

The effect of combined training on health-related physical fitness and high blood pressure in people with obesity

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Abstract

The study aims to examine the effect of combined training for 16 weeks on health-related physical fitness and hypertension in men (50-65) years old with obesity. 14 men participated in the study, which included aerobic exercises, resistance exercises, flexibility exercises, blood pressure measurements and health-related physical fitness tests before and after applying the program. The results showed an improvement in the level of cardio respiratory fitness, with improved strength and muscular endurance, and a decrease in systolic blood pressure (-6.72mm-Hg) and diastolic blood pressure (-7.86 mm-Hg). combined training is the most effective way to improve health-related physical fitness, lower high blood pressure in people with obesity, avoid serious health complications such as angina and stroke, increase insulin sensitivity, and reduce weight.

Keywords: combined training , health-related physical fitness, high blood pressure, obesity

1. Introduction

Overweight and obesity are considered one of the major global epidemics that have spread greatly, as global obesity rates have increased almost three-fold since the 1970s, with more than two billion people currently suffering from overweight and obesity all over the world. Obesity has become a global epidemic that represents a major challenge that hinders Developing human capital, increasing national wealth, and achieving the promotion of shared prosperity. Algeria was not spared from this scourge. According to the World Health Organization's progressive survey for the year 2016-2017, 9.7 million Algerians suffer from obesity, which represents 23% of the general population (Tebaibia, 2022).

Obesity increases the risk of developing diabetes, high blood pressure, heart disease and stroke. These non-communicable diseases cause 73% of all deaths in the world. In 2017, 28.8 million deaths were recorded as a result of the risk factors of high blood pressure and high body mass index (Sanjay, Gayatri Devi, and Jothi Priya 2022). And blood glucose levels, and no communicable diseases are expected to represent 81% of all deaths in the world in 2040 (Cleven et al. 2020).

There is a direct link between obesity and high blood pressure, and it has been reported that obesity is responsible for 60-80% of incident high blood pressure, and individuals with obesity are 3.5 times more likely to develop high blood pressure than individuals of normal weight, and it causes high blood pressure. There are 7.5 million deaths alone annually, and this is due to several factors, including stroke and coronary artery disease (Keating et al. 2020). Accordingly, many specialists have pointed out the necessity and importance of practicing physical activity for all individuals because of its positive results by maintaining It maintains the vitality of the circulatory and respiratory systems to cope with daily physical burdens with the least possible effort, control weight, and increase the body's capabilities, and avoid contracting diseases, especially chronic ones, such as: heart disease, high blood sugar, and circulatory problems, as well as angina, which may be the first sign of high blood pressure. Recently, in practice, there has been a strong positive relationship between practicing physical activities and a decrease in the incidence of heart disease and high blood pressure (Beyranvand et al. 2022), and this has been proven through many research and studies (Basman & Tariq, 2017). Regular physical activity helps improve cardiovascular health, reduces fat within the liver and increases blood flow in the capillaries (Battista et al. 2021a). Groups of overweight and obese adults who participate in physical

exercise programs have benefits in cardiovascular health, lower blood pressure, and improved lipid profile, especially if they participate in high-intensity exercise training (Shaw et al. 2006).

Endurance and dynamic resistance training reduce systolic and diastolic blood pressure while combined training reduces diastolic blood pressure only, and resistance has the ability to reduce systolic blood pressure only, and this is all for the pre-hypertension stage (Cornelissen and Smart 2013).

However, these studies have shown that there is a lack of focus, especially on overweight and obesity, despite the increasing number of people with overweight and obesity on the one hand. On the other hand, studies on groups of high blood pressure with overweight and obesity have shown that interventions with regard to physical activities cannot. Understanding it due to the joint interactions of medicines and food has become a major challenge and a wide gap that requires research and evidence, and therefore the special recommendations here to give a prescription for exercises for this category require studying each case separately and on the basis of consensus of experts and specialists.

Therefore, nowadays several Joint National Committees on the Prevention, Detection, Treatment, and Evaluation of High Blood Pressure recommend the use of non-pharmacological treatments such as increasing the level of physical activity as a first-line approach to treating patients with hypertension (Dengel et al. 1998). Therefore, this study chose joint training as a training recipe for people (50-65) years old. In addition to exploring the effect of combined training on healthy physical fitness and high blood pressure of people with obesity, it is also necessary to establish a standardized process to facilitate the use of this exercise. Promoting and implementing safe and effective training recipes, especially for this group at risk of obesity and complications of high blood pressure.

The main purpose of this study is to examine the effect of combined training on healthy physical fitness and high blood pressure in obese men (50-65) years old, who are at risk of complications of high blood pressure and cardiovascular disease. Exploring the role of improving physical fitness and its implications in reducing high blood pressure levels after a joint training intervention among people with obesity.

2. Material and methods

2.1. Participants

The research sample included 14 people with obesity (BMI \geq 30 Kg/m²) and high blood pressure, men aged between 50 and 65 years. The experimental method was used with a pre- and post-measurement design for one experimental group. All members of the sample committed to performing blood lipid tests. They performed an electrocardiogram, excluded cases whose patients were taking medications that affect the level of arterial blood pressure or the level of blood fats and could not do without them, and those with diabetes and other chronic diseases were also excluded.

Table 01 . Basic information of the subjects included age, BMI, SBP, DBP

	N	Mean \pm SD
Age (Year)	14	55.23 \pm 5.15
BMI (Kg/m ²)	14	33.995 \pm 1.80
SBP (mm-Hg)	14	146.43 \pm 7.80
DBP (mm-Hg)	14	89.43 \pm 5.25

SBP :Systolic blood pressure ; DBP :Diastolic blood pressure ; BMI :Body mass index.

2.2. Experimental design

A 16-week training program was designed in two stages:

1. The first stage aimed to improve cardiorespiratory fitness and flexibility at an intensity (50-65%) of the heart rate reserve, for a period of one month (12 sessions, 04 weeks) by continuing to continue the physical effort, with short rest periods and a shorter performance time. The ability to exert continuous physical effort to cover different distances (800m, 1200m, 1600m) without feeling tired or having difficulty breathing, through normal walking and walking with a steady rhythm.

2. The second phase aimed to improve health-related physical fitness at an intensity of (60-70%) of heart rate reserve for a period of three months, by further improving cardio-respiratoire fitness by reaching certain distances (1600m, 2400m, 2000m, 2800m) with a small increase. In terms of speed, the degree of continuous load reaches above the average intensity of 70%, developing strength and Resistance using Resistance Bands (Lunge with Biceps Curl, Bent-Over Row , Bridge Thrusts, Standing Hip Abductions, Bicycles, Crunch with Lat Pull-Down ...) and Weight training (strengthening the lower muscles Back, front of thigh muscles...). And using light weights for various areas of the body, especially focusing on

areas of fat accumulation in order to reduce the percentage of fat mass and increase muscle mass (arms, waist, hips, thigh and leg). All of this at an intensity of 50 - 70% of the maximum heart rate reserve, and the repetition of one exercise is from 8- 15 repetitions, in two sets, with a rest of 30 to 45 seconds between them, provided that each training unit concludes with flexibility exercises for the upper and lower joints of the body. Table 2 shows this.

Table 02. Aerobic exercises and resistance exercises applied in the training program

	Aerobic Exercise	Resistance Exercise
FREQUENCY	3days / week	3days / week
INTENSITY	Moderate (40-70%)	(40-70%) of 1-RM
TIME	30 – 60 minis/ continuous or intermittent	One set of 8-15 repetitions for each muscle group
TYPE	walking	resistance bands ; Body weight ;

Instructions to be followed before practicing any training session among sample members:

1. Measure blood pressure levels before the start of class and at rest, and consult a doctor if blood pressure exceeds 160/90 mmHg.
2. Emphasize sufficient warm-up and cool-down exercises.
3. Emphasis on breathing normally during aerobic exercises.
4. The ability to perform repetitions to develop strength and muscular endurance by working with Resistance Bands or Weight training comfortably while avoiding heavy loads and isometric exercises.

2.3.Measures

1.6-minute walking test: Its purpose is to evaluate cardiovascular and respiratory endurance. This test requires many means, such as a suitable walking track, a whistle, a decameter, a sufficient number of markers or markers of different colors, a heart rate monitor.

The practitioner's resting heart rate should be measured, and blood pressure levels should be measured. The test is conducted on a 30-meter flat track marked with start and end marks. The practitioner is allowed to sit on a chair if he feels tired, and the pace of walking is according to his functional capabilities, and the distance traveled is recorded (in meters).) and different heart rates per minute (GAUBERT, BERAGUAS, BAURET, & BONNAVENTURE, 2014)

2. Grip strength test: This test is widely used in the fields of physiological and physical tests, as some scientists see it as an indicator of the general body condition, and it is used to measure grip strength using a Hend grip strength device, so that the tester holds the device in the palm of the hand and the grip is made. With the fingers on the handle of the device, and during this, the device handle can be controlled to move closer or closer according to the size of the fist and the length of the fingers of the test person (Sayed, 2003).

3. Sit-up test with knees bent: Muscular endurance is usually measured by the sit-up test with knees bent for a minute, as an indicator of the strength and endurance of the abdominal muscles. This test aims to measure the strength and endurance of the abdominal muscles (Al-Hazza, 2001).

4. The test of bending the torso forward from a sitting position: One of the most important, most common, and easiest tests to measure flexibility is the test of extending the arms from a sitting position using a flexibility box (sit and reach), where the subject bends his torso forward slowly as much as he can, without bending the knees, preferably Having a colleague stabilize the knees, with the arms extended forward and touching the farthest point on the ruler or measuring tape, then reading the result (Mufdi Al-Jabour & Ahmed Qablan, 2012).

5. Blood pressure measurement: We used a blood pressure measuring device (OMRON) to measure systolic blood pressure (SYS) and diastolic blood pressure (DIA).
 statistical analysis:

Statistical analyzes were performed using the statistical program SPSS V26, and the data were presented and arithmetic means and standard deviations were calculated.

The Shapiro-Wilk test was used to show the moderation of the distribution for the various tests conducted on the sample before conducting the program to determine the moderation of the distribution among all sample members. It became clear that the Shapiro-Wilk value for the pre-measurement and its

significant value (Sig) were all greater than ($>.05$) and this indicates that the sample members follow a normal distribution and are therefore heading towards parametric tests.

Student's t-test was used between two related samples to show the differences between the means of the pre- and post-tests. The level of statistical significance was set at (0.05) and the confidence intervals were set at 95%.

3.Results

It is clear from Table 3 of the analysis of the differences between the pre- and post-tests regarding health-related physical fitness that there are statistically significant differences after 16 weeks of the training program in favor of the post-tests, which indicates the role of physical activities in improving cardiorespiratory fitness through the 6-minute test and grip strength. , muscular endurance and flexibility $p < .05$

Table 03. Changes in physical fitness before and after implementation of a combined health-related fitness training programme

Tests	N	Pre-test	Post-test	t value	pvalue
6 Minute walk(m)	14	609.25 ± 12.42	716.25± 14.93	13.72*	0
Grip Strength(kilogram)	14	41.65 ± 12.67	52.50 ± 6.96	3.905*	0.008
sit-up test(Crunches) (times)	14	21.59 ± 6.83	30.91 ± 6.02	4.47*	0.004
Sitting forward bend(cm)	14	-9.01 ± 5.29	-7.67 ± 0.43	4.503*	0.004

*Significant difference between before and after training programme intervention ; $p < .05$

It is clear from Table 04 for the blood pressure test that there are statistically significant differences between the pre- and post-tests among sample members at the 95% confidence level for both systolic blood pressure (SBP) and diastolic blood pressure (DBP) $p < .05$

Table 04. Changes in hypertension before and after the application of a combined training program on blood pressure levels

Tests	N	Pre-test	Post-test	t value	pvalue
SBP (mm-Hg)	14	146.43 ± 7.80	139.71 ± 10.18	6.068*	0.005
DBP(mm-Hg)	14	89.43 ± 5.25	81.57 ± 6.80	3.409*	0.001

SBP :Systolic blood pressure ; DBP :Diastolic blood pressure; $p < .05$

4.Discussion

The aim of this study was to examine the effect of combined training in improving health-related physical fitness and reducing high blood pressure levels in people with obesity, during a 16-week training program on aerobic activities, strength exercises, muscular endurance, and flexibility.

After 16 weeks, the maximum oxygen absorption increased significantly among the total sample, VMA = 6.82 km/h. This means that the loss of calories in the body has increased increasingly due to the increase in the distances traveled, starting from 800 meters, passing through 1200 meters, then 1600 meters. m... up to 3200 m, with an increase in intensity from 50 to 70% of the heart rate reserve, based on walking, and this led to an increase in oxygen flow and ventilation of the lungs, and this progression in physical load was reflected positively in an increase in the level of maximum oxygen consumption (Vo2max). It brings about positive changes in the functional efficiency of the heart, so that the heart rate decreases due to the enlargement of the heart cavity, which leads to absorbing the largest amount of oxygen for the purpose of producing energy with fewer heart beats This is consistent with the study (Williams and Thompson), which showed that Equivalent energy expenditures by moderate (walking) and vigorous (running) exercise produced similar risk reductions for hypertension, hypercholesterolemia, diabetes, and Coronary heart disease(Williams and Thompson 2013) . The strength of the cardiac muscle fibers also increases, which leads to an increase in the force of heart contraction and thus expelling the largest amount of blood. Blood flows to the arteries, and the circulatory and respiratory systems, especially the lungs, have the ability to work comfortably and adapt to the effort exerted. Here, a study (Mohamed El Amine) indicated that aerobic and resistance exercises in those who are overweight lead to improved cardiovascular performance(Mohamed El Amine et al. 2023). Returning to the proposed program, we find that we relied in the research on combined training that combines aerobic exercise and resistance exercises, all at the rate of three sessions per week with moderate to above-average intensity, taking into account individual differences and age. All of this gave significant reductions in blood

pressure levels in individuals. The sample improves many biochemical variables and physiological and physical indicators. All of this is physiologically linked to regular physical activity, which leads to an increase in blood flow that returns to cardiac output and a decrease in peripheral vascular resistance. This leads to an increase in the burden on the heart and blood vessels, so the heart rate increases and the efficiency of the capillaries increases. In the exchange of gases with the ability of blood vessels to get rid of harmful cholesterol stuck in them, and triglyceride levels decrease, this leads to avoiding the occurrence of atherosclerosis and high blood pressure. We conclude that practicing physical activity on a regular basis leads to improving cardiorespiratory fitness and increases insulin sensitivity and raises blood pressure. Cardiovascular efficiency and low fat, but all of this is coupled with the intensity, duration of effort, and intensity, because the intensity for people with high blood pressure should be from medium to above average, that is, from 40 to 70% of the heart rate reserve in all exercises, and this is consistent with the results. Several studies such as (Cleven et al. 2020; Dengel et al. 1998; Mertens and van Gaal 2000). This is confirmed by a recent study that training for 12 weeks, at a rate of 3 times a week and for 90 minutes in each session, through exercises (flexibility + strength + aerobic exercises) is sufficient to improve cardiorespiratory fitness and the strength of the upper and lower body muscles (Olivares et al. 2011). Similar to the findings of many previous studies, which indicated the importance of physical activity for people who suffer from overweight and obesity, especially aerobic training, which benefits heart health, metabolism, and reducing fat within the liver, so individual exercises must be prescribed on a large scale in the country. Management of people with obesity (Battista et al. 2021b). Some overweight and obese people can also improve blood pressure and arterial stiffness by participating in regular exercise, which reduces the risk of cardiovascular disease (Suleen S. Ho et al. 2012). Aerobic exercise is considered an effective and helpful treatment to reduce systolic blood pressure in patients with high blood pressure (Saco-Ledo et al. n.d.)

The varying improvement in grip strength among members of the research sample is due to the proposed physical activity program that aims to develop musculoskeletal fitness in general, by using rubber ropes and body weight in particular to maintain soft muscles and joints, and to move more easily. This is what required us to work on improving the strength of the large muscles, especially the upper and lower extremities, and the abdominal and back muscles in general, such as extending and developing the triceps muscle, developing the chest muscle, extending and strengthening the arms, extending and strengthening the back muscles of the arms.

It seems that muscular strength affected the levels of muscular endurance according to each individual. Looking at the results of muscular strength, we notice that this group achieved the highest percentage of improvement in muscular endurance levels by 43.17%. This compatibility between strength and muscular endurance is confirmed by Ibrahim Ahmed Salama that muscular endurance It depends largely on muscle strength, as a weak muscle cannot repeat the work for long periods.

This is what several studies have found, which indicated that a 12-week training program consisting of moderate-intensity resistance exercises for 30 minutes, 5 days a week, led to a reduction in cardiovascular risks in participants suffering from obesity (Suleen S Ho et al. 2012). Improving physical fitness through MICT or HIIT improves overall cardiovascular function in those with obesity (Fisher et al. 2015). Obese adults are more responsive than adults to the effects of HIIT on improving insulin sensitivity, blood pressure, and body composition (Campbell et al. 2019). and one study confirmed that many previous studies have shown that the increase in maximum oxygen consumption (Vo_{2max}) as a result of practicing activities Physical exercise and the positive effect of aerobic and resistance exercises on blood pressure levels (Marcos-Pardo et al. 2020). One study confirms that combined training (aerobic and resistance exercises) has benefits, as each also contributes specifically to the benefits of the body. Aerobic training stimulates aerobic and power changes, improves fat profiles and increases insulin sensitivity. It also increases growth hormone and adiponectin levels, which play a role in reducing abdominal fat and circulating free fatty acids in obese adults. Resistance training has the ability to change the metabolic properties of skeletal muscle. It results in an increase in body mass in overweight and obese people (O'Donoghue et al. 2021)

As a result of the training program, a decrease in blood pressure was recorded by -6.72 and -7.86 mmHg for systolic and diastolic blood pressure, respectively, with a reduction in net weight (-3.08 kg) and a significant improvement in the decrease in the percentage of lipids. This decrease in the level of blood pressure Blood pressure in general is higher than the reductions reported by (Abdelaal and Mohamad) in his study Obesity Indicators and Hemodynamic Response to Exercise for Hypertensive and

Diabetic Patients Suffering from Obesity, which were -4.79 and -6.02 mmHg for systolic and diastolic blood pressure, respectively. He noted that aerobic exercise is considered the best intervention to lower blood pressure (Abdelaal and Mohamad 2015). The results were similar to the reductions of 9 and 5 mmHg in systolic and diastolic blood pressure, respectively, reported by Scapini et al. in a systematic review and meta-analysis that included 31 studies and 1,254 participants and used aerobic training and resistance training and concluded that combined training is the way to go. Most effective for increasing aerobic capacity and controlling blood pressure in adults with high blood pressure (Scapini et al. 2019). While the reductions reported by (Keating et al) were 5.64 and 4.8 mmHg for systolic and diastolic blood pressure, respectively, for High-intensity interval training (HIIT) and -3.7 and -2.41 mmHg for systolic and diastolic blood pressure, respectively, for moderate-intensity continuous training (MICT) are less than the reductions we indicated in the research. The results of this study showed that high-intensity interval training (HIIT) was superior to moderate-intensity continuous training (MICT) in reducing nocturnal diastolic blood pressure (DBP), and a significant reduction in daytime systolic blood pressure was observed for the moderate-intensity continuous training (MICT) group compared to the high-intensity interval training (HIIT) group (Keating et al. 2020).

5. Conclusions

The results of the current study, which relied on combined training (aerobic exercises and Resistance) at a rate of three times a week at moderate intensity and on a regular basis, showed that there is an improvement in the levels of cardio-respiratory fitness and weight loss, with an improvement in muscle mass and a reduction in fat stores as a result of strength and Resistance exercises, and this brought about positive functional changes in the level of blood pressure, the cardiac system, and blood fats, while increasing insulin sensitivity. All of this is considered an effective treatment in maintaining cardiovascular health for people with obesity.

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