

An Experimental Study on the Effects of Strength Training and Aerobic Exercise on Female University Students' BMI and WHR

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Abstract

In order to satisfy the exercise purpose of female university students in weight control and keeping shape and explore more feasible and effective methods, this article divided the randomly sampled female university students into two comparable groups for a teaching experiment. Twenty minutes were added for the experiment group in their aerobic exercise class, while the control group had a 12 weeks' aerobic exercise according to the mode of regular aerobic exercise. The result showed that, the BMI and WHR of female university students in the experiment group were more obviously improved, which indicated that combined practice of strength training and aerobic exercise was able to more effectively attain the purpose of weight control and keeping shape.

Keywords: Strength training, Aerobic exercise, BMI (Body Mass Index), WHR (Waist Hip Rate)

Aerobic exercise is a kind of physical practice which employs a variety of movement patterns under accompaniment of the music and combines gymnastics, music and dance into a whole. Since aerobic exercise suits with the physiological and psychological characters of female students, it is popular among female students in the options of sports class in universities. In the teaching process of aerobic exercise class, we came to know that female students showed preference for aerobic exercise more because they wished to control their weight and mould a healthy and beautiful shape in addition to physical exercise and promotion of their health. However, in actual teaching, as a result of various reasons, pure aerobic exercise class teaching is not able to totally satisfy the will of female students. According to relevant theory that strength training can mould a healthy and beautiful shape, the author of this article tried to add strength training in aerobic exercise class to better satisfy the will of female students to pursue a beautiful shape.

1. Research object and research method

1.1 Research object

We randomly selected two teaching classes in the professional class of aerobic exercise among sophomore female student (with an age between 19 and 21) to conduct a teaching experiment that lasted for 12 weeks, and there were 32 students in each class.

1.2 Research method

1.2.1 Selection of the index

We selected height, weight, waist and hip as the indexes and calculated the value of BMI and WHR. After making a comparative analysis of changes of BMI and WHR of the two groups of respondents before and after the experiment, we came to judge different influences of pure aerobic exercise class and combination of aerobic exercise and strength training on fat control and building a healthy and beautiful shape.

1.2.2 Test method

The research objects received physical test before and after the experiment, with the test time from 2:00~3:30PM and the test condition at a room temperature of 22°C. In the test, the height and weight were measured on a height and weight gauge. The objects were required to be in unlined dress and take off their shoes. The waist and hip were measured with a flexible rule (taking cm as the unit). Test of the waist took the standard above the horizontal level of the navel and test of the hip took the standard of the horizontal level across the horizontal measurement (the maximum part of the buttocks) of most prominent position backward. The same person and instrument were applied in the two tests. The testing data were calculated with the following formula, in which the two digits after the decimal point were available.

BMI (Body Mass Index)=Weight(kg)/Height²(m²) WHR(Waist Hip Rate)=Waist(cm)/Hip(cm)

1.2.3 Data processing

As for changes of the mean value before and after the experiment, the T Test of pairing material was used, and $P \leq 0.05$ was the significance standard for the statistical result.

1.3 Content of the professional class of aerobic exercise

Both of the two groups were tested in the normal class time, with the class time of 90 minutes, once each week.

Experiment group: 15 minutes of warm-up, 10 minutes of flexibility exercise, 40 minutes of aerobic exercise, 20 minutes of strength training and 5 minutes of relaxation.

Control group: 15 minutes of warm-up, 10 minutes of flexibility exercise, 60 minutes of aerobic exercise and 5 minutes of relaxation.

2. Research results

2.1 Changes of BMI of the control group and the experiment group before and after the experiment

Insert Table 1 Here

From Table 1, it can be found that, since the age of female students who participated in the test was between 19 and 21 and they were maturely grown and developed, so no obvious change took place in their height after the 12 weeks' exercise. Female students in the control group were reduced in their weight after exercise, but there was no statistical significance to $P > 0.05$. Female students in the experiment group were obviously reduced in their weight, and $P < 0.01$, which indicated quite significant difference. According to the experiment result, combination of strength training and aerobic exercise is more likely to improve the BMI of female students compared with pure aerobic exercise.

BMI refers to weight index, and is also termed as Kettler Index, which is put forward with a variety of data from the perspective of immunology. BMI is an important evidence to evaluate the physical component and judge obesity. The evaluation method is as follows: BMI < 20 represents slightly thin and malnutrition; 20~24 is normal with balanced nutrition; 24~26.5 means slightly fat; BMI > 26.5 is obese and excessive nutrition. The standard physical weight established with this method is BMI = 22. According to the experiment result, after the experiment for 12 weeks, all female students had no obvious change in their height. The weight of female students in the control group was reduced, but the change of BMI was not obvious; the weight of female students in the experiment group was greatly reduced, and the reduction of BMI was obvious. The experiment result indicated that, combination of strength training and aerobic exercise was more likely to improve the BMI of female students compared with pure aerobic exercise. So far, BMI has been widely focused by researchers in epidemics. Huang Songqing, et al, discovered that, when BMI > 25, the rate of morbidity of these people with BMI > 25 was higher than other groups of people in high blood pressure and cerebral infarction.

2.2 Changes of WHR of the control group and the experiment group before and after the experiment

Insert Table 2 Here

From Table 1, it can be found that, after the 12 weeks' exercise, distribution of physical fat of all female students was changed. All their waist was reduced after the exercise, and the change of their hip was not that obvious. WHR was obviously reduced. P was less than 0.05 in the control group, which indicated significant difference. P was less than 0.01 in the experiment group, which indicated quite significant difference. According to the experiment result, combination of strength training and aerobic exercise is more likely to improve the WHR of female students compared with pure aerobic exercise.

WHR is a simple, effective and new method proposed by American scientific researchers to test health condition by measuring the waist and hip rate of people. The Waist hip rate was proposed on the basis of research on active role of fat in different physical parts. This method is more scientific than any other common methods which measure the total fat volume of the body and calculate the percentage of fat in the body, which can enable people to more accurately and conveniently control the health condition of themselves. After quite a lot of data test, it was concluded that, the average WHR of a healthy male is 0.85~0.9 and the average WHR of a healthy female is 0.75~0.80. From the experiment result, we can find that after the experiment for 12 weeks, WHR of the control group and the experiment group both had obvious changes, and WHR of the experiment group was more obviously changed. It should be noticed that, change of the waist was more obvious, while change of hip was not quite obvious, which indicated that distribution of physical fat had been changed and the abdominal fat was reduced. Reduction of the abdominal fat had positive effect on prevention of cardiovascular disease. According

to the research, the abdominal fat hunched and the intraperitoneal fat cells were more active than the fat cells in other parts of the body. Furthermore, owing to the favorable position and direction of blood flow, these active fat cells would bring triglyceride and cholesterol into blood, which then flew to the liver. When the liver was encountered with these free fatty acid of high index, lipoprotein with low density would be accelerated in production, which would then flow to the artery and the visceral organ of the whole body with blood. The lipoprotein was likely to be deposited and converted to lipid plaque on the vascular wall, which might lead to such heart cerebrovascular diseases as atherosclerosis, coronary heart disease, high blood pressure and apoplexy, etc. Reduction of the waist, reduction of the fat, and reduction of BMI and WHR is the major purpose of exercise for quite a lot of female students. After the experiment for 12 weeks, the female students in the experiment group were more satisfied with changes of their physical shape than the female students in the control group. They came to find out with surprise that their physical shape was more slender and beautiful compared with the physical shape before the experiment. Hence, they came to show favor for the exercise with combination of aerobic exercise and strength training, and they began to have exercise in their spare time.

3. Analysis

3.1 Analysis of reasons for changes of BMI

Change of BMI in the control group was not quite obvious, while change of BMI in the experiment group was obvious, which might be related with the following several factors. Firstly, although this experiment lasted for 12 weeks, students only exercised once each week because they could just employ the class time. They only practiced 90 minutes each time, with a limited period of time and low exercise frequency. Pure aerobic exercise merely added heat consumption in the class time, and the metabolism was not obviously increased, so the change of weight was not obvious. Secondly, obvious change in BMI in the experiment group was mainly because that the experiment group added strength training in the experiment, and the purpose of adding strength training was indeed to increase muscle since the metabolism rate of the muscle is higher than that of the fat. According to the latest research, one pound of muscle is able to consume 35 to 50 calories of heat each day, while a pound of fat can only consume 2 to 3 calories of heat each day. If we calculate in such a way, if we increased one pound of muscle through strength training, another 50 calories of heat had to be consumed each day, which meant 18250 calories of heat in the 365 days of one year. If we divide 18250 calories with 3500 calories (one pound of weight), it meant that we reduced 5.2 pounds of weight each year. If we increased 5 pounds of muscle through strength training, then we could reduce 26 pounds of weight each year. The reason why we maintain and increase our muscle is important is that, after one passes the age of 20, our body will be reduced 7 pounds of muscle every ten years, namely, 0.7 pound each year. For females, they lose one pound of muscle each year during the period of menopause and pausimonia. Thus, the situation is more unfavorable for them. That is why the older one becomes, the more difficult it is to control the weight.

3.2 Analysis of reasons for changes of WHR

After the experiment for 12 weeks, obvious changes have taken place in WHR in the control group and the experiment group, and quite obvious change took place in the experiment group. This might be related with the following several factors. Firstly, professional class of aerobic exercise is an aerobic movement of the whole body with strong sports movement. Content of each class includes warm-up, flexibility practice and aerobic exercise, etc, which is able to improve the aerobic working capacity of the human body, excite the sympathetic nerve and cause increased secretion of catecholamine and adrenal gland sebum and reduced secretion of insulin, etc. However, aerobic exercise can obviously increase activity of Lipoprotein Lipase (LPL), and increased activity of Lipoprotein Lipase (LPL) is able to promote decomposition of fat within the body during and after the movement and increase use of fat as energy. Thus, aerobic exercise is able to increase the ability of fat within the body used to supply energy, reduce the fat within the body. Practice of flexibility is also able to lengthen the line of the waist, reduce the waistline and reduce WHR. Secondly, strength training was added in the experiment group and strength training was able to increase muscle of the lean body mass, reduce internal fat, accelerate the speed of metabolism of the body and make the consumption of the heat in the body increase to a large extent within the 24 hours of one day. Besides, increase of the lean body mass may enable the free fatty acids decomposed by the adipose tissue to release with blood circulation to the muscle and oxidized for use of its energy. Thus, consumption of internal fat is more obvious. Thirdly, for muscle and fat with the same weight, the volume of fat is 8 times the volume of the muscle. Strength training is able to reduce the fat heaped up around the waist, increase the muscle and obviously reduce WHR. Hence, in order to make ourselves look more slender, we ought to reduce our fat and increase our muscle. Strength training is the most feasible way to increase our muscle.

Here, it should be mentioned, quite a large number of female students were at first worried that strength training might make them look like a body builder who is robust and has muscle pieces all over the body from head to foot. As a matter of fact, the intensify and volume of our strength training could not have brought about such an effect at all.

4. Conclusions and suggestions

1) Under the condition with limited time of practice and low frequency, pure aerobic exercise has no obvious improvement on the BMI of female students, while combination of strength training and aerobic exercise is more likely to obviously improve the BMI of female students compared with pure aerobic exercise.

2) Pure aerobic exercise and combination of strength training and aerobic exercise can both reduce the WHR of female students, while combination of strength training and aerobic exercise is more likely to obviously reduce the WHR of female students compared with pure aerobic exercise.

3) Combination of strength training and aerobic exercise is more likely to reduce fat, increase the lean body mass and build a healthy and beautiful shape.

4) Sports teachers ought to focus on teaching of physical fitness theory in their process of teaching, make clear wrong understanding of students, enable students to clearly know about the purpose and significance of exercise and make them actively and consciously do sports exercise and form the habit of sports in their life long time.

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Table 1. Changes of BMI before and after the experiment (n=64)

	Experiment class			Control class		
	Height	Weight	BMI	Height	Weight	BMI
Before the experiment	1.63±0.05	59.5±5.8	22.39±2.03	1.62±0.05	59.3±6.1	22.42±2.11
After the experiment	1.63±0.05	57.7±6.1	20.87±1.42	1.62±0.05	58.7±5.3	21.78±1.07
	P>0.05	P<0.01	P<0.01	P>0.05	P>0.05	P>0.05

Table 2. Changes of WHR before and after the experiment (n=64)

	Experiment class			Control class		
	Waist	Hip	WHR	Waist	Hip	WHR
Before the experiment	63.13±3.05	81.52±3.89	0.74±0.05	63.22±3.03	81.53±3.67	0.74±0.06
After the experiment	61.62±2.80	81.34±3.76	0.71±0.04	62.76±2.43	81.53±3.76	0.73±0.03
	P<0.01	P>0.05	P<0.01	P<0.05	P>0.05	P<0.05