกต์ 24 คน และกลุ่มควบคุม 26 คน ซึ่งได้การดูแลตามปกติ เก็บรวบรวมข้อมูลโดยใช้แบบสอบถาม วัดค่าน้ำตาลในเลือดปลายนิ้ว ค่าน้ำตาลสะสมในเลือด ดัชนีมวลกาย เส้นรอบเอว มวลไขมันในช่องท้องต่ำกว่า และมวลกล้ามเนื้อ โดยใช้สายวัด เครื่องวัดองค์ประกอบร่างกาย และเครื่องวัดระดับน้ำตาลในเลือด วิเคราะห์ข้อมูลก่อนละหลังโปรแกรมเพื่อหาความแตกต่างโดยใช้สถิติ t-test, one-way ANOVA และ ANCOVA ผลการศึกษาพบว่า หลังได้รับโปรแกรมการออกกำลังกายแบบแกว่งแขนดั้งเดิมและแบบประยุกต์ ผู้ที่เป็นเบาหวานชนิดที่ 2 มีค่าเฉลี่ยของค่าน้ำตาลในเลือดปลายนิ้ว ค่าน้ำตาลสะสมในเลือด ดัชนีมวลกาย เส้นรอบเอว มวลไขมันในช่องท้องต่ำกว่า และมวลกล้ามเนื้อสูงกว่าก่อนได้รับโปรแกรมอย่างมีนัยสำคัญทางสถิติ นอกจากนี้กลุ่มที่ออกกำลังกายแบบแกว่งแขนดั้งเดิมมีค่าเฉลี่ยน้ำตาลสะสมในเลือดต่ำกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ และมีค่าเฉลี่ยเส้นรอบเอวต่ำกว่ากลุ่มที่ออกกำลังกายแบบแกว่งแขนประยุกต์และกลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ แต่ค่าเฉลี่ยน้ำตาลสะสมในเลือดและเส้นรอบเอว ระหว่างกลุ่มที่ออกกำลังกายแบบแกว่งแขนประยุกต์และกลุ่มควบคุมไม่แตกต่างกัน ผลการศึกษาเสนอว่า การออกกำลังกายแบบแกว่งแขนดั้งเดิมมีประสิทธิภาพที่สุด พยาบาลวิชาชีพควรประยุกต์การออกกำลังกายแบบแกว่งแขนดั้งเดิมในผู้ที่เป็นเบาหวานชนิดที่ 2 เพื่อทำให้ค่าน้ำตาลในเลือดและภาวะโภชนาการดีขึ้น

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คำสำคัญ: ค่าน้ำตาลในเลือด ค่าน้ำตาลสะสมในเลือด การออกกำลังกาย โรคเบาหวานชนิดที่ 2

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