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The Effects of Combined Exercise Training on Body Composition Among Overweight Adults

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ABSTRACT

People who have overweight and obese are at increased risk for several serious diseases and health complications. Evidence suggests that exercise training improves overweight and obesity risk factors. However, it is unclear whether health benefits are limited to aerobic or resistance training or whether a combination is more effective in improving the overweight and obese. This study aimed to investigate the effects of combined aerobic and resistance training on body mass index (BMI) and waist-hip ratio (WHR) among overweight adults. This study used the true experimental design with the randomized pretest-posttest control group design. A total of 17 overweight participants took part in this study and were randomly assigned to the control and experimental groups. The experimental group performed eight weeks of aerobic and resistance combination training programs that consisted of 15-minute aerobic and 15-minute resistance exercises for each training session. The BMI and WHR data were obtained before and after the eight weeks of the training program. The paired t-test was used to analyse the pre and post-test data within-group. The combined exercise training significantly decreased the BMI in the experimental group (p = 0.001). However, there was no difference in the BMI in the control group. There was no significant improvement in the WHR for the experimental and control groups. The combined exercise training gave more benefits for weight loss. Therefore, programs designed to reduce overweight or obesity rates should encourage the practice of combined exercise training. In this study, eight weeks of combined exercise training was effective in reducing BMI but not in WHR among overweight adults.

Keywords: *Combined exercise training, overweight, body mass index, waist-hip ratio*

INTRODUCTION

Most Malaysian citizens are less aware of their overweight, then it could lead to obesity or even other co-morbidities. Based on statistics from National Health and Morbidity Survey (NHMS) in 2019, found that 50.1% of the adults are overweight and obese, where 30.4% are overweight, and 19.7% are obese (Institute for Public Health, 2020). The risk of exposure to cardiovascular disease is high, started being overweight (Poirier et al., 2006). It is proved that overweight and obesity are significant health concerns lead to other co-morbidities (Jakicic et al., 2018). Thus, an exercise program should be designed to lowering these ascending overweight trends.

According to Willis and colleagues (2012), studied had been conducted that aerobic exercise alone being effective among overweight and obesity for weight loss and fat loss. While resistance training was effective on improving lean body mass. There is no change in body weight but does increase lean body mass. Moreover, various experimental designs had been carried out by researchers on combined exercise training to reducebody weight among the overweight population (Tan et al., 2012). A twelve weeks of combined training program resulted in unique improvements to cardiovascular risk profile in overweight and obese participants (Ho et al., 2012; Schroeder et al., 2019). According to Castro et al. (2017), many researchers found that combined exercise training tends to have a greater influence on the cardiorespiratory response. Similar results had been shown that combination training can improve metabolism, reduce body fat, and lowering cardiovascular disease risk factors (Jang et al., 2019; Jin et al., 2018). Mostly combined exercise training studies were conducted internationally. Yet, there is little or no prior research, intentional of local studies on combined exercise training on body composition among Malaysian overweight. Thus, this study aimed to investigate the effectiveness of combined exercise training on body composition among overweight adults.

METHODOLOGY

Participants

A total of 17 overweight adults voluntarily participated in the study. They were randomly divided into two groups: experimental and control groups. The participants were assessed for overweight diagnosis based on BMI (25 - 29 kg m^{-2}), which is the general BMI Guideline of World Health Organisation (WHO, 2010).

Research Design and Procedure

This study used the experimental design with the randomized pretest-posttest control group design. All selected participants completed the PAR-Q+ and consent form after attaining information about the study. The participants were randomly assigned to the control and experimental groups after a pre-test (BMI and WHR measurements) was performed. The experimental group participated in an 8-week of combined exercise training program. The control group was instructed to do their daily routine activities without any training program. After completion of the 8-week program, post-test was performed. The results were analysed after all experiments were completed. A flow chart showing the selection process of participants and experimental procedure is shown in Figure 1. This study has been approved by the UiTM Research Ethics Committee (REC/11/2021 (UG/MR/863).

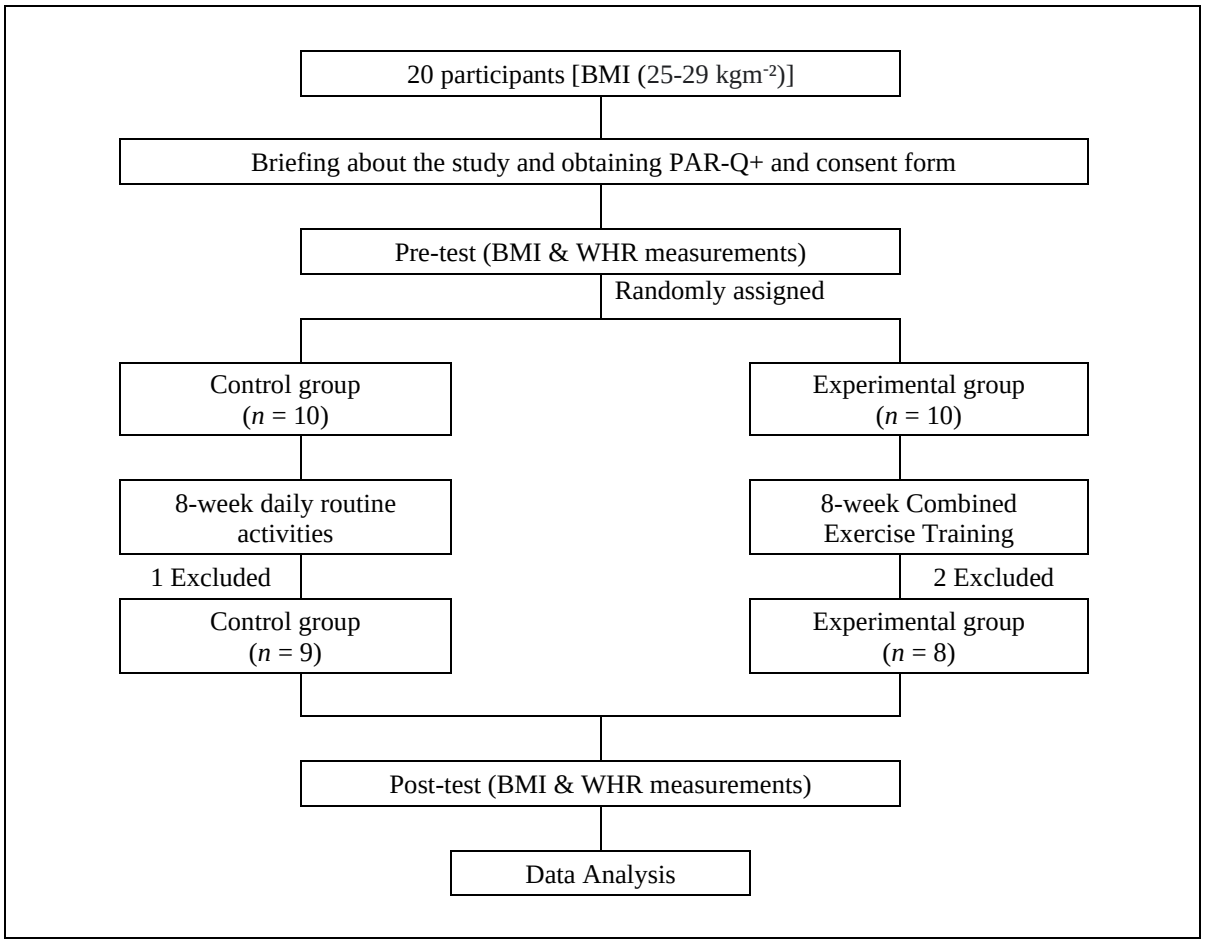

Figure 1. The participant's selection and experimental procedure flow chart

Combined Exercise Training Program

The training program implemented in this study was adapted the training protocol by Ho and colleagues (2012), where thirty minutes of combined exercise training (15-min of aerobic exercise and 15-min of resistance exercise). The aerobic exercise involved either treadmill, stationary bike or elliptical trainer at 60% heart rate reserve (HRR) ± 10 beats/min (moderate intensity). Karvonen equation (220-age-resting heart rate) implemented on HRR estimation (Karvonen et al.1957). The resistance exercise involved four sets of 8-12 reps at 10-RM for 30-sec with 1-min rest determined for major muscle groups. The combination of 15-min aerobic exercise and 15-min resistance exercise were performed two sets of each exercise at a baseline of 10-RM or approximately 75% of 1RM. The training program was conducted five times per week for eight weeks.

The experimental group (EG) performed 15-min of aerobic exercise and 15-min of resistance exercise (combined exercise training). After a standardized warm-up and cool-down were each carried out for 5-min stretching the entire body and 5 min walking on the treadmill with an intensity of 50% HRmax. Exercise intensity and participants' heart rate during exercise were observed using a polar heart rate monitor (Polar H10). The aerobic exercise mode included treadmill, elliptical trainer (Impulse; China) and cycle ergometer (Cybex; United States). The resistance exercise involved weight machines and free weights. Weight machines included leg curl, leg press, bench press, and rear deltoid row (BFT Fitness; Guangzhou, China). Moreover, free weight includes two sets of bicep curls and lunges and one set for dumbbell raise, calf lift and triceps and back extension, push ups and sit up. The exercise training session was conducted with close supervision by practitioner and qualified fitness trainer to ensure all exercises performed by the participants were correct and prevent the risk of injury.

Measurement of Body Composition

The body mass index (BMI) of each participant was calculated by dividing body weight in kilograms by the square of height in meters. Participants' body weight was measured using an electronic digital weighing scale and height was measured in centimetres using a stadiometer. The classification of BMI is based on the general BMI Guideline of World Health Organisation (WHO, 2010). The waist-hip ratio (WHR) was calculated as the circumference of the waist divided by the circumference of the hips. A horizontal measure was taken at the narrowest part of the torso (above the umbilicus and below the xiphoid process) for the waist measurement and a horizontal measure was taken at the maximal circumference of the buttocks for the hips measurement. All measurements were made with a flexible yet inelastic tape measure. The classification of WHR is based on the Report of WHO Expert Consultation (WHO, 2008).

Statistical Analysis

All the descriptive data were presented as mean and standard deviation (mean ± SD) and were analysed using the Statistical Package for IBM SPSS v26. All data obtained in this study were tested for the normality using Shapiro-Wilk test. The paired t-test was used to analyse the pre and post-test data within-group. The test significance level was set at $p \leq 0.05$.

RESULT AND DISCUSSION

This study investigated the changes in body composition (BMI and WHR) as a result of the 8-week training program or daily routine among overweight participants. The physical characteristics of the participants were shown in Table 1.

Table 1. Physical Characteristics of Participants

Variables	Experimental (n = 8)	Control (n = 9)
Gender (male/female)	4/4	5/4
Age (year)	29.40 (8.25)	27.80 (6.48)
Weight (kg)	82.13 (14.80)	83.66 (14.12)
Height (cm)	167.94 (8.97)	168.06 (12.29)
Waist circumference (inch)	38.39 (3.17)	38.64 (4.49)
Hip circumference (inch)	42.53 (2.61)	41.48 (4.63)

*Data were presented in means and standard deviation (SD)

Table 2 presented the BMI results of the participants before and after the eight weeks program. The experimental group ($p < 0.05$) showed a significant decrease in BMI after the 8-week combined exercise training. However, there was no significant change in BMI after the 8-week daily routine within the control group ($p > 0.05$) showed no significant change in BMI after the 8-week daily routine.

Table 2. Changes in BMI After 8-week Program

Group	BMI (kg/m^2) Pre-test Mean (*SD*)	BMI (kg/m^2) Post-test Mean (*SD*)	*P*-value
Experimental	28.87 (2.72)	27.76 (2.92)	0.001
Control	29.46 (2.86)	29.37 (2.89)	0.705

Based on Table 3, the results of the 8-week program regarding changes in WHR of the participants. Both the experimental group ($p > 0.05$) and the control group ($p > 0.05$) showed no significant change in WHR after the 8-week program.

Table 3. Changes in WHR After 8-week Program

Group	WHR (inch) Pre-test Mean (*SD*)	WHR (inch) Post-test Mean (*SD*)	*P*-value
Experimental	0.90 (.038)	0.89 (.040)	0.662
Control	0.93 (.017)	0.93 (.025)	0.545

In general, regular exercise training has a positive effect on weight loss by reducing body fat and increasing lean body mass (Park et al., 2003; Donnelly et al.,2004). In this study, BMI and WHR were measured to observe the body composition changes after an 8-week program of combined exercise training or the daily routine, and found that both groups showed statistically significant differences. The experimental group ($p = 0.001$) showed a significant decrease in BMI after the combined exercise training. However, there was no significant change in BMI in the control group ($p = 0.705$) after the daily routine. These findings are similar to the previous studies reporting a significant reduction in BMI for the combination group compared to the control group after the training program (Ho et al., 2012; Tan et al., 2012). The results also matched the study reported by Jin et al. (2018), stated that combined aerobic and resistance training for eight weeks improved body composition and physical fitness. These results are consistent with several research studies which reported that combined training can significantly improve body composition (Meng et al., 2022; Seong et al., 2022; Rejeki et al., 2023).

The results of this study show an improvement in body composition, which reduce fat mass, body weight, and body mass index, followed by an increase in lean body mass. This explains that training can be an effective method of obesity management. The best improvement in body composition was obtained from combination training (Rejeki et al., 2023). The maximal effect influenced by combination training is a combination framework of aerobic training, which will improve the oxidative system, metabolic capacity, and cardiorespiratory system, while resistance training will increase muscular strength, fibre diameter, and muscle mass (Sigal et al., 2014). Therefore, the results of this study can be the basis for recommending combined exercise training as a treatment for obesity management.

As for changes in WHR, there was no significant difference in WHR for the experimental and control groups. These results matched the previous study by Sanal et al. (2013), who reported no significant change in WHR after 12 weeks of training. Additionally, a 6-week study among rural black South African women also reported no change in WHR, and thus, the training program should be at least eight weeks and above (Ntshaba et al.,2021). The control group did not show any impact on the research either BMI or WHR (Ho et al., 2012; Tan et al., 2012). The control group needs to ensure validation of comparison between groups. Furthermore, future researchers should include another group such as the aerobic group to see more exact

differences. Thus, it can be summarised that combined exercise training provides beneficial for longer timelines among obese or overweight participants. To achieve more training effects, it is recommended to perform for a medium or longer duration of training. The combination of aerobic and resistance exercise can be good training for lowering any risk factors that lead to obesity.

CONCLUSION

An eight weeks training program of combined aerobic and resistance training at a moderate intensity for 30-min, five days per week resulted in decreasing BMI value but not in WHR among overweight adults. This study confirmed that combined exercise training is an appropriate treatment for weight loss. Therefore, programs designed to prevent the problem of being overweight or obese should encourage the practice of combined exercise training. Further study is required to investigate the effects of a longer and more intense combined training program in reducing the impact of morbidity and improving the quality of life of overweight adults.

AUTHORS' CONTRIBUTION

Tham Yin Choong suggested and planned this study, verified the data and discussed the results, and took the lead in writing the manuscript. Harris Mohd Khairi and Ahmad Dzulkarnain Ismail conducted the literature finding, data preparation and data collection. Tan Chee Hian and Ong Tah fatt conducted the data analysis and verified the content writing and contributed to the interpretation of the results. All authors provided critical feedback and helped shape the research and manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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