

# ผลของโปรแกรมการฝึกออกกำลังกายที่มีต่อสมรรถภาพทางกายเกี่ยวกับการมีสุขภาพดี ของนักเรียนหญิงที่มีน้ำหนักเกินเกณฑ์ปกติในโรงเรียนมัธยมแห่งหนึ่งในจังหวัดชลบุรี

## Effects of Exercise Training Program on Health-related Fitness of Overweight Female Students in a High School of Chon Buri Province

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### บทคัดย่อ

การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อศึกษา ผลของโปรแกรมการฝึกออกกำลังกายต่อสมรรถภาพทางกายเกี่ยวกับการมีสุขภาพดีของนักเรียนที่มีน้ำหนักตัวเกินเกณฑ์ปกติ กลุ่มตัวอย่างได้รับการคัดเลือกแบบเจาะจง โดยเป็นนักเรียนหญิง ระดับมัธยมศึกษาตอนต้นจำนวน 30 คน อายุระหว่าง 12-15 ปี ที่มีน้ำหนักตัวเกินเกณฑ์ปกติ ( $\geq +3$  S.D.) เครื่องมือที่ใช้ในการทดสอบ คือ แบบทดสอบสมรรถภาพทางกายเกี่ยวกับการมีสุขภาพดีของกรมอนามัย กระทรวงสาธารณสุข กลุ่มตัวอย่างถูกแบ่งออกเป็น 2 กลุ่ม คือกลุ่มที่ 1 ฝึกออกกำลังกาย เป็นเวลา 8 สัปดาห์ ๆ ละ 3 วัน ๆ ละระหว่าง 40-60 นาที และกลุ่มที่ 2 ไม่ฝึกออกกำลังกาย ตัวแปรที่ศึกษาคือ สมรรถภาพทางกายเกี่ยวกับการมีสุขภาพดี ได้แก่ ความแข็งแรงของกล้ามเนื้อ ความอดทนของกล้ามเนื้อ ความอ่อนตัว ความอดทนของระบบไหลเวียนโลหิต และการหายใจ และสัดส่วนของร่างกาย ข้อมูลที่ได้ถูกนำมาวิเคราะห์หาความแตกต่างค่าเฉลี่ยของกลุ่มตัวอย่างที่เป็นอิสระต่อกัน (Independent t-test) นัยสำคัญทางสถิติกำหนดไว้ที่ 0.05 ผลการวิจัยพบว่าหลังการฝึกออกกำลังกาย 8 สัปดาห์ มีสมรรถภาพทางกายเกี่ยวกับการมีสุขภาพดีระหว่างกลุ่มแตกต่างกัน 4 ด้าน ได้แก่ ความแข็งแรงของกล้ามเนื้อ ความอดทนของกล้ามเนื้อ ความอ่อนตัว และความอดทนของระบบไหลเวียนโลหิต และการหายใจ ในขณะที่พบว่ามีสมรรถภาพทางกายเกี่ยวกับการมีสุขภาพดี ด้านสัดส่วนของร่างกาย มีค่าที่ไม่แตกต่างกัน สามารถสรุปได้ว่า โปรแกรมการฝึกออกกำลังกายที่ผู้วิจัยสร้างขึ้น สามารถนำไปใช้ฝึกสำหรับนักเรียนที่มีน้ำหนักตัวเกินเกณฑ์ทำให้เกิดการพัฒนาสมรรถภาพทางกายเกี่ยวกับการมีสุขภาพดีได้ ส่วนเครื่องมือที่ใช้ในการทดสอบควรมีการวัดไขว้กันได้เป็นอย่างดีบนพื้นฐานการหาค่าดัชนีมวลกาย

**คำสำคัญ :** การส่งเสริมสุขภาพ โรคอ้วน สมรรถภาพทางกายเกี่ยวกับการมีสุขภาพดี โปรแกรมการฝึกออกกำลังกาย

## Abstract

The objective of this study was to determine the effects of an exercise training program on health-related fitness of high school students who are overweight in Chonburi province. Thirty female subjects in a high school, aged between 12-15 years old volunteered to participate in the study. A health-related physical fitness test based upon the growth standard of the Department of Health, Ministry of Public Health, Thailand was used to measure the effectiveness of the exercise training program. The subjects were divided into 2 groups; Group 1, experimental group, underwent the exercise regimen of 40-60 min. a day, 3 days a week for 8 weeks. Group 2 was the control group (no exercise). Health-related fitness parameters which included muscle strength, muscle endurance, flexibility, cardio respiratory endurance and body mass index were measured. Independent t-test was used for data analysis. Results showed that after 8 weeks of exercise training, 4 health - related fitness parameters including muscle strength, muscle endurance, flexibility and cardio respiratory endurance were statistically different between the two groups, whereas no significant difference was found in body mass index parameter. It could be concluded that exercise training program developed in this study improved muscle strength, muscle endurance, flexibility and cardio respiratory endurance of the overweight students. However, body composition parameter should be determined by skin fold thickness rather than body mass index.

**Keywords:** Health promotion, Overweight, Obesity, Health - related fitness, Exercise training program

## Introduction

Overweight and obesity are the major health problems in modern society around the world and this is especially in so-called more economic and technological advanced countries. The problem, which is associated with cases of atherosclerosis and other diseases in adult, appears to start at young age<sup>1</sup>. The overweight and obesity in the young

has increased at an alarming rate. In the United States, one of the most recent survey National Health and Nutrition Examination Survey indicated that over a third of American children aged 2-19 years were overweight. Overweight has increased significantly among both boys and girls over a relatively brief 6-year period, with rates of overweight among boys up from 14% in 1999-2000 to over 18%

in 2003–2004 and rates among girls rising from 13.8 to 16% over the same period<sup>2</sup>. A recent report in Taiwan revealed that among teenagers, 10–16% were classified as obese<sup>3</sup>. In Thailand, the prevalence of obesity in children is increasing with an estimation of 9.3% in high schools<sup>4</sup>. The causes of overweight and obesity are known to be multiple. The Division of Nutrition, Ministry of Public Health's reported that the causes may be divided into genetic and environmental factors. The environmental factors include eating habits and exercise in which imbalanced diet could lead to fat deposition in the body. Overweight and obesity at young age could also lead to psychological, social, and economic problems, as well as diseases such as hypertension, diabetes, atherosclerosis, hypercholesterolemia, gall bladder diseases, and cancers of various organs<sup>5</sup>. With all these problems, many countries have been finding ways to cope with it. In Thailand, the government had endorsed a national policy to cope with overweight and obesity problems in schools. Under this policy, measures were identified and used as guidelines for implementation which included drinking liquids, desserts, food and environment, and exercise<sup>6</sup>.

The benefit of exercise on health-related fitness to prevent and combat overweight and

obesity problems is well known but the value of exercise has been neglected in schools. Even with the policy and guidelines for implementation, there has been no evidence to show that a school has developed an exercise program to seriously cope with the problem. Moreover, research relating control measures are still limited. Therefore, this study was aimed to evaluate the exercise regimen on overweight students. The results could be used as a basis for establishing an exercise program to cope with overweight problem among students in a school or in a community.

## Materials and Methods

**Subjects:** Thirty apparently healthy but otherwise overweight female students of a school in Chonburi province (Southeast of Bangkok) aged between 12–15 years old volunteered to participate in the study. They were classified as "overweight" under the year 2000 standard ( $\geq +3$  S.D. of BMI) set by the Division of Nutrition, Department of Health, Ministry of Public Health, Thailand. The subjects were divided into 2 groups; exercise group and non exercise (control) group. No attempt was made to control daily dietary intake of the subjects. However, the subjects were asked to maintain their eating habits and

keep their food records in writing 3 times a week<sup>7</sup>, throughout the study period.

#### Data collection:

**Variable Measured:** The following 5 health-related fitness variables were measured<sup>8</sup> at pre and post exercise training programs that last for 8 weeks.

1. Muscular Strength (Push up)
2. Muscular Endurance (Abdominal Curl)
3. Flexibility (Sit-and-Reach Test)
4. Cardio respiratory Endurance (One Mile Walk/Run)

#### 5. Body Composition (Body Mass Index)

**Exercise Training Program:** We constructed an exercise training program which include warm up, muscle training, aerobic exercise, cool down, and stretching. The exercise group underwent the exercise regimen 3 days a week, 40-60 minutes a day for 8 weeks while the control group (non-exercise) was asked to maintain their normal life style without the exercise training program. Detail description of the program appears in Table 1

**Table 1** Exercise Training Program

Day	Exercise	Week 1-2			Week 3-4		
		Set	Repetition	Time (min)	Set	Repetition	Time (min)
Mon	1. Warm up and stretching			10			10
	2. Muscle training						
	- Abdominal muscle	2	12	5	3	15	5
	- Chest muscle	2	15	5	3	18	5
	- Leg muscle	2	15	5	3	18	5
	3. Aerobic exercise						
	- Walk and run			10			10
	- Triangle- hop step	2		10	2		10
	4. Cool down and stretching			10			10

Table 1 Exercise Training Program (continue)

Day	Exercise	Week 1-2			Week 3-4		
		Set	Repetition	Time (min)	Set	Repetition	Time (min)
Wed	1. Warm up and stretching			10			10
	2. Muscle training						
	- Abdominal muscle	2	12	5	3	15	5
	- Chest muscle	2	15	5	3	18	5
	- Leg muscle	2	15	5	3	18	5
	3. Aerobic exercise						
	- Nine square step	2		10	2		10
Fri	- Step up-down	2		10	2		10
	4. Cool down and stretching			10			10
	1. Warm up and stretching			10			10
	2. Muscle training						
	- Abdominal muscle	2	12	5	3	15	5
	- Chest muscle	2	15	5	3	18	5
	- Leg muscle	2	15	5	3	18	5
	3. Aerobic exercise						
	- Low-impact aerobics dance			20			25
	4. Cool down and stretching			10			10

Day	Exercise	Week 5-6			Week 7-8		
		Set	Repetition	Time (min)	Set	Repetition	Time (min)
Mon	1. Warm up and stretching			10			10
	2. Muscle training						
	- Abdominal muscle	3	18	5	3	22	5
	- Chest muscle	3	22	5	3	26	5
	- Leg muscle	3	22	5	3	26	5
	3. Aerobic exercise						
	- Walk and run			10			10
	- Triangle- hop step	2		10	2		10
	4. Cool down and stretching			10			10

Day	Exercise	Week 5-6			Week 7-8		
		Set	Repetition	Time (min)	Set	Repetition	Time (min)
Wed	1. Warm up and stretching			10			10
	2. Muscle training						
	- Abdominal muscle	3	18	5	3	22	5
	- Chest muscle	3	22	5	3	26	5
	- Leg muscle	3	22	5	3	26	5
	3. Aerobic exercise						
	- Nine square step	2		10	2		10
	- Step up-down	2		10	2		10
	4. Cool down and stretching			10			10
Fri	1. Warm up and stretching			10			10
	2. Muscle training						
	- Abdominal muscle	3	18	5	3	22	5
	- Chest muscle	3	22	5	3	26	5
	- Leg muscle	3	22	5	3	26	5
	3. Aerobic exercise						
	- Low-impact aerobics dance			30			35
	4. Cool down and stretching			10			10

**Data analysis:** Means, SD, and

## Results

independent t- test were employed for data analysis. Significant level was set at .05.

Both groups of the study subjects were similar in term of the age, resting heart rate, weight and height (Table 2).

**Table 2** Mean and SD of the subjects' physical characteristic prior to the study

Description	Exercise Group (n=15)	Non-Exercise Group (n=15)
Age (yrs.)	13.47±0.91	13.73±0.96
Resting HR (bpm.)	95.13±10.10	95.20±10.30
Weight (kg.)	75.74±6.31	75.96±7.65
Height (cm.)	157.13±4.57	157.93±5.25

Five health-related physical fitness variables were measured at pre and post exercise training program (Table 3). It could be noticed that significant differences were

found in sit and reach test, abdominal curls, push up and one mile walk/run. Significant difference was not found in the body mass index. (BMI)

**Table 3** Comparison of Health-Related Physical Fitness Variables between Exercise and Non-Exercise Groups at Pre and Post Exercise Training

Parameters	Pre Tests		t	p	Post Tests		t	p
	Exercise	Non-Exercise			Exercise	Non-Exercise		
BMI (kg./m <sup>2</sup> )	30.68±1.86	30.40±1.58	0.44	0.66	30.00±1.86	30.45±1.70	-0.69	0.49
Sit and Reach Test (cm.)	3.06±3.71	3.00±4.01	0.04	0.96	7.26±3.49	4.33±3.77	2.20	<0.01
Abdominal Curls (times/min.)	25.67±4.03	25.33±2.71	0.26	0.79	32.47±3.06	28.47±3.66	3.24	<0.01
Push Up (times/min.)	25.47±2.23	25.40±2.55	0.07	0.94	31.60±1.63	28.53±2.44	4.03	<0.01
One Mile Walk/Run (min.)	19.27±1.41	19.19±1.53	0.14	0.89	18.09±1.34	19.78±1.74	-2.96	<0.01

## Discussions

The exercise training program developed for use in this study was based on the concept of promoting health - related physical fitness and followed the criteria and guidelines for testing suggested by the Division of Nutrition, Department of Health, Ministry of Public Health, Thailand. It must be noted here that the Ministry aims to make the health-related physical fitness test simple and easy to implement in schools across the country. The results of this study revealed that the exercise training program affected health-related physical

fitness among the study subjects in a positive direction. At the pre-test, no significant difference was found on the variables tested, whereas significant differences were noticed for 4 parameters at the post-test except the BMI.

Muscular Strength (based upon push up test) was 31.60±1.63 times/min in the exercise group compared to 28.53±2.44 times/min in the non-exercise group. Muscular endurance, based on abdominal curl test, also showed significant differences (exercise group = 32.47±3.06 times/min and non-exercise group = 28.47±3.66 times/min). The finding thus

showed that the exercise training program improved muscular strength of the subjects and was in line with the results found by many authors<sup>9-11</sup>. The increase in muscular strength and endurance was the results of proper training demand. Because of neuromuscular adjustment at a late stage (after 4 weeks), the muscles increase their tones and hypertrophied with a result in an increase in strength and endurance. Unfortunately, we did not measure changes of muscles tone and hypertrophied of muscles involved in the exercise training program in this study.

Flexibility (based upon sit-and-reach test) showed significant difference between exercise and non-exercise groups;  $7.26 \pm 3.49$  cm and  $4.33 \pm 3.77$  cm., respectively. The program was thus effective in promoting flexibility. This large difference in flexibility between the two groups may be due to the fact that the program required the subjects to do stretching exercise for about 20 min. of every session. The improvement in flexibility could be expected once an exercise training program included stretching exercise in it. Similar results were found elsewhere<sup>11,13</sup>.

Cardio respiratory endurance, the key factor of health-related fitness, was measured by the one mile-run / walk test the exercise group had improved their time from

$19.27 \pm 1.41$  min. to  $18.09 \pm 1.34$  min. while such improvement was not found in non-exercise group. Significant difference was found at post test between the time taken to cover the distance of 1 mile run/walk between the two groups ( $18.09 \pm 1.34$  v.s.  $19.78 \pm 1.74$  min). The improvement in time after this exercise training program could be expected since the program had included the aerobic part in every session of training at least 20-35 min. Similar findings were found by many authors<sup>15,16</sup>.

The results also showed that the exercise training program did not have any effect on BMI of the subjects. The BMI of both groups remained unchanged ( $30.68 \pm 1.86$  v.s.  $30.00 \pm 1.86$  kg/m<sup>2</sup> in exercise group and  $30.40 \pm 1.58$  v.s.  $30.45 \pm 1.7086$  kg/m<sup>2</sup> in non-exercise group). This finding was consistent with other studies<sup>17,18</sup> in that BMI did not reflect fat/lean weight of a person. Body composition should be determined by skin fold thickness rather than BMI.

## Conclusions

The exercise training program used in the present study improved muscle strength, muscle endurance, flexibility and cardio-respiratory endurance of the overweight students and thus offered a school or a community to use for a long term combat with the overweight and obesity problems.



## References

1. McArdle WD, Katch FI, Katch VL. Exercise Physiology: Energy Nutrition and Human Performance. 4<sup>th</sup> ed. Baltimore, Md: Williams and Wilkins; 1996.
2. Cynthia LO, Margaret DC, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA* 2006; 295:1549-55.
3. Chu NF. Prevalence and trend of obesity among school children in Taiwan: The Taipei Children Heart Study. *Int J Obes Relat Metab Disord* 2001; 25(2): 170-6.
4. Division of Nutrition; Department of Hygiene, Ministry of Public Health. Guidelines for Use of Height-Weight to Evaluate Growth of Thai Children. Bangkok: Veteran Publisher Under Patronage of His Majesty The King; 2000.
5. Thongthai W. The Over Fat. [online]. 2007. [cited 2007 July 16]. Available from: <http://www.ipsr.mahidol.ac.th/content/Home/ConferenceIII/.htm>.
6. National Public Health Foundation. A Survey of Environmental factor contributing to overrating in primary school children; A Preliminary Report; 2005.
7. Charoenwattana S. Nutritional status of young basketball players [Master thesis in exercise and sport science]. Chon Buri: The Graduate school, Burapha University; 2004.
8. Division of Exercise for Health, Department of Hygiene, Ministry of Public Health. Procedures and Guidelines for Testing of Health-Related Fitness in Children aged 7-18 years old. Bangkok: Veteran Publisher Under Patronage of His Majesty The King; 2007.
9. Faigenbaum AD. The effects of strength training on children. *Diss. Abstr. Int* 1993; 53: 2753-A.
10. Tansoongnern B. The effects of using body weight as a resistance on muscle strength and endurance [Master Thesis]. Srinakharinwirot University; 2003.
11. Zakas A. The effect of stretching during warming-up on the flexibility of junior handball players. *The Journal of Sports Medicine and Physical Fitness* 2003; 43(2).