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Investigation of Cardiovascular Responses to Aerobic Exercise in Obese University Students

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Abstract

Background: Obesity and overweight have been studied for many years. Especially in recent years, studies on the subject have gained momentum with the increase in obesity prevalence. Regular physical activity is extremely important for the prevention of overweight and obesity. The most effective and easily sustained exercises according to health risks are aerobic ones. Effective intensity, duration and frequency characteristics for physical activity in obese individuals are controversial. This study was conducted to investigate cardiovascular responses to aerobic exercise at moderate intensity in obese university students.
Methods: A total of 26 obese university students (aged 18-24 years) voluntarily participated in the study. Two participants who did not meet the study criteria were excluded from the study. A total of 24 participants (12 males, 12 females) who met these criteria were administered a moderate aerobic exercise programme for a total of 6 weeks, 3 training sessions per week. Then, body weight, height, body mass index, body fat percentage, waist-hip circumference, waist-hip ratio, systolic blood pressure and diastolic blood pressure values were taken.
Results: It was determined that there was a statistically significant difference in the waist and hip circumferences of the participants ($p<0.05$). However, it was determined that there was no significant development in body weight, BMI, BMI, systolic and diastolic blood pressure and waist-hip ratio values ($p>0.05$).
Conclusion: Aerobic exercises performed at all three exercise intensities had a significant effect on the measured parameters of obese university students. It is recommended that future studies should apply the exercise protocols used in our study on large populations and different age groups.

Keywords: Aerobic Exercise; Obesity; Obese Individual; Student; Young Adult

Abbreviations

WHO: World Health Organisation; BMI: Body Mass Index; WHR: Waist-Hip Ratio; ACSM: The American College of Sports Medicine.

Introduction

Obesity is explained as a condition in which the body fat mass of an individual increases in case the balance between the energy taken into the body and the energy

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expended is disturbed [1,2]. The most important in the treatment of obesity are aerobic isotonic exercises. Here, it is recommended to perform aerobic exercises for at least 30-60 minutes a day. These aerobic exercises, done 5-7 days a week, help both in losing weight and preventing the regained excess weight. After sufficient weight loss is achieved with aerobic isotonic exercises, isometric exercises that increase resistance can be gradually added to both prevent the weakening of muscle mass and support the maintenance of the current weight loss. Aerobic isometric exercises are especially more beneficial for patients with diabetes. Because the glucose consumption of the increased muscle mass from these exercises is naturally enhanced.

According to WHO, the prevalence of obesity in the world is increasing day by day. The number of obese individuals has almost tripled since 1975. In 2016, 1.9 billion people aged 18 years and over were overweight and 650 million of them were considered obese. Accordingly, 39 per cent of the adult population worldwide was overweight and 13 per cent was classified as obese in 2016. The proportion of overweight and obese individuals has increased sharply in recent years and has become a leading public health problem [3]. The obesity epidemic can largely be explained by a failure to restrict energy intake and/or very low levels of energy expenditure. While the relative importance of these factors is still debated, there is a general consensus that a sedentary lifestyle is one of the most prominent risk factors for an increase in body mass index (BMI) [4].

Cardiovascular diseases, diabetes, musculoskeletal system disorders and different types of cancer are seen in overweight individuals and this situation causes obese individuals to experience serious health problems in later ages [2,4-8].

There are many different methods to measure overweight and obesity. In addition to the anthropometric method based on BMI classification, which is the most widely used method, two different approaches are used to assess overweight and obesity. Indirect measures of BMI include waist circumference, waist-to-hip ratio or percentage body fat based on skinfold thickness [9]. The World Health Organisation (WHO) assesses obesity not only by BMI but also by Waist-Hip Ratio (WHR). According to WHO, if the BMI of women is more than 0.85 and that of men is more than 1.0, these individuals are considered overweight (obese) [10]. Individuals with a Body Mass Index (BMI) value between 25-29.9 are defined as overweight and those with a BMI value of 30 or above are defined as obese. In addition, overweight BMI value between 27 and 29.9 is accepted [11].

Exercise is known to be an important component in the fight against overweight and obesity. The positive effects of exercise on physical and mental health have been shown in numerous studies and reviews [12]. However, according to WHO data in 2016, 28% of adults (> 18 years) worldwide were found to be insufficiently physically active. This means that these adults are physically active for less than 150 minutes at moderate intensity or less than 75 minutes at high intensity per week [13]. Chromosomal and genetic handicaps are hereditary factors that affect motor development in the prenatal period.

The American College of Sports Medicine (ACSM) recommends that adults aged 18-65 years should perform aerobic exercise of moderate intensity (30 minutes/day and 5 days a week) and/or vigorous intensity (20 minutes/day and 3 days a week) to lead a healthy life [5]. The data of recent studies in the literature report that this period can be applied up to 90 minutes, provided that the frequency is less [14]. For individuals who are new to exercise, 15-20 minutes of exercise on certain days of the week will improve their adaptation to exercise. There is a non-linear relationship between the duration and frequency of aerobic exercise. If a moderate intensity exercise is planned, 30 minutes and 5 days a week, if a high intensity exercise is planned, 20 minutes and 3 days a week. In the beginning, it is aimed to reach 150 minutes per week, while in the long term, 300 minutes of exercise per week should be targeted [5].

Exercise should be started at low intensity and the training load should be increased gradually according to the development of the individual [8]. The exercises to be performed by obese individuals should be planned as exercises that consume 100-250 kcal per day and a total of 1000 kcal per week. The ideal weight loss in obese individuals should be between 2-4 kg per month, mainly from fat. It is very important not to regain the lost weight. For this, a planning should be made at the rate of 10% of the body weight of the individual and 0.5 kg-1.0 kg per week [15]. This study was conducted to investigate the cardiovascular responses to moderate intensity aerobic exercise in obese university students. Obesity and overweight have been studied for many years. Especially in recent years, studies on the subject have gained momentum with the increase in obesity prevalence. Regular physical activity is extremely important for the prevention of overweight and obesity. The most effective and easily sustained exercises according to health risks are aerobic ones. Effective intensity, duration and frequency characteristics for physical activity in obese individuals are controversial. This study was conducted to investigate cardiovascular responses to aerobic exercise at moderate intensity in obese university students [16].

Materials and Methods

In the evaluation of obesity, many methods such as BMI, body circumference measurements, and ideal body

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weight according to height are utilized. Obesity is most commonly determined in practice according to BMI. (Tablo 1). BMI= Weight (kg) / Height^2 (m^2) Body circumference measurements are also frequently used in the assessment of obesity. In the assessment, the waist-to-hip ratio is used as a criterion. This value is 0.8 for women and 1 for men. Those who exceed these measurements are considered obese [17].

Body Mass Index (BMI) (kg/m2)		
	Lower Limit	Upper Limit
Normal	**20**	**24.5**
Slight Overweight	**25**	**29.5**
Obesity	**30**	**50**
Morbid Obesity	**50+**	

Table 1: Classification of Obesity According to Body Mass Index.

The lower limit of a normal individual's BMI is 19-20 kg/m^2, and the upper limit is 24-25 kg/m^2. A BMI between 25-29.5 kg/m^2 is considered mild overweight, 30-50 kg/m^2 is classified as obesity, and exceeding 50 kg/m^2 is regarded as morbid obesity (Table 1).

Participants

This study was planned as a 6-week study. A total of 24 obese university students (aged 18-24 years) voluntarily participated in the study.

Two participants who did not meet the study criteria were excluded from the study. A total of 24 participants (12 males, 12 females) who met the inclusion criteria were administered a moderate intensity aerobic exercise programme 3 days a week (Tuesday-Thursday-Saturday) for 6 weeks.

Body weight (kg), height (cm), body mass index (kg/m2), body fat percentage (%), waist-hip circumference (cm), waist-hip ratio (cm), systolic blood pressure (mmHg) and diastolic blood pressure (mmHg) values were taken as pre-test and post-test.

Body weight (kg); height (cm) were measured and body mass index (BMI) was calculated. BMI≤18.5 kg/m^2 was recorded as underweight, BMI 18.6-24.9 kg/m^2 as normal, BMI 25.0- 29.9 kg/m^2 as overweight, and BMI≥30.0 kg/m^2 as obese.

Body fat ratio, bioelectrical impedance analyser (Tanita BC 601 Innerscan Body Analyser) and blood pressure measurements were performed with a blood pressure device (Carino Brand Blood Pressure Tester).

Exercise Protocol

The exercise protocol was established according to the protocol recommended for the 18-65 healthy age group in the ACSM guideline [5]. Before the exercise protocols of our study, a warm-up protocol was applied with 3 minutes of walking at a speed of 3 km per hour and at the end of the tests, a cool-down exercise with the same workload was performed again for recovery.

The exercise programmes (Table 2), which gradually increased in intensity (50-60% HR max) and continued for 6 weeks, were performed on treadmills (Technogym Brand Treadmills) in the Pamukkale University Sports Sciences Research and Application Centre Fitness Hall.

Week/ Parameters	1-2 weeks	3-4 weeks	5-6 weeks
Training duration	40 min	45 min	50 min
Loading intensity	5 km/h	5 km/h	5 km/h
Training frequency	3 training sessions per week	3 training sessions per week	3 training sessions per week

Table 2: Load parameters of the applied exercise programme.

Statistical Analysis

SPSS package programme was used to analyse the data. Mean, standard deviation, minimum and maximum values of the data were calculated. Parametric conditions were evaluated by Shapiro-Wilk test. It was determined that the participants showed normal distribution; t test in dependent groups was used to determine the effect of training methods on the groups. All analyses were performed at 0.05 significance level.

Results

The descriptive characteristics of the participants in the study and the findings of the measured parameters are shown in Table 2. A total of 24 obese university students, 12 males and 12 females, whose informed written consent was obtained, participated in the study.

The ages of the participants ranged between 18 and 24 years, the mean age was 20.22±1.24 years, the mean height was 172±4.36 cm, the mean body weight was 92.20±6.28 kg, and the mean body mass index was 30.20±2.86 kg/m2.

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Parameters	Pre-test X±Ss	Post-test X±Ss	t	p
Age (years)	20,22±1,24	20,22±1,24	-	-
Height (cm)	172±4,36	173±2,84	-	-
Body weight (kg)	91,20±6,28	88,38±3,96	3,66	0,38
BMI (kg/m2)	30,20±2,86	29,14±4,22	4,84	0,24
Body fat percentage (%)	31,14 ±2,58	30,35 ±2,24	6,25	0,56
Systolic blood pressure (mmHg)	116,55±4,68	115,22±8,14	5,42	0,48
Diastolic blood pressure (mmHg)	76,52±5,24	75,66±7,54	8,22	0,52
Waist circumference (cm)	102,39 ±10,48	93,55±5,20	2,28	0,04*
Hip circumference (cm)	10,24 ±6,84	101,36 ±3.44	3,54	0,03*
Waist-to-hip ratio	0.91 ±0.22	0.89 ±0.04	6,64	0,28

Table 3: Participants' pre-test and post-test values t-test table.

When the pre-test and post-test values of the participants were compared, it was determined that there was a statistically significant difference in waist and hip circumferences ($p<0.05$). In addition, it was determined that there was no significant improvement in body weight, BMI, BMI, systolic and diastolic blood pressure and waist-hip ratio values ($p>0.05$) (Table 3).

Discussion

The findings of the present study revealed that a moderate aerobic exercise Programme applied to obese individuals for 6 weeks had a statistically significant difference in the waist and hip circumferences of the participants ($p<0.05$).

Research findings on the subject show that long-term regular aerobic exercise can effectively improve body composition and reduce cardiovascular risk factors for obese people. Long-term exercise is recognized as an important factor in weight loss. The appropriate amount of exercise to improve long-term weight loss is still a matter of debate [16]. Moreover, it is equally important to have a proper diet and maintain energy intake. Long-term weight loss is more effective when combined with exercise interventions [7].

Aerobic and resistance exercises for 70-80 minutes 3 days a week for 12 weeks had a positive effect on body weight, body mass index, waist and hip circumference, maximal VO2, fat percentage, hand grip strength, back and leg strength among health-related physical fitness parameters in obese and overweight individuals [18].

During a 12-month intervention, moderate to high intensity exercise combined with a reduction in energy expenditure can contribute to an 8-10% reduction in body weight [19]. Determining the level of exercise intensity and performing at least 150 minutes of moderate intensity exercise per week is important until the person's strength goes beyond the prescribed amount of exercise, i.e. 60 minutes per day [20-22]. Adequate levels of physical activity are always needed to maintain body weight. Minimum activity levels include walking between 6 and 9 km during the week, which reduces the amount of central fat and total body fat. Activity amounts can be stabilized without a change in diet and more exercise can enable congenitally obese people to lose weight [4,21,23].

It was determined that triglyceride level decreased significantly in obese individuals with weight loss after exercise, but triglyceride level did not decrease significantly in individuals with little weight loss after exercise [8,24]. Most of the relevant literature study findings reveal that exercise can reduce total cholesterol levels in the body [4,8]. Some studies in the literature have shown that moderate intensity aerobic exercise can significantly reduce total cholesterol, apolipoprotein B and low-density serum cholesterol content [18,20,22]. In addition, an epidemiological study on the subject reported that plasma total cholesterol levels of athletes performing endurance training were lower than normal people performing physical exercise [25].

Some study findings in the literature have shown that strenuous exercise can increase blood pressure and cause an increase in the tension of the arterial wall during exercise [26]. Long-term training may lead to a decrease in the thickness of the arterial wall. Therefore, it can be seen that different forms of physical exercise can regulate the difference between atherosclerotic pro genes and anti-atherosclerotic genes [27]. In addition, some study findings suggest that a short-term increase in circulating pressure may lead to anti-atherosclerotic changes in the arterial wall [19]. This is only a current hypothesis and future studies should further clarify the stimulatory effect of specific blood pressure patterns on arterial wall changes.

Conclusion

The research findings of this article reveal that moderate aerobic exercise provides significant improvements in some parameters of cardiovascular responses of obese university students. It was determined that aerobic exercise interventions provided a decrease in body weight and improvements in BMI values of university students, and caused significant changes in waist and hip circumference

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values. In addition, aerobic exercise can regulate university students' blood fat and blood sugar, which not only improves their body shape, but also may contribute to reducing the impact of complications caused by obesity. Therefore, the first condition for healthy living is regular exercise. It is also very important to avoid stress and to support the exercise programme with a diet programme. In conclusion, university academics should raise awareness of the importance and benefits of aerobic exercise among university students in order to improve their body shape, regulate body functions and become healthier individuals.

Suggestions

Obesity, which has reached global dimensions today, has important consequences for both the individual and society in terms of health care costs. Defining the mechanisms by which obesity mediates systemic disorders may provide great advantages in developing appropriate treatment strategies and determining public health policies. The fact that many individuals cannot comply with even the 'minimum physical activity' recommendations and that one of the most common barriers is 'lack of time' has led to the need to develop more time-efficient exercise programmes. For this reason, 'authenticity principle' and "time efficient" exercise programmes can be developed.

In addition, necessary arrangements can be made in the lifestyle of individuals, especially in nutrition and physical activity, not only when obesity is seen but also before obesity is seen. Control of sportive and vital areas that will enable obese individuals and society to lead a healthy life and improve their quality of life state institutions, local administrations, non-governmental organisations, etc. infrastructure arrangements can be implemented. First of all, low-impact aerobic exercises are an ideal starting point for obese individuals. Activities such as brisk walking, swimming, water aerobics, and cycling support calorie burning without putting too much strain on the joints.

Swimming is especially an excellent exercise option for individuals with joint problems because the buoyancy of the water supports body weight, making movement easier. Engaging in at least 150 minutes of moderate-intensity aerobic exercise per week is recommended by health authorities. Resistance training is important for maintaining muscle mass and boosting metabolism. Weight lifting, using resistance bands, or exercises done with body weight increase muscle mass, allowing the body to burn more calories. For beginners, starting with light weights and gradually increasing the weight reduces the risk of injury and ensures the sustainability of the exercise program. Doing resistance training two or three days a week helps obese individuals lose weight without experiencing muscle loss. Flexibility and balance exercises are also an important component for obese individuals. Exercises like yoga and Pilates increase the body's flexibility, improve mobility, and reduce the risk of injury. Additionally, these types of exercises can also be effective in reducing stress, which positively contributes to weight management. Balance exercises make daily activities safer by reducing the risk of falls [28].

The importance of public service announcements among the health communication tools used to help individuals acquire healthy habits and for these habits to spread throughout society is significant. Public service announcements are utilized in many areas, from preventing harmful habits such as obesity, smoking, alcohol, and drug use, which are major health issues both in our country and worldwide, to preventing the spread of infectious diseases. To prevent obesity, planned and programmed exercises and education are needed.

Conflict of Interest: The authors declare that they have no known competing financial interests or personal relationships that could influence the work reported in this article.

Ethics Committee Report and Institutional Permission: Pamukkale University permission was obtained for the research. This study was prepared in accordance with Research and Publication Ethics.

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Informed Consent Statement: All the subjects who were took part in the study provided informed consent.

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