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The Effectiveness of 3-Month Exercise Program on Body Composition in Overweight Adult Army Male Officers at Support Unit of Armed Forces Development Command, Bangkok, Thailand: A Quasi-Experimental Study

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Abstract— *Obesity and overweight have become epidemics in global health and may increase the risk of many health problems. The 3-month exercise program was designed to reduce the body composition parameters namely body weight, body mass index, waist line, waist hip ratio, fat percent, fat mass and visceral fat in overweight adult army male officers at support unit at Armed Forces Development Command Bangkok, Thailand. A total number of 110 overweight adult army male officers at support units whose annual checkup report in 2018 was overweight without diseases met the inclusion criteria and voluntarily participated in this study. They were divided into 2 groups: intervention group (n=55), and control group (n=55) by purposive sampling techniques based on 2 separate locations in the same area. Socio-demographic and economic information was recorded and found that both groups were homogenous. All the parameters in both groups were measured and recorded by a trained research assistant using TANITA body composition analyzer DC-360 at baseline and after the 3-month intervention program. The Chi-square test, Fisher's exact, Independent t-test and Mann Whitney u test were used for comparison before and after a 3-month intervention program within group and between groups. The results showed that body weight, body mass index, waist line, waist hip ratio, fat percent, fat mass and visceral fat decreased significantly within the intervention group but almost all the parameters increased in the control group. However, there was only a significant difference in waist hip ratio ($p<0.009$) between 2 groups. In conclusion, the 3-month exercise program can reduce all the parameters in the intervention group.*

Keywords— *Three-month exercise program, body weight, body mass index, waist line, waist hip ratio, fat mass and visceral fat*

I. INTRODUCTION

Obesity and overweight have become epidemics in global health. In 2016, World Health Organization (WHO) reported that more than 1.9 billion are obese, specifically 39% of adults [1-2]. One of the health problems which overweight causes is long-lasting inflammation, which may increase the risk of chronic disease including obesity, diabetes and cardiovascular diseases. The lack of exercise contributes to overweight. So, it would be difficult for people to reduce body fat stored in the abdominal region but exercise can reduce stored fat including visceral fat [3]. Thailand is one of the countries that have the obesity problems. The Asian Development Bank Institute (ADBI) reported the obesity in Thailand and its economic cost estimation of the fourth National Health Examination Survey in March 2017 that epidemiology of obesity was the most prevalent among adults aged 45-59 years (42.4%) follow by those aged 30-44 years (38.4%) [4]. This trend was similar for both genders [5]. A standard measurement tool to measure overweight or obesity is body mass index (BMI) as a screening test for overweight and it is recommended >23 in Asia Population [6]. Several parameters such as waist line, waist hip ratio, fat percent, fat mass and visceral fat can be measured by Bioelectrical Impedance Analysis (BIA) using TANITA body composition analyzer DC-360 the portable [7]. Waist hip ratio is considered as fast, easy to obtain and WHO guidelines in 2018 suggested that waist hip ratio that reflect abdominal obesity seemed to be superior to BMI [8]. BIA has been more widely used to measure body composition because it is fast, inexpensive, portable, non-invasive and easy to operate. It is a technological advancement offering precise prediction [9-10] by analyzing body compositions and other factors such as body type, age, weight, height, and gender [7]. In 2018 it was found that the annual checkup in adult army officers aged more than 35 years old from Armed Forces Development Command accounted for 41.32% exceeded BMI standards. Approximately 31.52 % was overweight and 9.7% was obese, which was related to epidemiology of obesity in the fourth National Health Examination Survey in March 2017 [4]. Their work which requires using computers and processing paper documents during office hours is sedentary. Although the army policy has a sport day on every Wednesday afternoon, these officers in support units do some leisure activities which are not intense enough to be exercise supported by a previous study which found that a group of young, healthy, normal-weight men who reduced their paces from 10,000 to 1,500 paces every day over 2 weeks experienced a significant rise of visceral fat volume (7%) despite a total average weight loss of 1.2 kg [9]. WHO has defined exercise as a subcategory of physical activity which is planned, structured, repetitive and purposeful in order to

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maintain or improve physical fitness as the objective [11]. The urban lifestyle limits their free time to do exercise because of their priority work. Another previous study revealed that a 3-month regular physical activity could help middle-aged, normal-weight or overweight men and overweight women reduce visceral fat volume by 10-19%. [12-13] However, to reduce the health risks caused by overweight and obesity, there is no exercise program designed for convenient exercise anywhere suitable for overweight adult army male officers to maintain or reduce weight effectively by themselves. Therefore, the exercise program which integrates the optimal aerobic and cardio fitness including high knees, jumping jacks, squats was created for simple and easy to do in a limited space anywhere without any equipment [14]. The objective of this study was to compare the parameters namely body weight, body mass index, waist line, waist hip ratio, fat percent, fat mass and visceral fat in overweight participants at base line and after 3-month exercise program.

II. METHODOLOGY

A quasi-experimental study which using the purposive sampling techniques was conducted in the overweight participants from 2 homogenous groups based on 2 separate locations in the same area to compare before and after the 3-month intervention program at Armed Forces Development Command (AFDC) in Bangkok, Thailand.

Participants: A total number of 110 overweight adult army male officers at support unit whose annual checkup report in 2018 aged between 35-45 years old without diseases who could do physical exercise, met the inclusion criteria and voluntarily participated in this study. The purposive sampling techniques were conducted and divided them into 2 groups: intervention group and control group. The sample size in this study was calculated based on a previous study conducted on effects of health promotion program on metabolic syndrome preventive behaviors among health volunteers in 2011 [15]. The sample size of the participants plus 30% dropout was 55 in the intervention group and 55 in the control group.

Procedures: The overweight adult army male officers at support unit from annual checkup report in 2018 without diseases were arranged by an official in charge of their units. The researcher approached, interviewed and selected the participants who met the inclusion criteria, voluntarily participated and became the sample size of both groups (n= 55 each group) in this study. Each participant was asked to complete the questionnaire of socio-demographic and economic information such as age, body weight, BMI, waist hip ratio, education, marital status, income, alcohol consumption, smoking, food and diet as well as physical activity and exercise. TANITA body composition analyzer DC-360 was used to measure all the parameters in both groups. The trained research assistant measured, recorded and collected both questionnaire and all the parameters at baseline and after the 3-month intervention program. Body weight, BMI, waist line, waist hip ratio, fat percent, fat mass and visceral fat are primary outcomes parameters. The total number of 110 participants aged between 35-45 years old whose waist circumference was higher than height divided by two [8], had BMI $\geq$ 23 kg/m^2 [6] or waist to hip ratio was more than (0.9) based on WHO cut-off points and risk of metabolic complications were included [8]. The exercise program which integrated the optimal aerobic and cardio fitness [14] by sport scientists as leading instructors and researcher's team as the supervisors was monitored and joined the exercise sessions in the intervention group. The exercise program consisted of 3 steps: step one was the stretching for warm-ups in Thai boxing style dynamic, step two was the aerobic exercise of four positions/session (3 sets of squat, high knee, plank and jumping jacks) (50 minutes) and step three was the stretching for cool-down in Thai boxing style dynamic. Both groups were scheduled to perform exercise 3 days/week on Mondays, Wednesdays and Fridays between 15.00 and 16.00 p.m. for 150 min/week for 3 months. The control group did the same leisure activity. The study area took place at the AFDC where both groups performed it in their own buildings.

Ethical considerations: This study was approved by The Ethics Review Committee for Research Involving Human Research Subjects, Health Science Group, Chulalongkorn University. The research approval number was 183.1/62. The researcher informed the participants about the study protocol and the risk of the intervention program before they signed a written consent form.

Statistical analysis: The $\chi 2$ tests were used to check the differences between parametric variables studied. The Kolmogorov-Smirnov Goodness of Fit Test was used for normality test. The result showed that there was normal distribution in all variables. The main objective of this study was to compare body weight, BMI, waist line, waist hip ratio, fat percent, fat mass and visceral fat in overweight participants at base line and after 3-month intervention program. Data were analyzed with Chi-square test, Fisher's exact test, Independent t-testy and Mann Whitney u test used for comparison at baseline and after 3-month intervention.
P-values (a) were used to compare within groups and (b) to compare between groups, respectively. All the results with $p<0.05$ were considered statistically significant. The data analysis was performed using SPSS 22.0 for Windows.

III. RESULTS

A total number of 110 participants had 12 dropouts from both groups (6 dropouts each) during the 3-month intervention program. Their works which required using computers and processing paper documents during office hours from 8.00 to 16.00 were the main job responsibilities in both groups on Mondays to Fridays. During the last week of November to December, some participants could not join the exercise sessions because they were adjusting the fiscal budget as an urgent matter in the budget department. So, there were 98 participants (intervention group; n=49 and control group; n=49) in total who participated in this study. The socio-demographic and economic data and outcome variables were similar between both groups and shown in table 1. The results

showed the general characteristics of the participants and found that a total number of 98 participants were 39.35±3.86 years old with an average weight of 82.28±11.22 kilograms. The average height was 171.44±4.97 centimeters. Most of them had a bachelor's degree or higher, representing 50% and 51% were married. Their monthly income 15,000-25,000 bath accounted for 40.8%. The majority who never smoked accounted for 49%. They drank 1-6 glasses of alcohol per week, representing 55.1%. For leisure activity or occasional exercising, 68.4% did exercise occasionally. 69.6% preferred going to do exercise alone; 57.6.6% went jogging /strolling as their other choice of exercise. 45.48% liked to do exercise in the park.

TABLE 1. Socio-demographic and economic characteristics and variables at baseline intervention group (N=49) and control group (N=49), P-value=0.05

Variables	Total	Intervention group	Control group	p-value
Age(years) mean±SD	39.35±3.86	39.31±3.87	39.39±3.88	0.917
Weight(kg.) mean±SD	82.28±11.20	83.65±10.79	80.90±11.54	0.225
Height(cm.) mean±SD	171.44±4.97	171.14±4.87	171.73±5.11	0.559
Education level				
High School	14(14.3%)	7(14.3%)	7(14.3%)	
Diploma	35(35.7%)	14(28.6%)	21(42.9%)	0.301
Bachelor's degree or higher	49(50.0%)	28(57.1%)	21(42.9%)	
Status				
Single	33(33.7%)	17(34.7%)	16(32.7%)	
Married	50(51.1%)	25(51.0%)	25(51.0%)	0.953
Divorce	15(15.3%)	7(14.3%)	8(16.3%)	
Income in Thai baht				
15,000-25,000	40(40.8%)	18(36.7%)	22(44.9%)	
25,001-35,000	31(31.6%)	16(32.7%)	15(30.6%)	0.682
35,001-45,000	27(27.6%)	15(30.6%)	12(24.5%)	
Smoking				
Non smoking	48(49.0%)	24(49.0%)	24(49.0%)	
Used to smoke but quit smoking	12(12.2%)	12(24.5%)	0(0.0%)	<0.001*
Smoking	38(38.8)	13(26.5)	25(51.0)	
The number of cigarettes smoked per day, median (IOR)	15(,20)	10(4,20)	20(12.5,20)	
Alcohol drinking				
Non-alcohol drinking	25(25.5)	25(51.0)	0(0.0)	
1-6 glasses/Week	54(55.1)	15(30.6)	39(79.6)	<0.001*
>6 glasses/week	19(19.4)	9(18.4)	10(20.4)	
Exercise				
No exercise	6(6.1)	6(12.2)	0(0.0)	
Exercise once a week	67(68.4)	18(36.7)	49(100)	<0.001*
Exercise 3 times a week	25(25.5)	25(51.0)	0(0.0)	
Number of persons who have exercised together				
Alone	64(69.6)	29(67.4)	35(71.4)	
With family or friends 2-4 persons	22(23.9)	11(25.6)	11(22.4)	0.918
With family or friends >5 persons	6(6.5)	3(7.0)	3(6.1)	
Exercise type (>1 type selected)				
Race walking	12(13.0)	12(27.9)	0(0.0)	<0.001*
Running	22(51.2)	22(51.2)	0(0.0)	<0.001*
Cycling	6(6.5)	6(14.0)	0(0.0)	0.027*
Team sport (football/muzzle)	8(18.6)	8(18.3)	0(0.0)	0.002*
Other sport without plan (jogging, strolling, etc.)	53(57.6)	4(9.3)	49(100.0)	<0.001*
Exercise location				
Home	14(15.2)	7(16.3)	7(14.3)	
Fitness/Sport center	33(35.9)	14(32.6)	19(38.8)	0.823
Park	45(48.9)	22(51.2)	23(46.9)	

Data were analyzed with Chi-square test, Fisher's exact test, Independent t-test and Mann-Whitney. *Statistically significant at the 0.05 level (α=0.5)

The mean changes of all the parameters (mean ± SD) within groups and between groups after a 3-month intervention program were compared, the results showed that all the parameters (body weight (p<0.001), BMI (p<0.001), waist line(p<0.001), waist hip ratio(p<0.001), fat percent (p=0.015), fat mass (p<0.001) and visceral fat (p=0.002)) within the intervention group decreased significantly but some parameters (mean ± SD) in the control group increased. However, there was only a significant difference in waist hip ratio (p= 0.009) between 2 groups.

The comparison of all the parameters (mean±SD) within the intervention group found that the body weight was at 83.65±10.79 and decreased significantly to 81.26±10.94 (p<0.001). The BMI was at 28.51±3.08 and decreased significantly to 27.69±3.18 (p<0.001). The waist line was at 40.41±2.92 and decreased significantly to 38.80±2.99 (p <0.001). The waist hip ratio was at 0.96±0.04 and decreased significantly to 0.93±0.04 (p<0.001). The fat percent was at 26.09±4.32 and decreased significantly to 25.62±4.23 (p=0.015). The fat mass was at 22.18±6.21 and decreased significantly to 21.16±6.04 (p<0.001). The visceral fat was at 13.49±2.14 and decreased significantly to 13.08±2.27 (p=0.002).The comparison of all the parameters (mean ± SD) within the control group after a 3-month intervention program found that the body weight was at 80.90±11.54 and increased significantly to 81.88±11.75 (p<0.001). The Body Mass Index was at 27.42±3.74 and increased significantly to 27.75±3.78 (p<0.001). The waist line was at 39.33±3.12 and increased significantly to 39.47±3.21 (p=0.001).

Patchamol Masakul and Kanchana Rungsihirunrat, "The Effectiveness of 3-Month Exercise Program on Body Composition in Overweight Adult Army Male Officers at Support Unit of Armed Forces Development Command, Bangkok, Thailand: A Quasi Experimental Study" *International Journal of Multidisciplinary Research and Publications (IJMRAP)*, Volume 3, Issue 3, pp. 31-36, 2020.

TABLE 2. Mean changes of all the parameters between intervention group (N=49) and control group (N=49), P-value= 0.05

Variables	Baseline (mean± SD)	3-month intervention (mean± SD)	p-value(a)
Body weight			
Intervention group	83.65±10.79	81.26±10.94	**<0.001***
Control group	80.90±11.54	81.88±11.75	<0.001*
p-value(b)	0.225	0.787	
BMI			
Intervention group	28.51±3.08	27.69±3.18	**<0.001***
Control group	27.24±3.74	27.57±3.78	<0.001*
p-value(b)	0.119	0.937	
Waist Line			
Intervention group	40.41±3.08	38.80±2.99	**<0.001***
Control group	27.42±3.74	39.47±3.21	0.001*
p-value(b)	0.246	0.286	
Waist Hip Ratio			
Intervention group	0.96±0.04	0.93±0.04	**<0.001***
Control group	0.95±0.04	0.95±0.04	0.035
p-value(b)	0.463	**0.009***	
Fat Percent			
Intervention group	26.09±4.32	25.62±4.23	**0.015***
Control group	25.82±4.63	26.01±4.65	0.448
p-value(b)	0.773	0.665	
Fat Mass			
Intervention group	22.18±6.21	21.16±6.04	**<0.001***
Control group	21.34±6.79	21.72±6.87	0.058
p-value(b)	0.526	0.664	
Visceral Fat			
Intervention group	13.49±2.14	28.71±18.65	**0.002***
Control group	13.00±2.59	27.94±16.73	0.083
p-value(b)	0.310	0.833	

Data were analyzed with paired simple t-test within groups (p-value(a)) and Independent t-test between groups (p-value(b)). *Statistically significant at the 0.05 level (α=0.5)

IV. Discussion

The study design was quasi-experimental and controlled. This program was designed to reduce all the parameters and to prevent risks of chronic diseases referred to the trend of the annual checkup report over last 2 years especially in 2018 which showed the health status of the army male officers in support units. The 3-month intervention program which integrated the optimal aerobic and cardio fitness [14] by training body weight and cardio exercise was effective in significantly decreasing all the parameters (body weight, BMI, waist line, waist hip ratio, fat percent, fat mass and visceral fat) within the intervention group. This study shared similar results with previous studies. For instance, a previous study investigated the effect of exercise on visceral adipose tissue in overweight adults and an overview of the effect of different exercise regimes, without caloric restriction. The researchers concluded that an aerobic exercise without restricted diet could provide positive effects to reduce visceral adipose tissue by more than 40 square centimeters among male adults after 12 weeks [16]. Exercise is so beneficial because it can reduce both body fat associated with age and abdominal fat. Abdominal fat is considered as a risk factor for age-associated pathological problems such as coronary heart disease and type 2 diabetes [17]. The intervention program recruited the overweight participants whose age was in the high prevalence of obesity [4]. They participated in doing exercise 3 days/week (150 minutes/week) for 3 months. All the parameters particularly visceral fat decreased significantly in the intervention group. Current literature of Brocklehurst's Textbook of Geriatric Medicine and Gerontology reported that abdominal fat mass is positively associated with mortality in middle-aged to elderly adults. Therefore, the researchers suggested that interventions which focus on preventing the abdominal accumulation of fat with advancing age are most important to develop [17].

This study included all the parameters namely body weight, BMI, waist line, waist hip ratio, fat percent, fat mass and visceral fat under investigation. body weight and BMI are the standard indicators [6] as policy criteria the government and the army are concerned about because they are the key performance index of screening tools for health status. If they are over the standard, they will be likely to cause chronic diseases. Waist line and waist hip ratio were chosen based on WHO guidelines in 2008 because they were alternative measures which were superior to BMI to reflect abdominal obesity which will cause obesity, metabolic syndrome [8]. A study conducted in Chinese population revealed that waist circumference was found to be the best obesity measurement but waist hip ratio might be used as an alternative obesity indicator [18]. Fat Percent, fat mass and visceral fat should be within suitable range or value. Aging causes fat mass to increase and its homeostatic regulation is in decline by advancing age. Moreover, sedentary lifestyle plays an important role in increasing fat mass associated with age but exercise can help reverse the trend [17]. Visceral Fat is stored within abdominal cavity and around many important internal organs including pancreas, the liver and intestines. Visceral Fat is considered as active fat or intra-abdominal fat because it can possibly affect how human hormones function. The higher amount of visceral fat individuals stored in their bodies, the higher risks of many health problems including type 2 diabetes and fatty liver leading to liver cancer they will have [19]. Storing some body fat is healthy and normal but excess visceral fat can be harmful as it causes serious health problems [20]. Fat Percent, Fat mass and Visceral Fat were those of the parameters in this study analyzed by Bioelectrical Impedance Analysis. From a previous study proposed the use of BIA because human body consists of fat and non-fatty substances to use the conductive differences of human body fat, water and other components of the body to determine the content of body composition [21]. BIA is new technological method to measure body composition which evaluates the weight, body distribution and nutrition. It offers many advantages because it is safe, easy to operate, noninvasive, economical, reliable, valid and suitable for large-scale research group and has an important value in the diagnosis obesity [22]. Another advantage of BIA which this study selected to analyze body composition was that such high abdominal fat at low BMI levels in Asians can be partly explained by the differences in trunk-to-leg-length ratio, physical activity level and diet compared to Caucasians [23]. Therefore, BIA was one of the measurement tools used in this study to indicate health status more precisely. This study used TANITA body composition analyzer DC-360 to measure all the parameters in both groups. K. Shiwaku *et al*. (2004) conducted a study on overweight Japanese with higher risks for obesity-associated disorders.

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The researchers also used TANITA body composition analyzer to measure body composition of the overweight participants [24]. The 3-month intervention program could decrease all the parameters significantly within the intervention group after all the participants joined the exercise program regularly according to the schedule. It could improve posture and their parameters to gradually lose and maintain weight. In addition, the exercise could boost the immunity. This study asked the participants to complete 50-minute exercise/day for 3 days a week. So, the exercise duration was effective in boosting the immunity system supported by a previous study which recommended that doing exercise which lasted almost an hour could stimulate the immune system sharply [25]. Moreover, this program is very suitable for the current global situation in 2020 because it provides individual exercise and social distancing supported by a previous study. One of the recommendations the researchers gave was that people should avoid going to the gym or outdoor places but they could do daily exercise at home to stay physically healthy in order to avoid overweight and obesity [26]. A recent study conducted on obesity and COVID-19 severity in a designated hospital in Shenzhen, China reported that COVID-19 patients in Shenzhen particularly men who were overweight ($24 \leq$ BMI < 28 kg/m^2) and obese (BMI ≥ 28 kg/m^2) patients at 32% and 10.7%, respectively had higher problems and risks of developing severe COVID-19 than patients with normal weight [27].

The intervention program provides individual exercise alone without equipment by themselves since it is very crucial to do exercise to stay healthy while keeping social distancing. The results of the mean changes showed the statistically significant decrease of all the parameters namely body weight, BMI, waist line, waist hip ratio, fat percent, fat mass and visceral fat in the intervention group. The mean changes caused by the intervention program were likely to be clinically significant if the participants continued to do regular exercise of the intervention program. In contrast, the control group did not follow the intervention program. After the 3-month intervention program was completed, all the parameters in the control group increased. The program is expected to continue for sustainability especially during the current situation because the intervention program which used the resources including human resources and facilities as well as the knowledge to design the program without using equipment in a limited space complied with the current policy on exercise.

V. Limitations and Recommendations

This study had some limitations. First, only male participants were recruited. So, it was unknown how effective the program was for overweight, healthy middle-aged females. Second, this study did not recruit the participants from the general population but only special groups of overweight army male officers in support units were selected. Third, whether it is possible to conduct this research at an urban area whose urban lifestyle limits free time to do exercise because of other priorities in other private occupations with similar income but no policy support in urban area is still unknown. The future study should recruit both genders from various occupations in urban and rural areas and investigate the effects of prolonged intervention program because prevention of visceral adipose tissue gain is important since visceral adipose tissue is more strongly related to cardiovascular disease and diabetes risk than fat in another depot.

VI. Conclusion

This study which used the intervention program and the parameters including BIA was one of the few studies conducted in army support departments in Bangkok, Thailand. All the parameters chosen in this study were proven to be precise and accurate to identify the health status of the participants. The intervention program was effective in significantly reducing all the parameters and is suitable for individual exercise without equipment since it can be performed in a limited space anywhere.

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Conflict of Interested

The authors have declared they have no potential conflicts of interest.

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