

The Effect of Aerobic Exercise on Body Composition and Muscle Strength of Female Students at Elementary Schools of Ali Abad Katoul in 2018

Parastoo Mohammad Gholinejad¹, Hamid Hojjati^{1*}, Saeed Ghorbani²

¹Department of Nursing, Ali Abad Katoul Branch, Islamic Azad University, Ali Abad Katoul, Iran

²Department of physical Education, Ali Abad Katoul Branch, Islamic Azad University, Ali Abad Katoul, Iran

*Corresponding author: Hamid Hojjati, Golestan Province, Aliabad Katoul University, University Boulevard, Islamic Azad University, Aliabad Katoul Branch. Email: h_hojjati@aliabadiu.ac.ir

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Abstract

Background: Physical activity stimulates the growth rate and reduces the risk factors of human health. The purpose of this study was to investigate the effect of aerobic exercise on the body composition and muscle strength of elementary school female students.

Methods: This quasi-experimental study was conducted on 42 elementary school female students at Ali Abad Katoul city of Golestan Province, Iran in 2018. The samples were randomly divided in two groups including intervention and control. Data collection tool included body composition, and leg and chest pressing device. The exercise protocol contained various aerobic exercises for four weeks, three sessions per week, each session takes 45 minutes. Pre-test and post-test measurements were made by body composition, and leg and chest pressing device in both control and intervention groups. Data were analyzed by SPSS software version 16 using descriptive statistics (mean and standard deviation) and inferential statistics (independent and paired t-test).

Results: The results of the test group indicated the average height of 152.79, standard deviation of 10.25, and so average weight of 49.28 and standard deviation of 12.86. The results showed that a four-week aerobic training period had no significant effect on the body composition and upper body muscle strength of female students ($P=0.83$), but this training course significantly increased the lower body muscle strength of female students in the intervention group ($P=0.01$).

Conclusion: Considering the effect of a four-week aerobic training course on lower body muscle strength of students, it is suggested that sport teachers use these types of exercises to increase the muscle strength of students.

Keywords: Body composition, Muscle strength, Aerobic exercise, Female students

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1. Introduction

Physical activity plays an important role in maintaining and promoting lifestyle and health of individuals (1). Scientific studies in children show that physical activity can increase their growth and reduce their health problems (2). Today, due to the industrialization of societies and the incidence of inactivity in adults and especially in children and adolescents, we witness many problems, such as obesity and changes in body composition (3). Therefore, considering the prevalence of obesity in adolescence and the change in their appearance during this sensitive period of personality formation, we can see many psychological problems among them (4). Today, 155 million children in the world are overweight or obese. From 16 million Iranian students, nearly 2 million are overweight or obese (5). The result of a study by Mirzadeh and coworkers showed a 3.4% prevalence of obesity and 11% prevalence of overweight in the age group of 6 to 18 years old. In general, the frequency of obesity is lower

in the Northern provinces and is lower in the Southern provinces of Iran (6). Recent statistics from the Centers for Disease Control, the National Institutes of Health, and the World Health Organization show that obesity has more than doubled since 1980 and almost 2 billion adults worldwide are overweight or obese (7). In children and adolescents, 17% of 2- to 19-year-olds are obese, with males and females equally affected (8). Overweight and obesity in the world were limited to adults several years ago, but during the last two decades, it has affected children and adolescents (9). Those with BMI of above average are more dissatisfied with their appearance and weight. Stirling and co-workers found that "young women are more likely to go on physical activity and exercise related to fitness as they are more dissatisfied with their body image" (10). Increasing physical activity in terms of health and physical fitness is associated with the reduction in mortality and illness, quality of life, psychological indicators, body composition, basic skills training, and balanced metabolism (11). Physical activity and exercise are two

completely different terms. Every movement that is caused by skeletal muscle is called physical activity, but physical exercise is a subset of physical activity that is planned and structured (12). Regular physical activity has many benefits, including reduced risk of infection, cardiovascular disease, diabetes, certain cancers, and depression, and increased personal satisfaction and good mood (13). Aerobic exercise is a type of sport that dates back to the traditional and synchronized movements of European societies. Aerobic musical movements were first established in 1969 by Jackie Sorenson, an old dancer. She believed in practicing dance as a useful way to achieve fit for fitness. Practicing musical and dance moves along with music, now known as aerobics, is an form of his main moves. The general rule for aerobics class is the same. It includes warming up and performing aerobic or cardiovascular exercises, and stretching and flexing exercises on specific muscles and joints, endurance movements and cooling. The scientific definition of aerobics is a practice that lasts for 2 minutes or more and uses oxygen during this time period (14). Physical activity in the form of aerobic exercise has a positive effect on most body organs, which contributes to caloric balance and body weight control (14). Aerobic exercise is a modest and relatively long activity that is accompanied by music and its energy is supplied through an aerobic device (15). Among the various exercises, women tend to undertake rhythmic and synchronized exercises like aerobic exercise more than other sports. Sport activities, especially aerobic type, may result in changes in energy balance, increase in the secretion of metabolic hormones, increase in appetite, and obesity (16).

Considering the expansion of urban life, its associated diseases, and the various effects of aerobic exercise on the body, further research is needed in this area. With the positive effects of aerobic exercise on controlling the obesity in school age, a step can be taken to prevent many diseases and promote physical and mental health of students.

2. Methods

The present research is a classic experimental study. The statistical population was elementary school female students at Ali Abad Katoul city. We used simple random sampling method. By using this sampling method, 42 subjects were selected by simple random sampling from one of Aliabad Katoul girls' schools. Then, by using a simple random coin-throwing method the subjects were assigned into two experimental and control groups. The inclusion criteria included having

the parents' consents for participation in the research, having no physical problems, being able to perform exercises, not using sedative drugs, and not having regular physical activity. Female students who had a desire to leave the study, those who could not perform the physical activity and students who had more than two absences in training sessions were excluded from the study. The sample size was determined to be 42 students (21 in each group) according to GPower statistical software and the study conducted by Haghighi and co-workers with the effect size of 80% and the test power of 0.8 at the significant level of 0.05. However, taking into account the possibility of sample drop, higher number of samples was considered (17). The data collection tool in this study was the Xplus2 body composite wind device. The validity of this device is 0.91, which has been proven by many researchers. Essmee A Bakker and co-workers have used this device (18). A standard Iranian measuring tape, which was based on centimeter with the accuracy of 0.1 mm, was used in this study. Reliability of measuring tape has been verified by Kalantari and colleagues (19). To determine the muscle strength, leg and chest pressing device was used. The validity of leg and chest pressing device has been proven by many researchers. Yin and colleagues and Manickand and co-workers have used this device (20, 21). Data collection was performed following the approval of the proposal by the nursing group of Islamic Azad University of Ali Abad Katoul Branch. Then, referring to the education department of city of Ali Abad Katoul, the schools were selected. The samples were randomly assigned into two groups of control and intervention and the method of study was explained to them. Individual information form was completed by the students and their consent was obtained and then, those who were eligible were asked to enter the study. Prior to the start of study, the students took part in an introductory session and the safety tips related to training and the correct way of exercising the movements were explained to them; for further familiarization, several demonstrations were also performed for each move. At first, the students' height was measured in cm (with the Iranian measuring tape) and then their body composition was measured by the body composition wind device. The researcher then described how aerobic exercise is performed, and the sport teacher taught the students the practical way of performing the exercises. The training protocol of this study was derived from the standard program of Leidy and co-workers (22). The training program lasted for 4 weeks, 3 sessions per week and 45 minutes for each session, but gradually the duration of sessions increased to 60 minutes, so that, 2 minutes were added

to the original time every 2 weeks.

An aerobic exercise session can be performed using a standard method of 45 minutes to 1 hour. For the planning of aerobic exercises, it is possible to move according to the standard 8 moves from dozens of moves and, with the success of these sequences, these eight chain movements are designed. The aerobic performance is due to its variety. Because every day you can select 8 new moves and invent a diverse chain, so the exercise session will not be boring and even.

An aerobics session is featured by the following divisions: warm up, body with various combinations, and cool down. Warming takes about 10 minutes, the body class lasts 35 minutes, abdominal movements take 10 minutes, and cooling the body takes 5 minutes. Types of aerobics exercises include spinings, steppes, budscalping, and pilates.

The aerobic exercises were being performed at high pressure. With an intensity of 70-80% of the maximum heart rate, the students performed the aerobic exercises (23). At the end of training, the body composition of students was measured again with the relevant device. The muscle strength of students was also measured by the leg and chest pressing device. The students performed several sub-maximized repetitions for each move. A maximal repetition was selected based on the Kramer and colleagues protocol (24). The resistance training consisted of three sets of 8 to 10 repetitions with 60% to 70% maximum repetition and 10 seconds

interval between each set. Each subject had to perform maximum 5 repetitions (25). A sport teacher was present during the training sessions that were held in a club. By putting the weight loads and number of repetitions in the Brezsky's formula, the maximum strength of subjects' upper and lower body muscles was measured maximally through front legs and chest pressing movements (26). At the end of training period, muscle strength was measured again. Data analysis was performed using SPSS software (version 16) and then analyzed using paired and independent t-tests.

3. Results

Comparing the demographic characteristics between the study subjects in the intervention and control groups, the independent t-test showed no significant differences in terms of height (P=0.7), weight (P=0.14) and age (P=0.18), (Table 1).

Paired t-test also showed no significant differences in the intervention group before and after the intervention in terms of body composition such as BMI (P=0.6), total body water (TBW, P=0.6), skeletal muscle mass (SM, P=0.7), overall body fat (BFO, P=0.46), fat weight (MBF, P=0.34), muscle weight (SLM, P=0.45) and edema (P=0.34), (Table 2). Moreover, paired t-test in the control group did not show significant differences in body composition before and after the intervention (Table 2).

Comparison of the muscle composition with

Table 1: Comparison of demographic characteristics in the control and intervention groups

Demographic characteristic	Intervention	Control	Total	P value
Height	152.79 (10.52)	145.21 (11.05)	149 (11.15)	P=0.7
Weight	49.28 (12.76)	41.93 (12.16)	45.61 (13.26)	P=0.14
Age	12.71 (0.9)	12.24 (1.29)	12.42 (1.13)	P=0.18

Table 2: Effect of aerobic exercise on the body composition of intervention and control groups

Group	Intervention group			Control group		
	Before intervention	After intervention	P value	Before intervention	After intervention	P value
BMI	20.83 (4.10)		P=0.06	19.51 (4.32)	19.52 (4.35)	P=0.38
TBW	26.52 (4.98)	26.74 (4.82)	P=0.6	22.9 (5.9)	22.42 (0.7)	P=0.27
SMM	14.91 (3.79)	15.1 (3.81)	P=0.7	12.55 (4.83)	12.65 (4.83)	P=0.1
BFO	12.42 (6.26)	12.7 (6.15)	P=0.46	10.17 (6.13)	10.19 (6.06)	P=0.65
MBF	6.39 (3.29)	6.31 (3.33)	P=0.34	5.9 (6.49)	5.9 (3.12)	P=0.31
SLM	17.2 (3.12)	17.51 (2.91)	P=0.45	13.88 (4.41)	14.88 (3.26)	P=0.16
EDEMA	0.01 (0.3)	0.7 (1.2)	P=0.34	0.37 (0.05)	0.4 (0.02)	P=0.07

BMI: Body Mass Index; TBW: Total Body Water; SMM: Skeletal Muscle Mass; BFO: Body Fat Optimal; MBF: Mass of Body Fat; SLM: Soft Lean Mass

Table 3: Effect of aerobic exercise on the muscle strength of intervention and control groups

Evaluation of muscle strength	Intervention		P value	Control		P value
	Before intervention	After intervention		Before intervention	After intervention	
Upper extremity	19.49 (15.57)	20.45 (11.54)	P=0.83	28.12 (8.61)	29.51 (11.42)	P=0.96
Lower extremity	39.35 (7.39)	43.76 (6.21)	P=0.01	36.25 (5.21)	36.22 (4.25)	P=0.26

paired t-test in the control group before and after the intervention did not show any significant difference in upper body muscle strength (P=0.96) and lower body muscle strength (P=0.26). Paired t-test in the control group showed no significant difference in upper body muscle strength (P=0.83), since women use less the upper limbs (hands), their upper extremities are weaker than the lower limbs (feet) (27). It showed a significant difference in lower body muscle strength (P=0.01), (Table 3).

4. Discussion

The results of this study indicated that aerobic exercise did not reduce the body mass, but it was effective in increasing the muscle strength of lower body extremity. In this regard, in a study by Ramezani and colleagues, exercise and physical activity did not affect the body mass (27). Skandarnejad and co-workers, in a semi-experimental study, examined the effect of aerobic exercises on the body image, the identity crisis, and body mass index of girls who were worried about their body image. They found that aerobic exercises reduced the body mass index, body image concern, and identity crisis of the participants (28). Muscle volume is higher in men than in women. In men, 43% and in women, 36% of body weight form the muscle tissue. Male muscle strength is higher than that of men due to more muscle and lower fat in men. Given the differences in hormones and the presence of testosterone in men, it cannot be expected that, naturally, women’s strength is as strong as men’s power. Since women use less of the upper limbs (hands), their upper extremities are weaker than the lower limbs (feet). Power exercises in women cause a slight increase in muscle volume (27).

The results of this study showed that aerobic exercise strengthened and increased the muscles of lower body extremity. Haghighi and colleagues stated that, “ regular exercises enhance muscle strength and improve the body composition of girls ” (17). Consequently, undertaking exercise for 3 times a week increases muscle strength and helps the growth of musculoskeletal system (29, 30). Sayyadi and co-workers concluded that performing aerobic exercise improves muscle strength and the range of joints’ movement,

and helps to maintain balance in women (31). Bahraei and colleagues showed that performing equilibrium exercises such as aerobic exercises enhances the muscle composition of body (32). Rezaei and co-workers stated that aerobic exercise improves cognitive and balance status by strengthening brain systems and maintaining balance in individuals (33).

Mental concentration plays an important role in performing aerobic exercises. This type of exercise causes subjective development, promotes creativity and makes the brain less involved with depression and anxiety (34). Since lower body muscles play an important role in weight bearing, the strength of these muscles is the best estimate to assess their functional status. This, while examining how leg press or squat exercise is performed, which are the most common practice exercises for strengthening leg muscles, shows that in the leg press the legs cannot bear the weight, but in the squat press they can (35). According to the aforementioned studies, exercise by using the stored fat leads to weight loss and fitness. The results of this study did not show any significant effect of aerobic effect on the body mass. Aerobic exercise, in addition to, causing a greater oxygenation, strengthens the heart, produces more veins in the body, eliminates muscle pains, and reduces the fat mass, leading to calorie balance and body weight control (36). Considering the research done on this subject and effects of aerobic exercise on muscle strength, this type of exercise is expected to be effective in muscle strength and body compositions in the long run.

This study had several limitations including the student’s individual differences in muscle strength, differences in their tendency toward the exercise and interest in sport, and inability to control environmental conditions (temperature and humidity) during the execution of the test. Also, this study was conducted only on female students aged 7 to 12 years.

5. Conclusion

Given that aerobic exercise is an aerobic sport and does not cost much, and since exercise encourages more mobility and uses more energy, it strengthens muscle

hypertrophy and prevents muscle atrophy. Thus, we can conclude that 4 weeks of aerobic exercise increases muscle strength. Also, as exercise increases the metabolism, it leads to weight loss and a combination of body changes that usually require more time to change.

Individuals with higher aerobic capacity can rebuild more amounts of high-energy phosphorus deposits; therefore, sports activities will be more effective for them. Given that the number of respiration in women is higher than that of men, and women's vital capacity is lower than that of men (probably due to respiratory muscle, which is more powerful in men than women), breathing in women is superficial and deep in men.

Women use intercostal muscles more than men in exercise; however, men use more from diaphragmatic muscles and abdominal muscles. Men's respiratory system performance is better than women. As a result, female students need more time to lose weight and change the physical composition.

It is suggested that, in future studies, male subjects should be investigated, the exercise period should be longer than 4 weeks to affect the body composition, and other types of exercise should be used in children than aerobics.

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Conflict of Interest

The authors declared no conflict of interest.

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