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# An investigatıon of the effect of aerobic and aerobic-submaximal exercises on body mass index in adolescents at the risk of obesity

**Faruk Akçınar* and Bilge Eroğlu**

Inonu University Faculty of Sport Sciences, Turkey.

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**ABSTRACT**

The aim of the study is to examine the effect of aerobic and aerobic-submaximal exercise on adolescents who are at risk of obesity. This research is an experimental study in the screening model. The sample group consists of volunteer 72 students but it continued with the 45 healthy volunteer students. The exercise groups were organized according to the same level age (12 years) by basing on resting pulse. The study was divided into three groups consisting 15 (8 girls, 7 boys), as control, aerobic exercise and aerobic-submaximal exercise. Data of the study were uploaded to the SPSS program and statistical procedures were measured by the Independed Sample T test, the Paired Sample T test and the Anova test. The level of significance was adopted as $\alpha = 0.05$. In our study, there was no significant difference in height, body mass index (BMI), waist circumference, waist circumference, waist hip ratio, body fat percentage (BFP), body fat mass (BFM), body muscle mass (BMM) variance in control group ($p < 0.05$). While there was no significant difference in height variable in the group performing aerobic exercise, there was a significant difference in BMI, waist circumference, hip circumference, BFP, BFM, BMM variance ($p < 0.05$). While there was no significant difference in height variable in the group performing aerobic-submaximal running exercise, there was a similar difference in BMI, waist circumference, hip circumference, BFP, BFM, BMM ($p < 0.05$). In our study, between all girls and boys in all groups, men's waist circumference ($p < 0.05$), hip circumference ($p < 0.10$), BFP ($p < 0.05$) and BFM ($p < 0.05$) values were found more significant than women's. In this study, while there was no significant difference in height, weight, waist hip ratio in aerobic exercise and aerobic submaximal exercise method and significant difference ($p < 0.05$) was found in waist circumference, hip circumference, BMI, BFP, BFM, BMM. The hip circumference of the group applied the aerobic exercise method had a significant effect on the BFP variables compared to the aerobic-submaximal exercise group.

**Keywords:** Obesity, aerobic exercise, submaximal exercise, adolescent.

*Corresponding author. Email: farukakcinar44@gmail.com.

## INTRODUCTİON

Obesity is no longer a physical disorder or a cosmetic problem, it has become an increasingly chronic health problem. The World Health Organization (WHO) first published obesity in the world health report in 1997 and adversely affected health, defined as body fat accumulation above normal (WHO, 2013). Inadequate physical activity caused by the supply of electronic tools that facilitate our lives caused by technology, the malnutrition habits of families and the fast-food nutrition style that serves to the people trying to catch up with time, and genetic factors, diseases and many other causes have caused the prevalence of obesity.

Due to the increase in the number and volume of fat cells in infancy and adolescence, which are critical periods in the development of obesity, which is mainly due to malnutrition and inadequate physical activity, it is necessary to give the necessary importance to balanced and regular nutrition and the physical activities required in certain programs. In addition to healthy nutrition and physical activity in obesity, age, gender, hormonal

factors, diet, environmental factors, family, economic status, psychological factors and wrong diet programs cause obesity.

Adolescence is the period of biological and psychological end of childhood and the beginning of responsibilities and young adulthood. World Health Organization (WHO) defined the term 'adolescent' the period between 10-19 years of age (http://www.who.int/maternal_child_adolescent/topics/en/20016). In this critical period, where various psychological problems were also overcome, although the external appearance of the individual is important, it should be remembered that health is the main importance.

The risk of obesity can be measured by indirect and direct methods. Body Mass Index (BMI) is the most frequently used method used by the World Health Organization to determine obesity. BMI is calculated by dividing a person's body weight in kilograms (kg) by the length (square meters) in meters (m) (BMI = $kg/m^2$) (WHO, 2012; Serter, 2003).

There is no standard used for the detection of obesity in children and adolescents as the physical development is continuing (Yosmaoglu et al., 2010). For this, percentile (percentage ) and Z score values are examined. BMI in children less than 5 percentile output 'Very Poor', 5-15. Percentile 'Weak', 5-85. Percentile 'Healthy Body', 85 - 95. Percentile 'Light Weight', 95 and above 'Obese', 99. If it is above percentile that is (Morbid Obese) (Zorba et al., 2011). The Z score indicates how close a physical measurement is in terms of standard deviation (SD) from the mean of the reference population. Z score ranges from +2 SD to -2 SD (WHO, 1995).

Physical activity, which is defined as all bodily movements resulting in all kinds of energy expenditure by using skeletal muscles in daily life, has a great effect on obesity in adolescence. The best exercise is the one which done regularly, planned and scheduled. The best physical activity in childhood and adolescence is to play a game. A minimum of 60 minutes per day, at least 3 times a week, to ensure the oxygen cycle, to regulate metabolic processes, to improve strength and endurance, to reduce body fat, muscle-joint flexibility and physical, mental and social health should be implemented by the development of physical activity (Karacabey, 2009). Regular exercise is not only effective on muscles, joints, body complexes, it can discipline the person to cope with stress and to provide a regular life in psychological terms.

Determining the type of exercise in adolescents is as important as doing the exercise. The physical capacity of the individual should be well known and unnecessary stress must be avoided. In other words, in order to determine the exercise methods, the intensity, duration, rest interval, number of repetitions of the training should be arranged according to the person and appropriate exercise methods should be selected.

Exercise types are generally divided into aerobic and anaerobic. Aerobic exercise is the continuous activity of large muscle groups in the presence of oxygen (Yildiz, 2012). Aerobic exercises are effective on systems such as circulatory system, skeletal muscle system and body weight. Exercises such as walking, jogging, running, swimming, cycling, skiing are examples of aerobic exercises.

Submaximal exercises are exercises that are below the maximal intensity. It is used to determine the relationship between heart rate response and oxygen consumption rate and predict maximal oxygen consumption ($VO_2$ max) during an exercise with increasing intensity. Submaximal tests are bicycle ergometry tests, treadmill tests, step tests and field tests (Koz, 2017). People with obesity problems and the possibility of resting pulse may be partially higher than normal. Moreover, it is appropriate to choose submaximal exercise rather than performing maximal exercises because the pulse will increase more than normal for obese individuals during any physical activity.

This study examines the effect of aerobic exercise and aerobic-submaximal exercise on body mass index in adolescents at risk of obesity.

## MATERİALS AND METHODS

### Research model

This study is an experimental study in screening model.

### Participants

The sample group consisted of 72 volunteer students from 91.000 Giant Student Secondary School with the written approval of the Provincial Directorate of National Education. Adolescents with health problems are exempted from the study. The study continued with 45 healthy volunteers in the same age group (12 ages). The rest of these students had a resting pulse and students with a resting pulse over 100 were not included in the study. The study consisted of 1 control group and 2 exercise groups.

**Control group:** The control group consisted of 8 female and 7 male students.
**Aerobic exercise group:** It consisted of 8 female and 15 male students.
**Aerobics - submaximal exercise group:** It consisted of 8 female and 15 male students.

### Data collection tool

BMI, Weight, VYY, VYO, VKK measurement, waist circumference measurement, hip circumference measurement, resting heart rate measurement and heart rate determination variables were used to collect data.

**Statistical analyses**

The level of significance was taken as α = 0.05. The strength of the test was determined as 0.80 and the effect size was taken as 0.80. Based on these parameters, the sample size was determined as 15 using G * Power 3.0 program. Height, weight, waist circumference measurement, waist / hip ratio and body mass indexes and resting pulses of the groups will be taken before this application. As a result of the application of the same exercise methods for 8 weeks, the post-test scores of the groups were obtained and the pre-test and post-test scores were compared with the Paired T-Test (Wilcoxon Test in nonparametric data). One-way ANOVA test (Kruskal Wallis Test in non-parametric data) was used for the final test scores of the groups. Significance level was accepted as α = 0.05 in the tests.

**RESULTS**

Table 1 sets descriptive icons for all groups. The average of pulses taken from 45 people was x = 97.20. While the average length of pre-test results was 155.17, the standard deviation was 7.16, the average of post-tests was 155.77 and the standard deviation was 7.76. While the average of the pre-test results was 56.16, the standard deviation was 7.06, the average of the post-tests was 55.93 and the standard deviation was 7.25. While the mean BMI pre-test results were 23.73, the standard deviation was 1.53, the average of the final tests was 23.12 and the standard deviation was 1.77. While the average waist circumference was 81.55, the standard deviation of 5.53, the average of the final tests was 80.15 and the standard deviation of 5.54. The mean hip circumference was 94.04 for pre-test results, 6.40 for standard deviations, and 92,000 for final tests, and 6.95 for standard deviations. The average waist-hip ratio was 86 and the standard deviation was 07. While the average of the pre-test results was 29.01, the standard deviation was 4.98, the average of the final tests was 27.15 and the standard deviation was 5.50. While the average of pre-test results was 16.41, standard deviation was 4.14, average of post-tests was 15.26 and standard deviation was 4.38. While the average of pre-test results was 37.70, the standard deviation was 4.60, the average of post-tests was 38.30 and the standard deviation was 4.59. While descriptive statistics were found to be significant in weight, BMI, waist circumference, hip circumference, waist-hip ratio, VYY, VYK, VKK, there was a significant difference in the variables.

As can be seen in Table 2, Kolmogorov-Smirnov test the results of a single sample to determine whether the results were normal for the resting pulse were not significant due to the p value of 0.24> 0.05. In other words, the variables exhibit normal distribution. Therefore, parametric tests were used in statistical analysis.

In Table 3, pre-test and post-test results were compared with independed sample t test. According to this table, waist circumference, hip circumference, VYY and VYK values were found to be significant in men. Waist-hip ratio was found to be significant in females than males.

In Table 4, the 8-week pretest and post-test values of the control group consisting of 15 people were measured with paired sample t test. No significant difference was found in the variables of height, weight, BMI, waist circumference, hip circumference, waist-hip ratio, VYY, VYK and VKK.

In Table 5, aerobic exercise method was applied to this group of 15 people. The aerobic exercise method included 13 min of running exercise at 40% tempo and 2 min of active rest without a break. This exercise was continued without 3 sets. According to this table, pre-test and post-test statistics of aerobic exercise performed for 8 weeks were calculated by paired sample t test, and there was a significant difference in BMI, waist circumference, hip circumference, VYY, VYK and VKK variables. There was no significant difference in height, weight and waist-hip ratio. If the duration of the exercise program is increased in adolescents at risk of obesity, the aerobic exercise program may also have an effect on the weight variable.

In Table 6, this group of 15 people who were trained by aerobic-submaximal exercise method for 8 weeks, had aerobic exercise run at 40% tempo for 4 min and increased to 70% tempo for 1 min without interruption and continued for 45 min. Aerobic-submaximal exercise group 's pre-test and post-test results were done with paired sample t test. According to this table, a significant difference was found in BMI, waist circumference, hip circumference, VYY, VYK and VKK. There was no significant difference in height, weight and waist-hip ratio

In Table 7, anova test was performed to measure the significance of the difference between the averages of the control group, aerobic group and aerobic-submaximal groups. Although there were significant differences in some variables in the aerobic and aerobic-submaximal groups, there was no significant difference between all groups because the differences in these variables showed similar changes. The same changes were observed in the aerobic and aerobic-submaximal groups in variables such as height, weight, BMI, hip circumference, waist-hip ratio. A significant difference was found between the groups at the 0.10 level in the final test applied in the measurements of VYI and hip circumference. Hip circumference and BMI measurements showed a difference between the control group and other groups. While the control group had the highest average, the second high mean belonged to the aerobic-submaximal group and the lowest hip circumference and the mean VYY belonged to the aerobic group.

**Table 1.** Arithmetic means and standard deviations of the pre-test and post-test results of the descriptive statistics of all groups according to resting pulse.

| Variables | N | Measurement time | X | SS |
|---|---|---|---|---|
| Resting pulse | 45 | | 97.20 | 11.01 |
| Length | 45 | Pre test | 155.17 | 7.16 |
| | | Post test | 155.77 | 7.76 |
| Weight | 45 | Pre test | 56.16 | 7.06 |
| | | Post test | 55.93 | 7.25 |
| BMİ | 45 | Pre test | 23.73 | 1.53 |
| | | Post test | 23.12 | 1.77 |
| Waist circumference | 45 | Pre test | 81.55 | 5.53 |
| | | Post test | 80.15 | 5.54 |
| Hip circumference | 45 | Pre test | 94.04 | 6.40 |
| | | Post test | 92.00 | 6.95 |
| Waist-hip ratio | 45 | Pre test | .86 | .075 |
| | | Post test | .87 | .076 |
| Body fat percentage (BFP) | 45 | Pre test | 29.01 | 4.98 |
| | | Post test | 27.15 | 5.50 |
| Body fat mass (BFM) | 45 | Pre test | 16.41 | 4.14 |
| | | Post test | 15.26 | 4.38 |
| Body muscle mass (BMM) | 45 | Pre test | 37.70 | 4.60 |
| | | Post test | 38.30 | 4.59 |

Power analysis suggested.

**Table 2.** Kolmogorov-Smirnov test results for single sample to determine if the resting pulse scores show normal distribution.

| Values | | Resting heart rate |
|---|---|---|
| Parameters | N | 45 |
| | X | 97.20 |
| | SS | 11.01 |
| K-SMİRNOV Z | | 1.48 |
| P | | 0.24 |

## DISCUSSION

Nowadays, the expansion of the still lifestyle and obesity in this regard, seems to be accompanied by various health problems. Exercise methods on adolescents in our country I believe that this study can also contribute to scientific studies.

The importance of aerobic exercise on children, adolescents, adolescents and adults at risk of obesity is clearly stated. The aim of this study was to investigate the effect of aerobic-submaximal exercise and aerobic-submaximal exercise on adolescents at risk of obesity for 8 weeks, 3 times a week, on body mass index and some variables.

In this study, adolescents at risk of obesity were divided into three groups as control group, aerobic exercise group and aerobic-submaximal exercise group. The effect of 3 times weekly exercises on height, weight, BMI, waist circumference, hip circumference, waist-hip ratio, VYY, VYK and VKK variables in the control group, aerobic exercise group and aerobic-submaximal exercise group were examined.

Adolescents at risk of obesity in the control group were not subjected to any exercise and they were asked to continue their lifestyle as they were. Data were collected separately before and after 8 weeks and there were no

**Table 3.** Arithmetic average and standard deviations of pre-test and post-test results of all groups by gender.

| Variables | Gender | N (455) | Measurement time | X | SS | P | |
|---|---|---|---|---|---|---|---|
| | | | | | | Pre-test | Post-test |
| Length | Female | 24 | Pre test | 154.79 | 7.72 | .355 | .431 |
| | | | Post test | 156.04 | 7.55 | | |
| | Male | 21 | Pre test | 152.61 | 7.83 | | |
| | | | Post test | 154.19 | 8.06 | | |
| Weight | Female | 24 | Pre test | 56.80 | 7.68 | .523 | .517 |
| | | | Post test | 56.59 | 7.93 | | |
| | Male | 21 | Pre test | 55.43 | 6.39 | | |
| | | | Post test | 55.17 | 6.50 | | |
| BMI | Female | 24 | Pre test | 23.72 | 1.58 | .946 | .943 |
| | | | Post test | 23.10 | 1.85 | | |
| | Male | 21 | Pre test | 23.75 | 1.50 | | |
| | | | Post test | 23.14 | 1.72 | | |
| Waist circumference | Female | 24 | Pre test | 78.66 | 4.47 | .000* | .012* |
| | | | Post test | 78.25 | 4.79 | | |
| | Male | 21 | Pre test | 84.85 | 4.77 | | |
| | | | Post test | 82.33 | 5.65 | | |
| Hip circumference | Female | 24 | Pre test | 95.66 | 7.47 | .069* | .042* |
| | | | Post test | 93.95 | 7.81 | | |
| | Male | 21 | Pre test | 92.19 | 4.38 | | |
| | | | Post test | 89.76 | 5.13 | | |
| Waist-hip ratio | Female | 24 | Pre test | .82 | .07 | .000* | .000* |
| | | | Post test | .83 | .07 | | |
| | Male | 21 | Pre test | .91 | .03 | | |
| | | | Post test | .83 | .07 | | |
| Body fat percentage (BFP) | Female | 24 | Pre test | 31.65 | 3.15 | .000* | .000* |
| | | | Post test | 30.21 | 3.43 | | |
| | Male | 21 | Pre test | 25.99 | 5.02 | | |
| | | | Post test | 23.65 | 5.38 | | |
| Body fat mass (BFM) | Female | 24 | Pre test | 18.10 | 3.75 | .002* | .001* |
| | | | Post test | 17.27 | 4.03 | | |
| | Male | 21 | Pre test | 14.48 | 3.77 | | |
| | | | Post test | 12.95 | 3.62 | | |
| Body muscle mass (BMM) | Female | 24 | Pre test | 36.72 | 4.32 | .128 | .119 |
| | | | Post test | 37.30 | 4.20 | | |
| | Male | 21 | Pre test | 38.82 | 4.75 | | |
| | | | Post test | 39.45 | 4.84 | | |

* $p < 0.05$ and $p < 0.10$ are significant.

significant differences in height, weight, BMI, waist circumference, hip circumference, VYY, VYK, VKK variables.

The group was trained with aerobic exercise method, 10 min warm-up exercise, 13 min calculated according to the carvonene method 40% tempo and then 2 min of

**Table 4.** Control group arithmetic averages, standard deviations and significance levels of 8-week pre-test and post-test results.

| Variables | n | Measurement time | X | SS | P |
|---|---|---|---|---|---|
| Length | 15 | Pre test<br>Post test | 155.67<br>155.80 | 8.26<br>8.23 | .164 |
| Weight | 15 | Pre test<br>Post test | 58.07<br>58.15 | 8.33<br>8.56 | .799 |
| BMI | 15 | Pre test<br>Post test | 23.83<br>23.54 | 1.61<br>1.72 | .248 |
| Waist circumference | 15 | Pre test<br>Post test | 82.00<br>82.06 | 6.64<br>6.67 | .670 |
| Hip circumference | 15 | Pre test<br>Post test | 95.26<br>95.33 | 7.77<br>7.68 | .670 |
| Waist-hip ratio | 15 | Pre test<br>Post test | .86<br>.86 | .08<br>.08 | .670 |
| Body fat percentage (BFP) | 15 | Pre test<br>Post test | 30.45<br>29.32 | 4.64<br>4.20 | .040* |
| Body fat mass (BFM) | 15 | Pre test<br>Post test | 17.91<br>17.01 | 4.64<br>4.32 | .016* |
| Body muscle mass (BMM) | 15 | Pre test<br>Post test | 38.09<br>3822 | 4.38<br>4.58 | .858 |

* $p < 0.10$ are significant.

active rest was given. This exercise continued for 45 min without interrupting the sets, and stretching exercise was performed for 5 min at the end of the exercise. There was no significant difference in height variable of aerobic exercise group and there were significant differences in BMI, waist circumference, hip circumference, VYY, VYK, VKK variables ($p < 0.05$).

The group was trained with aerobic-submaximal exercise method and 10 min of warm-up exercise was done. This exercise continued for 45 min and 5 min of stretching exercise was performed at the end of the exercise. There was no significant difference in height variable in the aerobic-submaximal exercise group, but there were significant differences in BMI, waist circumference, hip circumference, VYY, VYK, VKK variables ($p < 0.05$).

In this study, a significant difference was found in male ($p < 0.10$) in waist circumference and hip circumference on male and female adolescents at risk of obesity, and significant difference was found in male and female ($P < 0.05$).

As a result of this study, it was found that there were significant differences in BMI, waist circumference, hip circumference, VYY, VYK, VKK whether they were performed through aerobic exercise or aerobic-submaximal exercise.

While there was a significant difference between the aerobic and sub-maximal exercise methods in the data of the aerobic-submaximal exercise group in terms of hip circumference and VYY variables, there was no difference between these two groups in terms of height, weight, BMI, waist circumference, VYK, VKK. There was a significant difference on these variables in groups.

In this study, the pre-test results were 155.17 and the final test results were 155.77 in all groups. Özer and colleagues, in the study of the prevalence of metabolic syndrome in obese children did not find a significant difference in height variable as in our study (10). This shows that all children with the same age in the developmental period reflect the characteristics of the same period.

In our study on the weight variable, the pre-test results were 55.65 while the post-test results were 55.26, and the pre-test results were 54.78 while the post-test results

**Table 5.** Arithmetic mean, standard deviations and significance levels of 8-week pre-test and post-test results of aerobic exercise group.

| Variables | N | Measurement time | X | SS | P |
|---|---|---|---|---|---|
| Length | 15 | Pre test<br>Post test | 152.40<br>152.46 | 8.89<br>8.99 | .082* |
| Weight | 15 | Pre test<br>Post test | 55.65<br>55.26 | 4.74<br>4.65 | .185 |
| BMI | 15 | Pre test<br>Post test | 23.81<br>22.88 | 1.35<br>1.73 | .003* |
| Waist circumference | 15 | Pre test<br>Post test | 81.20<br>78.86 | 4.75<br>4.45 | .002* |
| Hip circumference | 15 | Pre test<br>Post test | 92.93<br>89.80 | 2.96<br>3.42 | .000* |
| Waist-hip ratio | 15 | Pre test<br>Post Test | .86<br>.87 | .04<br>.05 | .384 |
| Body fat percentage (BFP) | 15 | Pre test<br>Post test | 27.22<br>24.84 | 5.53<br>6.12 | .001* |
| Body fat mass (BFM) | 15 | Pre test<br>Post test | 15.09<br>13.74 | 3.24<br>3.74 | .001* |
| Body muscle mass (BMM) | 15 | Pre test<br>Post test | 38.47<br>39.38 | 4.92<br>4.57 | .000* |

* $p < 0.05$ and $p < 0.10$ are significant.

were 54.38 and the post-test results were 54.38. Wats and colleagues conducted a study on 14 obese adolescents using aerobic exercise method for 8 weeks and found no significant difference in body weight as in our study (Watts et al., 2004). In the study of İpekoğlu, which examined the changes in fat oxidation during intermittent and continuous aerobic exercises, no significant result was found in the weight variable as in our study (İpekoğlu, 2013). This shows us that an 8-week exercise program and exercise duration should be increased in order to achieve weight loss. In addition, it should be considered that the development of the subject group continues dynamically as it is in the adolescent period. This study is in parallel with the studies in this work for weight variable.

In this study, the pre-test results of the aerobic exercise group were 23.81 while the post-test results were 22.88, the pre-test results of the aerobic-submaximal exercise group were 23.56 and the post-test results were found to be 22.94, and a significant difference was found in the BMI variable. Zorba et al. (2015) examined 40 obese adolescents in the control and exercise groups. The exercise group had aerobic exercise consisting of 12 weeks of walking and jogging and the control group did not have any exercise. At the end of 12 weeks, they observed a significant difference in weight, BMI, body fat ratio (Zorba et al., 2015). This study is in parallel with the literature in the BMI variable on both exercise groups. As with the weight variable, increasing the duration of the exercises seems to be more effective on BMI.

In this study, there was no change in waist circumference variable in the control group, but there was a significant difference in waist circumference in both exercise groups. While the waist circumference variable of the aerobic exercise group was 81.20, the post-test results were 78.86, the pre-test results of the aerobic-suubmaximal exercise group were 81.46 and the post-test results were 79.53. There was a significant difference in waist circumference in both exercise groups.

Dias and colleagues divided the adolescents who live obesity into two groups as control group and aerobic exercise group, and the control group did not have any exercise, while the exercise group received resistance training with aerobic exercise method for 12 weeks, as a

**Table 6.** Arithmetic averages and standard deviations and significance levels of 8-week pre-test and post-test results of aerobic-submaximal exercise group.

| Variables | N | Measurement time | X | SS | P |
|---|---|---|---|---|---|
| Length | 15 | Pre test<br>Post test | 153.40<br>153.60 | 5.96<br>6.06 | .082* |
| Weight | 15 | Pre test<br>Post test | 54.78<br>54.38 | 7.66<br>7.87 | .028* |
| BMI | 15 | Pre test<br>Post test | 23.56<br>22.94 | 1.69<br>1.90 | .001* |
| Waist circumference | 15 | Pre test<br>Post test | 81.46<br>79.53 | 5.39<br>5.12 | .002* |
| Hip circumference | 15 | Pre test<br>Post test | 93.93<br>90.86 | 7.53<br>7.91 | .000* |
| Waist-hip Ratio | 15 | Pre test<br>Post test | .86<br>.87 | .09<br>.09 | .306 |
| Body fat percentage (BFP) | 15 | Pre test<br>Post test | 29.37<br>27.28 | 4.4<br>5.40 | .000* |
| Body fat mass (BFM) | 15 | Pre test<br>Post test | 16.22<br>15.02 | 4.18<br>4.67 | .000* |
| Body muscle mass (BMM) | 15 | Pre test<br>Post test | 36.56<br>37.32 | 4.57<br>4.69 | .001* |

* $p < 0.05$ and $p < 0.10$ are significant.

**Table 7.** Significance of the difference between the averages of the control group, aerobic group and aerobic-submaximal exercise groups.

| Variables | Groups | N | Measurement time | X | SS | P | |
|---|---|---|---|---|---|---|---|
| | | | | | | Pre test | Post test |
| Length | Kontrol | 15 | Pre test<br>Post test | 155.67<br>155.80 | 8.26<br>8.23 | .485 | .657 |
| | Aerobic | 15 | Pre test<br>Post test | 152.40<br>152.46 | 8.89<br>8.99 | | |
| | Aerobic-submaximal | 15 | Pre test<br>Post test | 153.40<br>153.60 | 5.96<br>6.06 | | |
| Weigh | Kontrol | 15 | Pre test<br>Post test | 58.07<br>58.15 | 8.33<br>8.56 | .427 | .337 |
| | Aerobic | 15 | Pre test<br>Post test | 55.65<br>55.26 | 4.74<br>4.65 | | |
| | Aerobic-submaximal | 15 | Pre test<br>Post test | 54.78<br>54.38 | 7.66<br>7.87 | | |
| BMI | Kontrol | 15 | Pre test<br>Post test | 23.83<br>23.54 | 1.61<br>1.72 | .868 | .545 |
| | Aerobic | 15 | Pre test | 23.81 | 1.35 | | |

**Table 7.** Continues.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Aerobic-submaximal | 15 | Post test | 22.88 | 1.73 | | |
| | | | Pre test | 23.56 | 1.69 | | |
| | | | Post test | 22.94 | 1.90 | | |
| Waist circumference | Kontrol | 15 | Pre test | 82.00 | 6.64 | .925 | .254 |
| | | | Post test | 82.06 | 6.67 | | |
| | Aerobic | 15 | Pre test | 81.20 | 4.75 | | |
| | | | Post test | 78.86 | 4.45 | | |
| | Aerobic-submaximal | 15 | Pre test | 81.46 | 5.39 | | |
| | | | Post test | 79.53 | 5.12 | | |
| Hip circumference | Kontrol | 15 | Pre test | 95.26 | 7.77 | .617 | .066* |
| | | | Post test | 95.33 | 7.68 | | |
| | Aerobic | 15 | Pre test | 92.93 | 2.96 | | |
| | | | Post test | 89.80 | 3.42 | | |
| | Aerobic-submaximal | 15 | Pre test | 93.93 | 7.53 | | |
| | | | Post test | 90.86 | 7.91 | | |
| Waist-Hip Ratio | Kontrol | 15 | Pre test | .86 | .08 | .947 | .811 |
| | | | Post test | .86 | .08 | | |
| | Aerobic | 15 | Pre test | .86 | .04 | | |
| | | | Post test | .87 | .05 | | |
| | Aerobic-submaximal | 15 | Pre test | .86 | .09 | | |
| | | | Post test | .87 | .09 | | |
| Body fat percentage (BFP) | Kontrol | 15 | Pre test | 30.45 | 4.64 | .198 | .080* |
| | | | Post test | 29.32 | 4.20 | | |
| | Aerobic | 15 | Pre test | 27.22 | 5.53 | | |
| | | | Post test | 24.84 | 6.12 | | |
| | Aerobic-submaximal | 15 | Pre test | 29.37 | 4.47 | | |
| | | | Post test | 27.28 | 5.40 | | |
| Body fat mass (BFM) | Kontrol | 15 | Pre test | 17.91 | 4.64 | .174 | .120 |
| | | | Post test | 17.01 | 4.32 | | |
| | Aerobic | 15 | Pre test | 15.09 | 3.24 | | |
| | | | Post test | 13.74 | 3.74 | | |
| | Aerobic-submaximal | 15 | Pre test | 16.22 | 4.18 | | |
| | | | Post test | 15.02 | 4.67 | | |
| Body muscle mass (BMM) | Kontrol | 15 | Pre test | 38.09 | 4.38 | .494 | .481 |
| | | | Post test | 38.22 | 4.58 | | |
| | Aerobic | 15 | Pre test | 38.47 | 4.92 | | |
| | | | Post test | 39.38 | 4.57 | | |
| | Aerobic-submaximal | 15 | Pre test | 36.56 | 4.57 | | |
| | | | Post test | 37.32 | 4.69 | | |

* $p < 0.10$ are significant.

result of the study, body fat, waist circumference measurement found a significant difference in waist-hip ratio (Dias et al., 2015). This study shows parallelism with waist circumference.

In this study, there was no difference in the hip circumference variable in the control group, while the pre-test results of the aerobic exercise group were 92.93, the post-test results were 89.80, and the pre-test results of

the aerobic-submaximal group were 93.93, while the post-test results were 90.86. A significant difference was observed in both groups after 8 weeks of exercise, but was more significant in the aerobic exercise group around the hip than in the aerobic-submaximal exercise group. In the study, Zileli et al. (2017) examined the effect of walking exercise on some physical fitness parameters in obese and obese women. Found significant differences in VYY variables.

In our study, although the BFAs of the adolescents with 12-year-old obesity risk were included in the control group, the pre-test results were 29.01, whereas the post-test results showed a significant difference as 27.15. Physical activity, which decreases inversely with increasing age, causes obesity in each passing time. Aerobic exercise regulates blood pressure, is effective on metabolic syndrome, decreases BMI, VYO and intraabdominal fat in individuals with increased risk of obesity by increasing bone mineral density (Meydanlıoğlu, 2015). In our study, significant differences in waist circumference, hip circumference, VYY, VYK and VKK variables confirm the studies in this work.

In the study of İpekoğlu, which examined the changes in the fat oxidation rate during intermittent and continuous aerobic exercises, similar changes were observed in both methods and there was no significant difference between the two exercise methods (İpekoğlu, 2013). In our study, no significant difference was found between aerobic exercise and aerobic-submaximal exercise method in weight, BMI, hip circumference, waist-hip ratio variables, but there was a significant difference in aerobic exercise around the hip.

It is known that physical activities performed with aerobic exercise methods affect not only physical and healthy appearance on all adolescents at risk of obesity but also mental and mental health positively. In the studies of Akçınar and Eroğlu (2016). Examining the anxiety levels and anxiety levels of secondary school students according to their sporting status, there was no significant difference in their anxiety levels according to sport categories (minors, stars), but a significant result was found in the anxiety levels according to sport ages. while there was no difference between the test anxiety. This shows us that exercise decreases test anxiety for adolescents at risk for obesity and proves that it affects mental and physical health positively.

In our study, aerobic exercise or aerobic-submaximal exercises led to significant changes in BMI, waist circumference, hip circumference, VYY, VYK, VKK variables in adolescents at risk for obesity. However, the hip circumference and VYI variables of the aerobic exercise group were more significant than the aerobic-submaximal group ($p < 0.10$).

In our study, there was no difference in the variables of height, weight, BMI, waist circumference, hip circumference, waist-hip ratio, VYY, VYK, VKK. Significant differences were found in the BMI, waist circumference, hip circumference, VYY, VYK, VKK variables of the group who trained with aerobic exercise method. There was a significant difference in the variables of BMI, waist circumference, hip circumference, VYY, VYK, VKK, as in the aerobic-submaximal exercise group.

This study shows that when compared to the control group, an exercise program prepared by either aerobic exercise method or aerobic-submaximal exercise method has an effect on BMI, waist circumference, hip circumference, VYY, VYK, VKK on adolescents at risk of obesity. When the two exercise groups were compared with each other, it was found that the aerobic exercise method was found to be more significant than the aerobic-submaximal exercise group. When girls and boys were compared, waist circumference ($p < 0.05$), hip circumference ($p < 0.10$), VYY ($p < 0.05$) and VYK ($p < 0.05$) values were found to be significant compared to women. In females, waist-hip ratio was found to be significant ($p < 0.05$).

Although adolescent children are aware of the benefits of exercise programs, they are bored very quickly during the studies. This study sheds light on the exercise programs prepared by applying both aerobic-submaximal exercise method in order to reduce the annoyance of long-term exercise practices, to save the exercise from monotony and to increase the applicability of long-term regular physical activities, especially in adolescents.

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