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EFFECTS OF AQUA-AEROBIC EXERCISE ON THE CARDIOVASCULAR FITNESS AND WEIGHT LOSS AMONG OBESE STUDENTS

[*1]Fariba Hossein Abadi
[1]Gunathevan Elumalai
[1]Mohansundar Sankaraval
[2]Farizul Athir Bin Mohd Ramli

ABSTRACT

Background: Evidence revealed that aquatic exercises are safer than land-based exercises and it allows increased movement amplitude and energy expenditure for obese, middle-aged, or elderly people, it is important to ascertain the physiological effects of aqua aerobic exercise on health among the obese students. This study aimed to determine the effects of aqua aerobics exercise on cardiovascular fitness (VO_{2max} and resting HR) and weight loss (weight, BMI, and WHR) among obese students.

Methods: Fifty healthy obese college students (22.28±1.83 years) with minimum BMI value of 28 kg.m-^{2}, voluntarily took part in this study. They have been divided randomly into an exercising group (n=25 and BMI=33.11±5.32kg.m^{-2}) and control group (n=25 and BMI=33.64±3.12kg.m^{-2}). The exercising group participated in an aqua aerobic exercise at 60-75% of maximum HR for 60 minutes, three times per week for 12 weeks. The changes (by pre and post-test) in weight, WHR, resting HR and VO_{2max} were measured for both groups via In Body Scan 370, Polar heart rate monitor and Bleep test, respectively.

Results: There was a significant ($p \leq 0.001$) improved in weight loss (-8.78±3.61kg), and the changes of BMI (-3.24±1.1 kg.m^{-2}), WHR (-0.056±0.035), resting HR (-1.48±1.004 bmp), and VO_{2max} (4.43±2.51 ml.kg^{-1}. min^{-1}) in the exercising group, compared to the control group. The results indicate that the aqua aerobic exercise is an effective way to enhance cardiovascular fitness and weight loss among obese students.

Conclusion: Aqua aerobic exercise as a favorable exercise environment for the obese can be advised such a significant intervention strategy for weight loss and improvement in cardiovascular fitness.

Keywords: aqua aerobics exercise, weight loss, resting HR, WHR, cardiovascular fitness, obese.

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[2]Department of Sports Rehabilitation,
Faculty of Sports Science and Coaching,
University Pendidikan Sultan Idris (UPSI),
Tanjong Malim, 35900, Malaysia.

CORRESPONDING AUTHOR

[*1]Fariba Hossein Abadi

Department of Sports Rehabilitation,
Faculty of Sports Science and Coaching,
University Pendidikan Sultan Idris (UPSI),
Tanjong Malim, 35900, Malaysia.
Email: fariba@fsskj.upsi.edu.my,
Tel: +601127538021.

INTRODUCTION

Exercise in the water or aquatic program developed by National Arthritis Foundation YMCA (1980), as a therapeutic medium in health care[1]. In the past two decades, aqua aerobic exercise or water-based exercise become as an alternative exercise program to achieve fitness and rehabilitation purposes for individuals who physically had difficulty in exercising on land [2, 3]. Many studies proved aquatic exercise can increase fitness components such as flexibility, muscle balance, muscle strength, cardiovascular endurance, and decreases the body fat percentage of patients, arthritis and disabled population and elder people [4-7] and it has a significant multiple health outcomes and positive physical and psychological effects [8, 9].

Besides, water exercise which also called aquatic exercise program, aqua aerobics, water aerobics, shallow -water or deep -water running or walking exercise, and shallow or deep -water, aqua aerobic exercise, or similar titles are safer than land-based exercise to reduce risk of injuries and difficulty of exercise [1, 5, 10-12]. All these exercises typically are aerobic exercises and performed in shallow water. Meanwhile, the water density is approximately 800 times of air. Exercising in the water media provides high levels of expending energy with relatively little effort to the body [13], which is essential to expend calories and weight loss.

Furthermore, numerous researchers have investigated the effects of water-based exercise or aqua aerobic exercise on cardiovascular risk factors and obesity which revealed the significant improvement health benefit among elderly people [3] as well as land base aerobic exercise [14]. Takeshima et al. has reported it., (2002), that a water-based exercise in 12 weeks, 70 minutes; 3 days per week showed significant improvement in cardiorespiratory fitness (12 % increase in peak VO_2), body fat (-8% decrease in skin-fold thickness), muscular strength, and total cholesterol among older adult women compared to no exercise group [15].

According to Farahani, et al., (2010), 10-weeks water aerobic exercise recommended to improve resting blood pressure for obese and elderly people with orthopaedic and bronchospasm problems [16]. The results of similar study (Barbosa, et al., 2011) in an aquatic exercise program with 26 weeks, 2 session per week; 40 minutes found significantly promoted body composition (skinfold assessed) and the response of physiological variables in healthy middle- age women even though there was non-significant improvement in their weight and BMI [17].

A study by Kumar & Sundar (2016), in 6 weeks (60 minutes and three sessions a week) aqua aerobic exercises and aerobic exercises proved effect on BMI among college mail students (17-23 years, BMI; 24.53kg.m^{-2}) Compared to the control group. These results indicated that both aqua aerobic exercises (-2.59kg.m^{-2}) and aerobic exercise (-2.05kg.m^{-2}) improve BMI, and it has been suggested that the water exercise provides an alternative of exercising for overweight, injured or ill individuals [10].

Moreover, Piotrowska-Całka (2010), has been conducted a study on "effects of a 24-week deep water aerobic training program on cardiovascular fitness". There were 38 unfit middle age women (30-62 years) participate in the control and training (randomly divided) groups. The findings showed a significant improvement among training group in their aerobic capacity after the training program (pre-test: 10.1±2.2 MET, post-test: 11.1±2.0 MET) and a reduction in resting HR (pre-test: 84.5±14.3 post-test: 75.8±10.0 bpm) [18].

Meanwhile, American College of Sports Medicine (ACSM), in 2013, recommends that an increment energy expenditure using exercise and a reduction of energy intake should be associated with a weight loss program [19, 20]. Aqua aerobic exercise can increase energy expenditure while immersing the body in water and weigh up to 90% less than on land [18] and it is non-weight bearing nature [3]. Furthermore, recently a prospective study estimated the obesity's prevalence at the global level, based on a Socio-demographic index (SDI), has been significantly increased at the age of 20 years and above [21], while it is the age when students are nearly beginning their college or university. According to the study of Afshin et al., (2017), entitled "Health Effects of Overweight and Obesity in 195 Countries over 25 Years" study, in 2015, there was a total of 603.7 million obese adults and 107.7 million obese children, and it has been estimated to increase in future [21]. Therefore, it is more vital valuable for obese students to improve their health and fitness during their young age.

Water-based exercise is adequately common forms of physical activity among the elderly population [6, 22], obese people well- satisfied and motivated with a chest-deep water because they can hide their bodies from the view of others during the exercising [15]. However, it is unclear how to effect the aqua aerobic exercise on change of health risk factors particularly weight loss, BMI, and waist to hip ratio (WHR) and cardiovascular fitness; resting heart rate (RHR), and VO_{2max} among obese students. Therefore, this study aimed to investigate the effect of 12 weeks aqua aerobic exercise; 60 minutes, three sessions a week on weight loss, BMI, WHR, RHR, and VO_{2max} among obese students (with BMI ≥28 kg.m^{-2}).

METHODS

Subjects: In response to the researcher's advertisement, more than 70 obese students from University Pendidikan Sultan Idris (UPSI) volunteered to participate in the study, but 50 healthy obese students (19-27 years) with minimum BMI value of 28 kg.m-^{2} selected for this research. By WHO guidelines for Asian range classification of BMI; BMI≥28 was considered as obesity class 1 [23]. The subjects randomly divided into 2 groups; exercising (n=25 and BMI=33.11±5.32kg.m^{-2}) and control (n=25 and BMI=33.64±3.12kg.m^{-2}) groups. The subjects reported they have not involved in any similar exercise or physical training program. All subjects were recommended to maintain their daily routines during the research and frequently reminded not to change diet or physical activity routines. Before participation, each subject also completed a related health history questionnaire and signed an informed-consent document.

Aqua aerobic exercise program: This 12 weeks aqua aerobic exercise program included warm-up, intervention exercise, and cool-down exercise were performed during 60 minutes and in 3 sessions per week [24, 25]. The exercise in warm-up section consisted of 10 minutes of combination stretching, static walk, Jog in a place, step side to side. Aqua aerobic exercise as the main exercise consisted of 40 minutes of a combination jumping Jacks, high knees, jab punches, snap kicks, back kicks, running laps and rotate jumps. The cool-down exercise included 10 minutes of a combination of stretches, ball game, relaxing and deep breathing. All the training sessions were carried out at UPSI shallow swimming pool (outdoor), which the subjects nearly immersed to the immersed to the xiphoid flow and the cadence of music has been approximately ranged between 120-150 bpm. Control group did not engage in the exercise program. The exercise program took place between February to May 2017, for 12 weeks.

Testing protocol:

All data were collected in two phases; before starting the program (pre-test), and after finishing the exercise program at the 12th week (post-test) in the morning time. Anthropometrical data included the measurement of the weight, height, body mass index (BMI), and waist to hip ratio (WHR) were measured via InBody Scan 370, body composition analyzer [26]. Resting HR was measured with a wireless heart rate monitor (Polar Electro OY, Finland) while the subjects are wearing it. After the subjects rested for five minutes in the sleep position, a minimum of two readings was taken at intervals average of as a minimum of one minute [19]. All of these data measurements have been conducted at the exercise physiology lab in Faculty of Sports Science and Coaching, UPSI.

Predict of VO_{2max} were made via bleep test (20m shuttle run test), which measured the level and number of the shuttle of running [27]. Participants were instructed to run in a straight line, to pivot on completing a shuttle, and to pace themselves by the audio signals. The test ends when the participant stops since of happening the fatigue which shown their cardiovascular fitness capacity and VO_{2max} computed as:

$VO_{2max} = 3.46 \times (Level + No.\ of\ Shuttles / (Level \times 0.4325 + 7.0048)) + 12.2$ [28].

Statistical analysis:

All data were analyzed by using IBM SPSS Statistics (Version 23).The data are presented by comparisons of means at pre and post-test between exercising and control groups. They were performed using descriptive, two-tailed paired sample t-test and independent t-test. A significance level of $p<0.05$, in this study was considered statistically significant.

RESULTS

The collected data of fifty students (BMI >28 kg.m-^{2}) while the average attendance of exercising group was 84 % of aqua aerobic exercising sessions in 12 weeks. The demography for physical characteristics of the subjects particularly in exercising and control groups are described in Table 1.

Table 1: Demography of physical characteristics of the subjects in both groups

group	Gender % (n)	Age (yrs)	Height (cm)	Weight (kg)	BMI (kg.m^{-2})
Exercising (n=25)	Female: 68 (17) Male: 32 (8)	22.6± 1.92 (19-27)	163.48± 8.03 (151.8-178.9)	89.03± 19.05 (63.4-137.3)	33.11±5.32 (28.34-45.28)
Control (n=25)	Female: 60 (15) Male: 40 (10)	21.96± 1.72 (20-26)	163.49± 7.78 (152.40-179.30)	90.41± 14.49 (69.7-128.20)	33.64±3.12 (28.29-40.10)

Value are Mean ±SD and range.

The dependent variables such as weight, BMI, WHR, resting HR, and VO_{2max} for both the exercising and control groups can be seen in Table 2. After analyzing the weight parameters such as weight, BMI, and WHR, it was illustrated significant decreases in the exercising group. These results show a significant weight loss in exercising group (-8.79kg) compared to the control group (-0.97 kg). As regards the changes in BMI and WHR in exercising group compared to control group, BMI, and WHR of the exercising group were significantly decreased ($p<0.001$). Although the control group showed a change in weight loss (-0.97 kg), the changes were not significant in this variable between pre- and post-test.

Considering the changes in cardiovascular fitness variables; resting HR and VO_{2max} of the exercise group was significantly improved ($p<0.001$), compared to the control group. The results showed no significant changes in these variables between pre- and post-test in control group.

(Table 2 and figure 1)

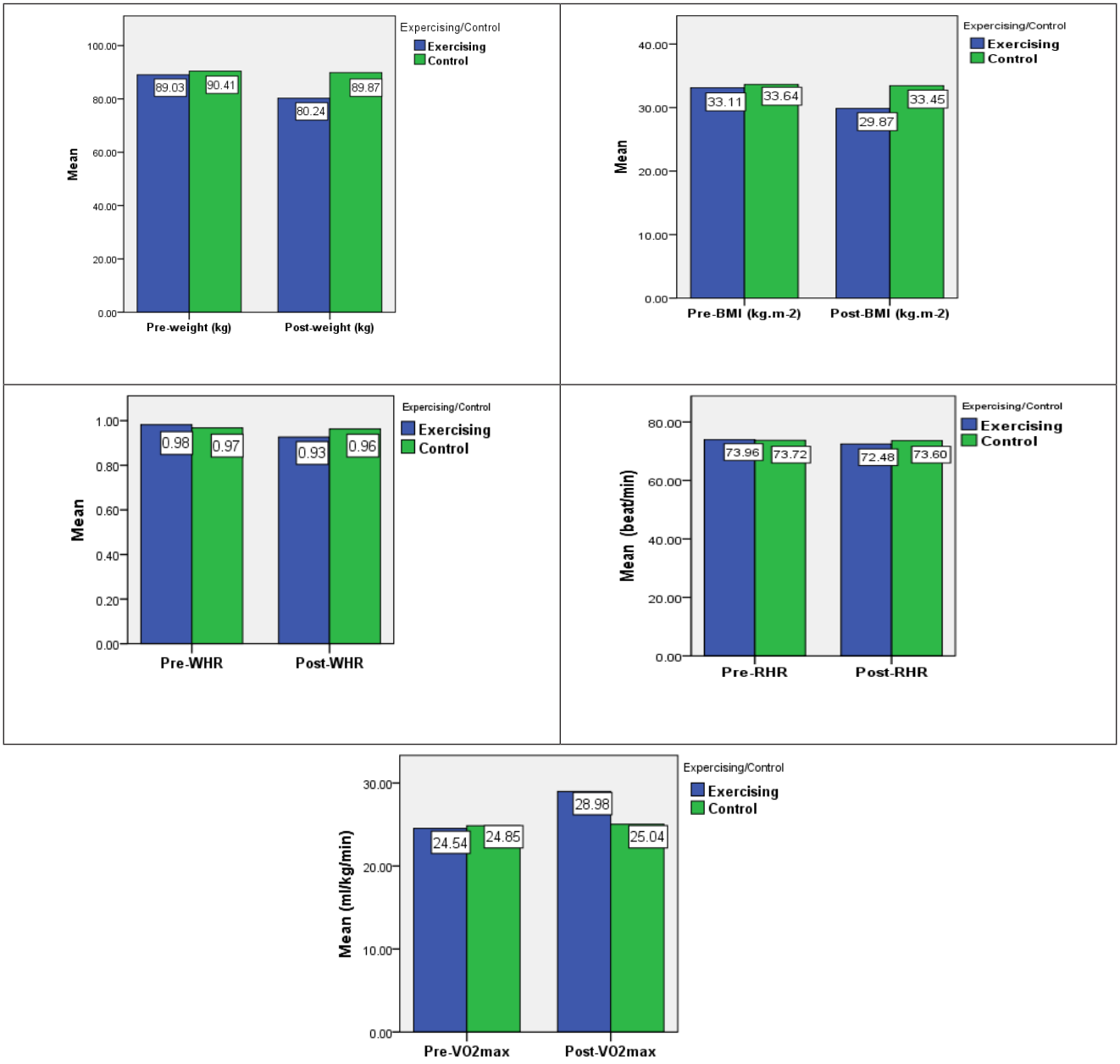
Table 2. Changes in the weight parameters and cardiovascular fitness variables before and after 12 weeks aqua aerobic exercise

variables	group	Pre-test	Post -test	*P*
Weight (kg)	Exercising Control	89.03±19.05 90.41±14.49	80.24±16.22** 89.44±14.09	0.000 0.063
BMI (kg.m^{-2})	Exercising Control	33.11±5.32 33.64±3.12	29.87±4. 59** 33.28±2.80	0.000 0.074
WHR	Exercising Control	0.976±0.063 0.967±0.078	0.935±0.623** 0.962±0.079	0.000 0.143
Resting HR (bmp)	Exercising Control	73.96±3.35 73.88±2.26	72.44±3.15** 73.72±2.15	0.000 0.083
VO_{2max} (ml.kg^{-1}.min^{-1})	Exercising Control	23.48±2.3 24.41±2.31	28.5±3.22** 24.52±2.16	0.000 0.206

Value are Mean±SD, **significant difference, $p<0.001$

Figure 1 also illustrates the comparison of differences between (Mean ± SD) pre and post-test for the variables in both groups.

Figure 1: Comparison of differences between (Mean ± SD) pre and post-test for weight, BMI, WHR, Resting HR, and VO_{2max} in both groups.



DISCUSSION

This study is the first to investigate the effect of aqua aerobic exercise on weight loss parameters (weight, BMI, and WHR) and cardiovascular fitness parameters (resting HR and VO_{2max}) among young obese students. In this study, aqua aerobic exercise conduces to a significant improvement in weight loss and cardiovascular fitness parameters of obese students with BMI>28 $kg.m^{-2}$. Previous recommendations have been extrapolated the effect of aquatic exercise or water-based exercise as an intervention program to reduce or stop the progression of the disease for the therapeutic purpose [1, 5, 7, 15, 29]. Whereas ACSM's guidelines and the new perspective study highly recommended increasing energy expenditure in a weight loss and health program [19, 25], obese persons not only can expend high-level energy in chest-deep water [4, 29] but more motivated since hidden their bodies in water during training [15]. Therefore, this intervention program contributing towards weight loss and enhance cardiovascular fitness to improve the health system among obese students during young ages which resulted in better life quality in future.

In this study, weight loss, BMI and WHR significantly improved as a result of 12 weeks aqua aerobic exercise. The findings are in agreement with previous findings by Rodrigues (2015) from comparing the effect of 8 weeks continuous and intermittent water exercise in weight and body circumferences of women (42.8±7.4 years and BMI 36.1±6.3$kg.m^{-2}$) which reported all of the variables (weight, BMI, and the body circumferences) significantly decrease and no differ in the effect of two water program [29]. Similarly, Kumar and Sundar (2016), found better BMI value improvement (-2.59 $kg.m^{-2}$) in 6 weeks aqua aerobic exercise comparing aerobic exercise in college male students (17-23 years and BMI: 24.5 $kg.m^{-2}$) and suggested as an alternative exercise for overweight, injured or ill individuals [10].

However, even though our results in weight loss, BMI changes and WHR are consistent with these similar findings in body composition, BMI and body circumferences,

there is also some evidence that cannot be associated with our BMI variable result. Contrary findings were revealed by Kantyka et al. (2015), who observed the absence of significant differences for BMI while body composition, free fat mass, lipid profile and blood count has been significantly improved by aqua aerobic in sedentary female (56±20 years and BMI: 27.86±1.74kg.m^{-2}) [5]. Jasiński et al. (2015), reported similar findings that eight weeks water aerobic exercise is not sufficient to significantly change body composition towards a reduction of body fat content in women with BMI 27.3 ±1.54 (kg.m^{-2}) and aged over 50 years [22].

In this sense, observing a non-significant change in the BMI can relate to a main reduce in the fat mass which resulted in the lean mass increases. It has been mainly shown as the muscle mass [17]. Also, even though, "overall adiposity might be protective in old age" [5], it can probably be caused by the period or the aim of the exercise program which effort to increase strength, joint flexibility, and condition particular muscle groups. However, information regarding BMI and WHR changes resulted in different age categorize, is not sufficient and further investigation is required on this topic.

Furthermore, earlier studies about the effectiveness of aquatic exercises on cardiovascular fitness, particularly during this two decades [3, 7, 9, 15, 16, 18] revealed that training in water media could significantly increase cardiorespiratory fitness level. The previous study by Takeshima et al., (2002) revealed that the water-based exercise led to a significant ($P < 0.05$) increase in peak VO_2 (12%) and VO_{2max} at lactate threshold (20%) [15]. Similarly, Piotrowska-Calka (2010), who conducted deep-water training program at 24 weeks and significantly observed an increase (10.99%) of aerobic capacity, a decrease in HR of activity (-5 bmp) and HR recovery (-6.2 bmp) in training group [18]. However, they used in an experimental resulted of aerobic capacity though; their results are consistent with our findings via indirect VO_{2max} is estimating. Our results also are similar to the findings by Kang et al., (2016) which found that a significant improvement in VO_{2max} (2.4 ml.kg^{-1}.min^{-1}) and resting HR (-2.9bmp) during 12 weeks aerobic exercise in middle-aged female patients with metabolic syndrome [14].

Although earlier studies recommended water-based or aquatic exercise as a practical alternative to land-based exercise for individuals with illness problems in middle-aged and older adults, they are consistent with our findings in the resting HR and VO_{2max} subjects who were healthy, young and obese. Overall, because of finding a significant change in the weight, BMI, WHR, resting HR and VO_{2max} of the exercising group (who motivated to reduce their weight) compared to control group, it seems well-controlled studies are needed to control energy intakes and daily activity routines.

CONCLUSION

As a conclusion, these findings create an opportunity to extend the influence of aqua aerobic exercise as a method of training to improve weight loss and cardiovascular fitness for young obese students to decrease or stop the health risk factors in younger age. Therefore, aqua aerobic exercise can be suggested as a notable intervention strategy for weight loss and cardiovascular fitness which are indicators of health issue while obese students are without shame effortlessly expend higher energy during a favorable exercise.

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