การศึกษาผลของการออกกำลังกายโดยการแกว่งแขน และการออกกำลังกายโดยใช้ฮูลาฮูปที่มีต่อผู้มีภาวะเสี่ยงโรคไขมันในเลือดสูง

A Study to Determine the Effects of Arm Swing Exercise and Hula Hoop Exercise on Persons at Risk of Dyslipidemia Disease

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บทคัดย่อ

การวิจัยนี้มีวัตถุประสงค์เพื่อเปรียบเทียบผลของการออกกำลังกายแบบแกว่งแขนและการออกกำลังกายโดยใช้ฮูลาฮูปที่มีต่อระดับไขมันในเลือดในผู้มีภาวะเสี่ยงโรคไขมันในเลือดสูง กลุ่มตัวอย่างเป็นผู้มีภาวะเสี่ยงโรคไขมันในเลือดสูงทั้งเพศชายและหญิง อายุ 25-50 ปี จำนวน 50 คน แบ่งออกเป็นสองกลุ่มได้แก่กลุ่มออกกำลังกายโดยการแกว่งแขนจำนวน 25 คนและกลุ่มออกกำลังกายโดยใช้ฮูลาฮูป 25 คน โปรแกรมการออกกำลังกายในทั้งสองกลุ่มถูกออกแบบให้มีการใช้พลังงานและระยะเวลาการฝึกที่เท่ากัน โดยเป็นการออกกำลังกายครั้งละ 30 ครั้งต่อนาที 3 ครั้ง/สัปดาห์เป็นเวลา 8 สัปดาห์ การออกกำลังกายทั้งแบบแกว่งแขนและฮูลาฮูปออกแบบให้เป็น moderate aerobic exercise สำหรับแต่ละบุคคล ทำการเก็บข้อมูลตัวแปรทางสารชีวเคมีในเลือด นำผลที่ได้มาวิเคราะห์ทางสถิติเปรียบเทียบความแตกต่างระหว่างก่อนและหลังการทดลองด้วยสถิติ Paired t-test เปรียบเทียบความแตกต่างระหว่างกลุ่มด้วยสถิติ Independent t-test ที่ระดับนัยสำคัญทางสถิติที่ 0.05 ผลการวิจัยพบว่าระดับคอเลสเตอรอล ไตรกลีเซอร์ไรด์ ไฮเดนซิตี้ไลโปโปรตีน และโลว์เดนซิตี้ไลโปโปรตีนของทั้งกลุ่มออกกำลังกายแบบแกว่งแขนและกลุ่มออกกำลังกายโดยใช้ฮูลาฮูปไม่มีความแตกต่างทางสถิติ เมื่อเปรียบเทียบกับก่อนการฝึกออกกำลังกาย ค่าเฉลี่ยตัวแปร

ระดับไขมันในเลือดของกลุ่มการออกกำลังกายโดยการแกว่งแขน แตกต่างอย่างไม่มีนัยสำคัญได้แก่ คอเลสเตอรอลรวม (p = 0.81) ไตรกลีเซอร์ไรด์ (p = 0.25) ไฮเดนซิตี้ ไลโปโปรตีน (p = 0.44) และโลว์เดนซิตี้ ไลโปโปรตีน (p = 0.46) ส่วนค่าเฉลี่ยตัวแปรระดับไขมันในเลือดในกลุ่มการออกกำลังกายโดยใช้ฮูลาฮูปแตกต่างอย่างไม่มีนัยสำคัญได้แก่ คอเลสเตอรอลรวม (p = 0.34) ไตรกลีเซอร์ไรด์ (p = 0.16) ไฮเดนซิตี้ ไลโปโปรตีน (p = 0.30) และโลว์เดนซิตี้ ไลโปโปรตีน (p = 0.20) เปอร์เซนต์ไขมันของทั้งกลุ่มออกกำลังกายแบบแกว่งแขนและกลุ่มออกกำลังกายโดยใช้ฮูลาฮูป มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ เมื่อเปรียบเทียบก่อนและหลังการฝึกออกกำลังกาย โดยกลุ่มออกกำลังกายแบบแกว่งแขนมีความแตกต่าง (p = 0.003) และกลุ่มออกกำลังกายแบบใช้ฮูลาฮูปมีความแตกต่างกัน (p = 0.002)

ผลการวิจัยสรุปได้ว่าการออกกำลังกายโดยการแกว่งแขน และการออกกำลังกายโดยใช้ฮูลาฮูปไม่สามารถลดระดับไขมันในเลือดของผู้ที่มีภาวะเสี่ยงต่อโรคไขมันในเลือดสูงได้ แต่การออกกำลังกายทั้งสองแบบมีแนวโน้มเป็นประโยชน์ในการลดเปอร์เซนต์ไขมันในร่างกายผู้มีภาวะเสี่ยงต่อโรคไขมันในเลือดสูง

คำสำคัญ: การออกกำลังกายโดยการแกว่งแขน/การออกกำลังกายโดยใช้ฮูลาฮูป/ผู้มีภาวะเสี่ยงต่อไขมันในเลือดสูง

Abstract

The objective of this study was to compare the effects of arm swing exercise and hula hoop exercise on lipid profiles in persons at risk of dyslipidemia disease. A total of 50 participants at risk of dyslipidemia disease aged 25-50 years were randomly assigned to arm swing exercise (ASE) group (n=25), and hula hoop exercise (HHE) group (n=25). ASE and HHE training programs were designed to yield the same energy expenditure/exercise sessions and included performing for 30 minutes/day, 3 times/week for 8 weeks. The ASE and HHE in this study were designed to be moderate aerobic exercise for individual. Lipid profile variables between pretest and posttest were analyzed by paired t-test. Independent t-test was used to compare the variables among groups. Differences were considered to be significant at $p<0.05$. The results of the present study were as follows: levels of cholesterol, triglyceride, HDL, and LDL in both the ASE and HHE groups were not significantly different when compared with pretest results. For the ASE group, there was no significant difference in the levels of cholesterol ($p=0.81$), triglyceride ($p=0.25$), HDL ($p=0.44$), and LDL ($p=0.46$). For the HHE group, there was no significant difference in the levels of cholesterol ($p=0.34$), triglyceride ($p=0.16$), HDL ($p=0.30$), and LDL ($p=0.20$). It was concluded that arm swing exercise and hula hoop exercise cannot improve lipid profiles in persons at risk of dyslipidemia. However, arm swing exercise and hula hoop exercise can reduce percent body fat for persons at risk of dyslipidemia. Percent body fat in both the ASE and HHE groups decreased significantly when compared with pretest value: ASE ($p=0.003$) and HHE ($p=0.002$). Although arm swing exercise and hula hoop exercise cannot improve lipid profiles, both exercises can reduce percent body fat for persons at risk of dyslipidemia.

Keywords: arm swing exercise/hula hoop exercise/dyslipidemia

Introduction

The health and healthy living of population has been a major concern of many countries including Thailand. According to the dyslipidemia in Thai population, National Health Examination Survey IV, 2009, many leading institutes in Thailand discovered that cardiovascular diseases (CVD) were among the leading causes of death in Thai population. Low HDL-cholesterol and high LDL-cholesterol are associated with increased risks of CVD major events. The prevalence of dyslipidemia other than high total cholesterol level is not clear in Thai population due to low rate of screening and treatment. Therefore, it is very vital to monitor and evaluate the situation of dyslipidemia in Thai population (Aeplakorn et al, 2014). Dyslipidemia is a risk factor of atherosclerosis and cardiovascular diseases and mostly coronary heart disease, cerebrovascular disease, and peripheral arterial disease. There are different disorders of lipoprotein abnormalilties such as high total cholesterol (TC), elevated low-density lipoproteins (LDL), elevated triglycerides (TG), and decreased high-density lipoproteins (HDL). Dyslipidemia is a major risk factor of developing cardiovascular disease (CVD). It is a significant public health problem of elderly worldwide including Thailand. Previous studies had limited information on the CVD risk factors for the different Thai population groups. Clinical observational surveys has clearly shown that dyslipidemia is very common in Thai population and it increases with age. The most common dyslipidemia is low HDL-cholesterol in women and high TG level in men, and high LDL-cholesterol level is more common in those living in urban areas (Aeplakorn et al, 2014). Thai Health Promotion Foundation (ThaiHealth, 2009) reported the status of health of Thai population in "Burden of Disease in Thailand, 2009." The report used Disability-Adjusted Life Year (DALY) to explain the magnitude of the health conditions. DALY is the sum of the years of life lost due to premature mortality (YLL) and the equivalent healthy years lost due to disability (YLD). One DALY is one lost year of healthy life. In this report, cardiovascular diseases ranked first in burden (DALY) among leading broad disease groups. In a closer look at the burden, 30-59 years of age, for male 13% of 2.6 million DALYs were lost due to cardiovascular disease, and for women 11% of 1.8 million DALYs were lost due to the same disease. For men and women who were 60 years of age and over 23% of 1.5 million DALYs for men and 23% of 1.7 million DALYs for women were lost due to CVD. This issue is significant to seek any treatment modalities for improving health conditions in Thai population. Exercise

can help people to lose their weight and that will lower their total cholesterol level. LDL-cholesterol is the kind of lipoprotein that has been link to CVD and tends to be higher in individual who is overweight (Davis, 2007). Davis (2007) explained further how exercises could lower total cholesterol level. The first mechanism, exercise stimulates enzymes that help mobilized LDL-cholesterol from the blood circulation and also blood vessel walls to the liver. Then, the cholesterol is converted into bile for digestion or excreted out of the liver. In conclusion, the more a person exercise, the more his or her body removes LDL-cholesterol. The second mechanism, exercise increases the size of lipoprotein, the protein particles that carry cholesterol through the blood. The small, dense LDL particles are more dangerous than bigger ones because the smaller ones can squeeze into the linings of the heart and blood vessels and damage the cardiovascular system. Exercise can help increases the size of the protein particles that carry both good and bad lipoproteins. This study was to determine the effects of arm swing exercise (ASE) and hula hoop exercise (HHE) on lipid profiles in persons at risk of dyslipidemia in order to provide a guide to training and practice.

The Purpose of the Study

The purpose of this study was to determine the effects of arm swing exercise on lipid profile in persons at risk of dyslipidemia disease compared to the effects of hula hoop exercise.

Scope of the Study

This study enrolled the participants who were women or men in the 25- 50 years of age range, lived in Bangkok and were engaged in various life styles and occupations. The LDL-cholestero levels of these participants were above 100 mg/dL and no medications for cholesterol were taken. These participants could perform arm swing exercise or hula hoop exercise continuously during the training period. The participants' health characteristics and lipid profiles were collected prior to the exercise program intervention and after the eight week experimental exercise programs were completed. Outcome variables in this study included arm swing exercise and hula hoop exercise and baseline characteristics as independent variables, and lipid profiles as dependent variables.

Research Design

This study was a quasi-experimental design. The Pretest and Posttest Control Group Design was used. In the first day of the first week, participants in both arm swing exercise (ASE) group and hula hoop exercise (HHE) group had the following health characteristics measured: height, weight, BMI, percent body fat (by using body fat measuring caliper), blood pressure, pulse at rest and other needed information. Lipid profile tests were done prior to the exercise intervention in the first week. In the eighth week, all measurements in the first week were repeated. Fifty participants were selected by purposive sampling method. These participants met the inclusion criteria and lived in Bangkok area. Then, fifty selected participants were randomized assigned to groups of exercise by using simple random sampling: 25 participants for ASE group and 25 participants for HHE group. Both groups were assigned to exercise for 30 minutes per day, 3 days per week. Both ASE and HHE were designed to be moderate aerobic exercise programs. They were instructed to include warm up prior to and cool down after their 30 minutes exercise routines. All study participants were instructed to adhere to study protocol, including dietary consumption records.

Statistical Analysis

The data collected included participants' sex, age, body mass index (BMI), lipid profiles, percent body fat, and calories intake. These data then was used to compare lipid profiles and percent body fat. Because data within arm swing exercise (ASE) group, data within hula hoop exercise (HHE) group, and data between ASE group and HHE group were normally distributed based on Skewness and Kurtosis normal distribution test, t-test and analysis of variance were used in this final data analysis.

Independent t-test was used to determine if there was a significant difference in mean and standard deviation of age, weight, height, body mass index , percent body fat (PBF), total cholesterol, LDL, blood pressure, and pulse at rest of the two groups before the experiment. Paired t-test was used to determine if there was a significant difference in lipid profiles and percent body fat of the two groups before the exercise programs and after the completion of eight week experimental exercise programs. Independent t-test was used to determine if there was a significant difference in percentage of lipid profiles and percent body fat of the two groups after

the completion of eight week exercise programs. One-way analysis of variance with repeated measurement was used to determine if there was a significant difference in mean of calories intake of the two groups during week 1, week 4, and week 8. Level of significance of all tests was set at 0.05 level.

Results

Participants' Characteristics

Selected data related to health characteristics of participants before exercise programs were collected and analyzed. The mean of each characteristics was compared to determine if there was a statistically difference. The results were shown in Table 4.1.

Table 4.1 Comparisons of Characteristics of Participants in ASE Group and HHE Group Before Exercise Programs

Characteristics of the Participants	ASE Group (n=20)		HHE Group (n=20)				
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	t	df	p-value
Age (years)	40.75	7.91	37.15	8.46	1.39	38	0.173
Body Weight (kilogram)	70.71	16.65	63.64	14.74	1.42	38	0.163
Height (centimeter)	161.15	6.80	161.30	6.14	-0.07	38	0.942
BMI (kg/meter^2)	27.22	6.19	24.31	4.50	1.70	38	0.097
Percent Body Fat	37.10	6.67	34.24	3.43	1.71	38	0.096
Total Cholesterol (mg/dL)	217.85	34.66	214.95	25.00	0.30	38	0.763
LDL (mg/dL)	157.90	35.37	144.25	26.38	1.38	38	0.175
Systolic Blood Pressure (mmHg)	126.70	12.05	122.40	12.89	1.09	38	0.283
Diastolic Blood Pressure (mmHg)	86.20	11.04	78.55	11.21	2.17	38	0.036
Pulse at rest (beats/minute)	78.35	9.28	77.35	11.80	0.29	38	0.767

An independent t-test was conducted to compare the mean of age, weight, height, body mass index, percent body fat, total cholesterol, LDL, systolic blood pressure, diastolic blood pressure, and pulse at rest of participants in ASE group and HHE group before taking exercise programs. There was no significant difference in each of these characteristics except diastolic blood pressure of participants in these two groups. Participants' diastolic blood pressure levels were different at 0.05 level of significance. The reason why diastolic was lower in HHE was because of lower BMI and lower percent body fat.

Out of 25 participants enrolled in arm swing exercise program, 20 participants completed all required activities assigned to them (one of them had an accident and was unable to perform the exercise, one did not show up for lipid profile test after the 8th week, and three of them had to discontinue due to lack of at least 80% of the exercise completion). At the same time, out of 25 participants enrolled in hula hoop exercise program, 20 participants completed their activities and their data were used in analysis (four of them had to discontinue because they did not complete up to 80% of the exercise requirement, one did not show up for the lipid profile test after the 8th week).

Journals of food intake of participants in both ASE and HHE groups were collected and analyzed to determine the effects of calories taken in the period of eight week exercise programs. Three periods of food intake were compared: week 1, week 4, and week 8.
A one-way analysis of variance with repeated measurement was conducted to compare the changes in calories of each group during these periods. There was no significant difference at 0.05 level of calories intake in these three periods, $F(2,38)=0.825$, $p=0.446$. These results suggested that calories intake had no effect on changes in lipid profiles and percent body fat during eight week exercise programs.

Comparisons of the Average of Lipid Levels

Paired t-test was conducted to compare the levels of total cholesterol, triglyceride, HDL-cholesterol, LDL-cholesterol, and percent body fat of the ASE group before and after eight week exercise programs. The HHE group was also tested by the same method. Independent t-test was conducted to compare these variables between ASE group and HHE group

both before and after the eight week exercise programs. Results of comparisons were shown in Table 4.2.

Table 4.2 A Comparison of Lipid Profiles and Percent Body Fat of ASE and HHE Groups Before and After Exercise Programs

	Pretest		Posttest (at 8th week)					
Variables of lipid profile and percent body fat	$\bar{X}$ (n=20)	S.D.	$\bar{X}$ (n=20)	S.D.	d(S.D.)	t	df	p-value
Total Cholesterol (mg/dL)								
ASE Group	217.85	34.66	219.65	23.81	-1.80(32.51)	-0.25	19	0.807
HHE Group	214.95	25.00	210.55	33.13	4.40(19.90)	0.99	19	0.335
t; df: p-value	0.303;38:0.763		0.998; 38: 0.325		-0.728;38:0.471			
Triglyceride (mg/dL)								
ASE Group	141.30	51.38	127.20	58.86	14.10(53.07)	1.19	19	0.249
HHE Group	104.30	36.31	95.25	37.75	9.05(27.71)	1.46	19	0.161
t; df: p-value	2.630;38:0.012		0.043;38:0.048		0.377;38:0.708			
HDL (mg/dL)								
ASE Group	52.70	9.61	53.80	10.94	-1.10(6.21)	-0.79	19	0.438
HHE Group	70.35	14.47	68.45	13.25	1.90(7.97)	1.07	19	0.300
t; df: p-value	-4.543;38:<0.001		-3.813;38:<0.001		-1.329;38:0.192			
LDL (mg/dL)								
ASE Group	157.90	35.37	152.00	23.04	5.90(35.15)	0.75	19	0.462
HHE Group	144.25	26.38	138.60	32.17	5.65(18.98)	1.33	19	0.199
t; df: p-value	1.384;38:0.175		1.515;38:0.138		0.028;38:0.978			
Percent body fat								
ASE Group	37.10	6.67	35.13	6.45	1.97(2.61)	3.38	19	0.003*
HHE Group	34.24	3.43	32.22	3.99	2.02(2.55)	3.55	19	0.002*
t; df: p-value	1.705;38:0.096		1.508;38:0.140		-0.063;38:0.950			

Comparisons within ASE group and HHE group

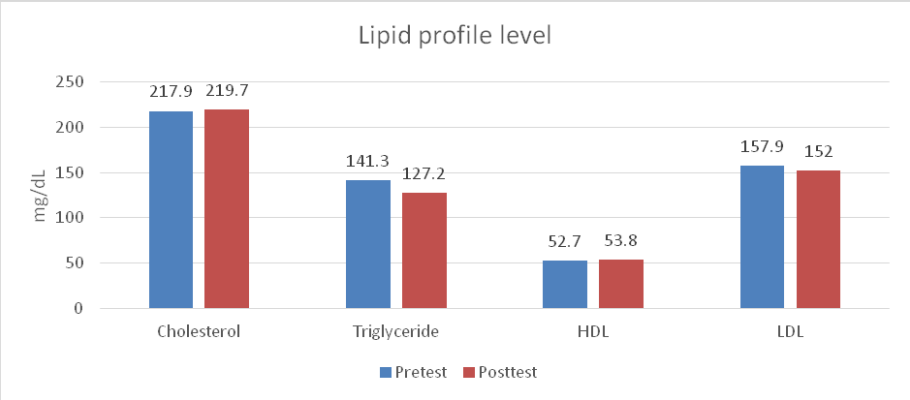
There was no significant difference in the levels of total cholesterol, triglyceride, HDL, LDL for ASE group and HHE group before and after eight week exercise programs. There was significant difference in percent body fat for ASE group before exercise program ($\bar{X}$=37.10%, SD=6.67) and after eight week exercise programs ($\bar{X}$=35.13%, SD=6.45); t(19)=3.38, p=0.003. There was significant difference in percent body fat for HHE group before exercise program ($\bar{X}$=34.24%, SD=3.43) and after eight week exercise programs (M=32.22, SD=3.99); t(19)=3.55, p=0.002. In the analysis of the changes, it was found that ASE group reduced percent body fat by 5.31 percent while HHE group reduced the same by 5.90 percent. These results suggested that there was no significant changes in total cholesterol, triglyceride, HDL, and LDL. However, a considerable change was found in the percent body fat levels in both ASE and HHE groups after the intervention of exercise programs.

Comparisons between ASE group and HHE group

There was no significant difference in the levels of total cholesterol, LDL, percent body fat for ASE group and HHE group before and after eight week exercise programs. There was significant difference in the levels of triglyceride and HDL for ASE group and HHE group before and after eight week exercise programs. These results indicated that there were significant differences in triglyceride and HDL levels of ASE group when compared to HHE group before exercise programs. The significant differences at 0.05 level in triglyceride and HDL were found again at the end of eight week exercise programs.

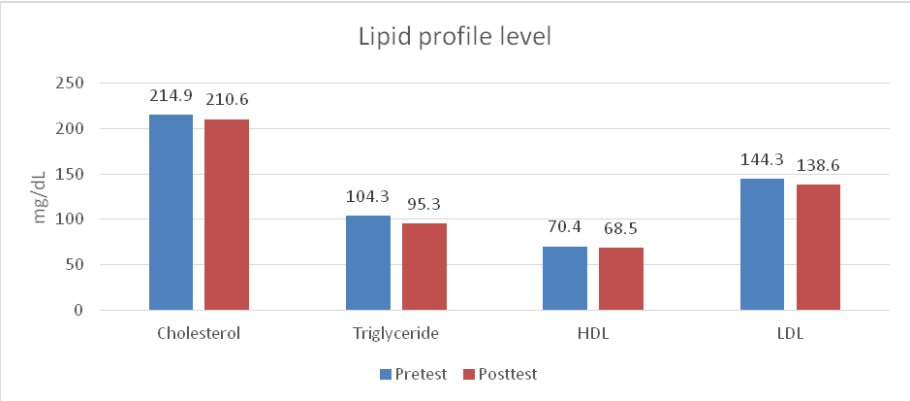
There was no significant difference in the mean of the difference in the levels of total cholesterol, HDL, LDL, and percent body fat for ASE group and HHE group after eight week exercise programs. Based on the analysis of the mean of the difference, the ASE group and the HHE group were not significantly different. Further analysis by using percent of change was conducted in comparison of changes. Figure 4.1, 4.2, and 4.3 showed the mean of percent of changes of lipid profile levels and percent body fat.

Figure 4.1 Mean of Lipid Profile Levels of ASE Group



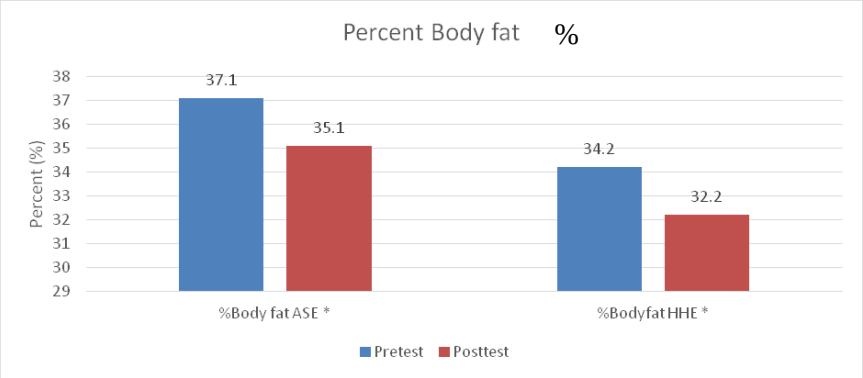
After the completion of the eight week exercise programs, participants in ASE group had their cholesterol increased from 217.9 to 219.7 mg/dL, triglyceride decreased from 141.3 to 127.2 mg/dL, HDL increased from 52.7 to 53.8 mg/dL, and LDL decreased from 157.9 to 152 mg/dL.

Figure 4.2 Mean of Lipid Profile Levels of HHE Group



After the completion of the eight week exercise programs, participants in HHE group had their cholesterol decreased from 214.9 to 210.6 mg/dL, triglyceride decreased from 104.3 to 95.3 mg/dL, HDL decreased from 70.4 to 68.5 mg/dL, and LDL decreased from 144.3 to 138.6 mg/dL.

Figure 4.3 Mean of Percent Body Fat of ASE Group and HHE Group



*p < .05

After the completion of the eight week exercise programs, participants in ASE group had their percent body fat decreased from 37.1 to 35.1%. The mean difference was statistically significant at 0.05 level. The participants in HHE group had their percent body fat decreased from 34.2 to 32.2%, and the mean difference was also significant at 0.05 level.

Comparisons of Changes

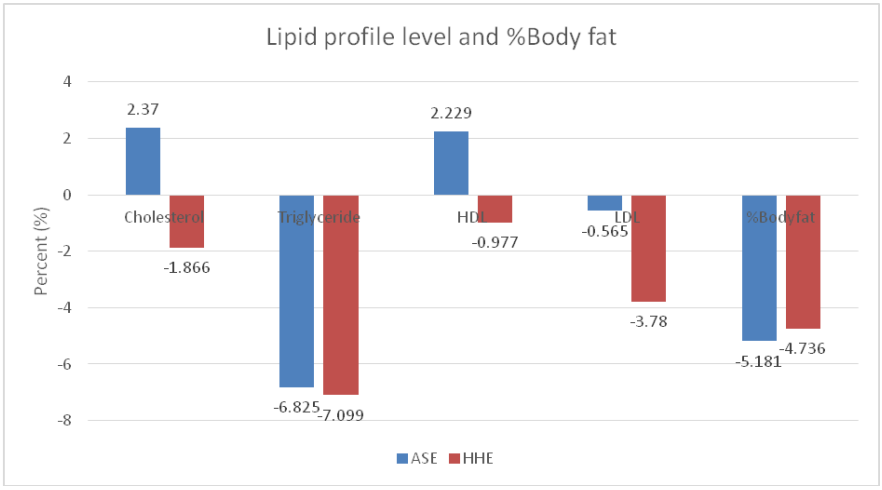
This part showed the comparisons of lipid profile levels and percent body fat of ASE and HHE groups after the completion of the eight week exercise programs. An independent t-test was conducted to compare the percent of changes in total cholesterol, level of triglyceride, HDL-cholesterol, LDL-cholesterol, and percent body fat. The results were shown in Table 4.3. and Figure 4.4.

Table 4.3 Comparisons of Percent of Change from the Baseline between ASE Group and HHE Group after Exercise Programs at 8th Week Visit

Variables of lipid profiles and percent body fat	Percent of Changes at 8th week							
	ASE Group (n=20)		HHE Group (n=20)					
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{d}$ (S.D.)	t	df	p-value
Cholesterol (mg/dL)	2.370	13.37	-1.866	9.29	4.236(3.642)	1.163	38	0.252
Triglyceride (mg/dL)	-6.825	33.86	-7.099	23.58	0.274(9.226)	0.030	38	0.976
HDL (mg/dL)	2.229	11.84	-0.977	8.41	3.206(3.248)	0.987	38	0.330
LDL (mg/dL)	-0.565	19.30	-3.780	13.29	3.215(5.241)	0.613	38	0.543
Percent body fat	-5.181	7.31	-4.736	5.93	-0.445(2.104)	-0.211	38	0.834

There was no significant difference in the levels of total cholesterol, triglyceride, HDL, LDL, and percent body fat for the ASE group and the HHE group after eight week exercise programs. These comparisons indicated that there were not significant statistical changes in the variables of lipid profiles and percent body fat between the group performing arm swing exercise and the group performing hula hoop exercise after eight week training. However, participants in both groups consistently performed exercises as directed and found that in ASE group total cholesterol increased, triglyceride level decreased, HDL increased, LDL decreased, percent body fat decreased. In HHE group total cholesterol decreased, triglyceride decreased, HDL decreased, LDL decreased, and percent body fat decreased.

Figure 4.4 Comparisons of Percent of Change



Participants in ASE group had a mean of 2.370 % change in cholesterol, -6.825% change in triglyceride, 2.229% change in HDL, -0.565% change in LDL, and -5.181% change in percent body fat while participants in HHE group had a mean of -1.866 % change in cholesterol, -7.099% change in triglyceride, -0.977% change in HDL, -3.780% change in LDL, and -4.736% change in percent body fat. The means of the percent of these changes were not statistically differences at 0.05 level when compared between ASE and HHE groups.

Conclusion and Discussion

According to the hypothesis of this study, arm swing exercise could improve lipid profiles in persons at risk of dyslipidemia disease better than hula hoop exercise. In the analysis of the percent of changes, the results of the study indicated that there were insufficient evidences to support the hypothesis. There were no significant differences at 0.05 level in total cholesterol, triglyceride, HDL, and LDL for both groups after the completion of eight week experimental exercise programs. In comparing changes within each group, there were significant differences at 0.05 level in percent body fat in both groups after the intervention of exercise programs. The calories intake during eight week exercise programs had no effects on changes in lipid profiles and percent body fat.

Eckel and Jakicic (2014) studied aerobic exercise training and lipids. The results of the study provided an evidence that LDL level was reduced 3-6 mg/dL on average. The present study

was one type of aerobic exercise training and LDL was reduced 5.9 mg/dL on average for ASE group and 5.65 mg/dL for HHE group. Change as a result of the exercise in this study was from a moderate exercise program. The vigorous aerobic exercise as suggested by Kraus et al (2002) could also lower cholesterol level.

Miller, et al. (2011) summarized research findings on physical exercises and triglycerides. Overall, exercise was most effective in lowering triglycerides (20% to 30%) when baseline levels were elevated (greater than 150 mg/dL). The present study found that triglyceride was reduced by 10% from 141.30 mg/dL to 127.20 mg/dL for ASE group, and was reduced by 8% from 104.30 mg/dL to 95.25 mg/dL for HHE group.

The findings of this study supported the study conducted by Leeyanuwat (2006) which investigated the effects of arm exercise on high blood glucose and high density lipoprotein (HDL) concentrations and insulin resistance in T2DM patients. The study indicated that arm swing exercise reduced glycated hemoglobin (HbA1c) concentration after exercise training than the baseline. The study suggested that 30 minutes arm swing per day for 8 weeks contributed to a reduction in blood HbA1c concentrations in T2DM patients. HbA1c concentration is a major biomarkers for cardiovascular risks. According to Leeyanuwat's research results, there was no significant different in lipid profiles, insulin sensitivity, high sensitive c reactive protein, and anthropometric parameter between any period. The present study similar to Leeyanuwat's results on no significant changes in lipid profiles, but was different in the percent body fat. In the present study, there was a significant reduction on percent body fat at 8 week exercise than the baseline.

The result of this study was also similar to the study conducted by Rungudom and Suksom (2012) which sought to determine the effects of hula hoop exercise on overweight women. The researchers found that hula hoop exercise program had a favorable effect to reduce waist circumference and subcutaneous fat in specific body parts. Rungudom and Suksom's study results suggested improving in muscle strength, no change in body weight, percent body fat, or lipid profile. There was also a different result in this study which was the significant reduction in percent body fat. This present study also had no significant change in lipid profile like Rungudom and Suksom's results. The difference was that this study had significant reduction in percent body fat. In the analysis of the changes, it was found that ASE group reduced percent body fat by 5.31 percent while HHE group reduced by 5.90 percent.

Tunkamnerdthai, et al. (2015) investigated the effects of arm swing exercise on lung function and obesity in overweight T2DM patients. After arm swing training period, the tests revealed that the force vital capacity, forced expiratory volume in the first second of expiration, and maximal voluntary ventilation were increased when compared with after the control period. HbA1c, LDL level and the percent body fat were significantly improved. The decrease in percent body fat in their study may be due to increased fat oxidation during the exercise which was similar to this study. The difference was that in their study there was also a decrease in LDL level, but in this study there was no significant difference in lipid profile. Van Aggel, et al (2002) also found that low-intensity exercise contributed to increased fat oxidation during exercise in obese subjects. ASE was considered a low-intensity exercise, but in this experiment, ASE was designed to be a moderate aerobic exercise, therefore more fat oxidation should be used. More importantly, the calories intake during eight week exercise programs had no effect on changes in lipid profile and percent body fat. Then the significant decrease in percent body fat of both ASE and HHE groups was mainly from the practice in the exercise programs.

This study has demonstrated the benefits of arm swing exercise and hula hoop exercise to health. The experimental exercise programs used in the study can be applied and adapted to the needs of individual. It is imperative that male and female in their adult life should consistently engage in an exercise in order to have a healthy living. Good health means less healthcare cost and good health also promotes economic growth of individual and country.

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