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Influence of aerobic lt intensive training on obese female college students.

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Abstract

This paper adopts literature, experiment, and mathematical statistics, and conducts aerobic Lactate threshold (LT) intensive training for 30 cases of obese female college students without sports training history, medical history, or sports contraindications. For the high obesity rate of female college students, this paper aims to explore secure and effective weight loss plan for this group based on experimental research. After 15 weeks aerobic LT intensive training, the results are as follows:
(1) The body composition of the obese female college students tends to be normal, which means the goal of weight loss is fulfilled (P<0.05).
(2) The function index in the oxygen transport system of obese female college students is significantly improved, as well as respiratory and circulatory function (P<0.05).
(3) The blood sugar, blood fat, and serum insulin level of obese female college students are significantly improved and tend to be normal (P<0.05). The exercise load method can decompose the fat of obese female college students and increase Lean body mass (LBM), making body composition gradually to a normal level.

Keywords: Lactate threshold intensity, Aerobic exercise, Obesity, Female college students.

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Introduction

With the development of economy and the improvement of people's living standards, obesity has become a chronic non-communicable disease, which has become the main killer of people's health, instead of diseases caused by malnutrition and infection [1]. The increasingly higher obesity rate of female college students causes a lot of trouble for their life and employment. What's worse, obesity may lead to multiple chronic diseases, including hypertension, hyperlipidemia, coronary heart disease, stroke, diabetes, and fatty liver [2]. In this case, scientific intervention to lose weight has caused the attention of the whole society, despite long term aerobic exercise is widely considered to be a reasonable and effective method to lose weight [3]; in fact, the young obese group cannot stick to the habit due to the long-time duration. Then some scholars suggest that within the limit of the body, 85% $VO2_{max}$ high intensive exercise method with appropriate positive rest in short time should be a more effective way to lose weight [4]. However, high intensity means high exercise risk. On the above basis, this paper puts forward the LT intensive training method. Lactate threshold intensity is the highest intensity for aerobic exercise [5]. This method can ensure high intensity as well as long time. For the obesity of female college students, this paper explores secure and effective method to lose weight for this group, based on theoretical and experimental research.

Materials and Methods

Samples

35 cases of obese female college students without sports training history, medical history, or sports contraindications were selected (BF ≥ 30%, WHR ≥ 0.82). Refer to table 1 for details. The study was approved by Northeast Normal University ethical committee.

Table 1. *Basic body condition of the subjects before exercise (X ± SD) N = 35.*

Categories	Values
Number	35
Age	20.9 ± 3.5
Height (cm)	157.24 ± 5.12
Weight (kg)	65.32 ± 8.14
BF (%)	32.2 ± 5.23
WHR	0.83 ± 0.03
BMI	26.55 ± 1.81

Experiment

Subjects are connected to the METALYZER cardiopulmonary function test system introduced by German CORTEX through

the work platform and wear the Dutch telemetering heart rate meter Polar. Adopting load increasing method, lactate threshold, $VO2_{max}$, and VT of subjects are measured by gas low slope method while they are riding Monark839E bike. The corresponding intensity of LT is the LT intensity, which is the $_{max}$imum intensity of aerobic exercise. In this experiment, the lasting time of LT intensity exercise is 40 min each time, 4 times a week, for 15 weeks.

Before the experiment, conventional measuring method is used to measure the height, weight, WHR, BF%, and BMI of subjects. Adopt touch method to measure the HR_{Rest} (heart rate values at rest), mercury sphygmomanometer to measure Blood pressure (BP) (SBP and DBP, tested at 9:00 am), pneumatometer to measure Vital capacity (VC), glucose oxidase method to measure blood sugar, and automatic chemiluminescence analysis method to measure insulin. The measurement is completed by laboratory department of First People's Hospital of Chang De City. Four inspections of blood fat (plasma total cholesterol, triglycerides, high-density lipoprotein cholesterol, and low density lipoprotein cholesterol) are completed by First People's Hospital in Changde City. Repeat the above test after 15 weeks LT intensive aerobic exercise. The detection personnel, keeping personnel and participants were blind to each other.

Mathematical statistics

SPSS11.0 is used to perform statistical analysis of measured data, and the average ± standard deviation is used to observe the difference of subjects before and after experiment. T test was used in the comparison between different groups. $P<0.05$ means the difference is significant, and $P<0.01$ means the difference is very significant.

Results

Analysis on the morphological change of obese female college students before and after exercise

Table 2. *Morphological changes before and after exercise (M ± SD) N=35.*

Categories	Before training	After training
Weight (kg)	65.32 ± 8.14	61.59 ± 5.04
BMI	26.55 ± 1.81	24.87 ± 1.95
WHR	0.83 ± 0.03	0.80 ± 0.04
BF (%)	33.42 ± 5.23	29.12 ± 5.62
LBM	43.59 ± 3.7	43.98 ± 2.9

Analysis of weight change: The weight (total weight of the body) of obese female college student is beyond the average level. As is shown in Table 2, after 15 weeks exercise, the weight of subjects reduced from 65.32 ± 8.14 kg to 61.59 ± 5.04 kg. The difference is significant, with $P<0.05$.

Analysis on the change of BMI: BF and WHR. As is seen from table 2, BMI is reduced from 26.55 ± 1.81 to 24.87 ± 1.95. The difference is significant, with $P<0.05$. BF% is reduced from 33.42 ± 5.23 to 29.12 ± 5.62. The difference is significant, with $P<0.05$. WHR is reduced from 0.83 ± 0.03 to 0.80 ± 0.04. The difference is significant, with $P<0.05$.

Analysis on LBM change: LBM is weight without body fat, which is mainly composed of muscle and bone. LBM is in positive correlation with basal metabolic rate, i.e. the larger LBM, the more energy used during resting. In Table 2, LBM is increased from 43.59 ± 3.7 to 43.98 ± 2.9. Although the difference is not significant ($P>0.05$), after continuous exercise, the LBM improvement is expected to be more obvious and the body fat will be lower.

Analysis on the change of oxygen transport system function index of obese female college students before and after exercise

Analysis on HR_{Rest} change: In this experiment, as is shown in table 3, after 15 weeks exercise, the HR_{Rest} is reduced from 79.21 ± 2.58 to 77.34 ± 2.32 beat/min. The difference is significant, with $P<0.05$. The result shows that LT intensive exercise can effectively improve heart pump function and slow the HR_{Rest}.

Table 3. *Change of oxygen transport system function index before and after exercise (M ± SD) N = 35.*

Categories	Before training	After training
HRRest (beat/min)	79.21 ± 2.58	77.34 ± 2.32*
SBP (mmHg)	129.76 ± 9.06	126.03 ± 4.62*
DBP (mmH)	81.87 ± 5.32	79.73 ± 4.27*
VC (ml)	2585 ± 307.52	2986 ± 349.32*
VO2max (mg/kg/min)	32.9 ± 3.8	34.6 ± 4.3*
VT (mg/kg/min)	22.1 ± 3.8	23.9 ± 4.3*

* Compared with before training group, the level of index were increased or decreased significantly ($p<0.05$)

Analysis of BP change: As is seen from table 3, SBP is reduced from 129.76 ± 9.06 to 126.03 ± 4.62, while DBP is reduced from 81.87 ± 5.32 to 79.73 ± 4.27. The difference is significant, with $P<0.05$, which means LT intensive exercise can improve heart function and the function of cardiovascular system.

Analysis of VC change: The result shows that, VC is increased from 2585 ± 307.52 ml to 2986 ± 349.32 ml (the different is significant, with $P<0.05$), while the body weight is reduced, therefore, the VC body weight is significantly increased. After exercise, the coordination between breathing and movement is improved, respiratory muscle strength is increased, lung tissue elasticity is enhanced, and respiratory function is improved, thus the VC is increased.

Analysis of $VO2_{max}$ and VT change: The result shows that $VO2_{max}$ is increased from 32.9 ± 3.8 mg/kg/min to 34.6 ± 4.3 mg/kg/min, an average increasing of 1.7 mg/kg/min.

Analysis of biochemical index change of obese female college students before and after exercise

Analysis of blood sugar change before and after exercise: As is can be seen from table 4, blood sugar is decreased from 4.72 ± 0.18 mmol/L to 4.43 ± 0.09 mmol/L.

Table 4. *Change of biochemical indexes before and after exercise (mmol/L) (M ± SD) N=35.*

Categories	Before training	After training
Blood sugar	4.72 ± 0.18	4.43 ± 0.09*
Insulin (ng/L)	29.83 ± 12.32	17.69 ± 10.34 *
Triglycerides	1.53 ± 0.48	1.12 ± 0.37*
Total Cholesterol	4.78 ± 0.39	4.09 ± 0.28*
High density lipoprotein cholesterol (hdl-c)	1.67 ± 0.19	1.83 ± 0.31*
Low density lipoprotein cholesterol (hdl-c)	3.47 ± 0.38	2.66 ± 0.35*

* Compared with before training group, the level of index were increased or decreased significantly (P<0.05)

Analysis of serum insulin change before and after exercise: Table 4 shows that after 15 weeks LT aerobic exercise, serum insulin is reduced from 29.83 ± 12.32 ng/L to 17.69 ± 10.34 ng/L. The difference is significant, with P<0.05.

Analysis of four items change of blood fat before and after exercise: As can be seen from table 4, the total cholesterol is reduced from 4.78 ± 0.39 mmol/L to 4.09 ± 0.28 mmol/L. The difference is significant, with P<0.05.Ldl-c is reduced from 3.47 ± 0.38 mmol/L to 2.66 ± 0.35 mmol/L. The difference is significant, with P<0.05. At the same time, hdl-c is increased from 1.67 ± 0.19 mmol/L to 1.83 ± 0.31 mmol/L. The difference is very significant, with P<0.01. The result shows that long term aerobic LT intensive exercise can help improve the blood fat of obese female college students, thus to reduce the incidence of atherosclerosis and CHD.

Discussion

LT intensity is the highest exercise intensity, which provides energy by consuming body fat. Being able to keep on exercising for a long time, the accumulation of body fat is reduced to realize the goal of losing weight. The results show that LT intensive exercise can improve body sympathetic excitement, enhance lipase activity and the ability of muscle to use fat, thus to reduce body fat, especially from the belly, shape figure, and effectively prevent cardiovascular disease.

Oxygen transport system is composed of circulatory and respiratory systems. Studies have shown that in resting state, when cardiac output increases, the HR_{Rest} will decrease, meaning the HR_{Rest} reservation increases, which is an important indicator for strengthening of cardiac function [6].

For obese people, excessive fat is accumulated in the body, consumes a lot of blood supply and increases the burden of oxygen transport system. The accumulation of abdominal fat forces diaphragm to move up, which leads to the reduction of returned blood volume in diastole. What's more, the fat accumulation on the heart leads to weakening of heart contraction, reducing the cardiac output, and slowing blood flow. Therefore, obese people are easy to feel shortness of breath and fatigue.

BP includes SBP and DBP, which are important indicators of cardiovascular function. For obese people, large amount of fat is accumulated in blood vessel, narrowing the diameter, increasing the resistance, and raising the blood pressure. The risk of SBP and DBP of obese girls are 8.89 times and 7.06 times of normal weight girls. The resting BP of people of regular exercise is lower [7].

VC is the maximum lung ventilation capacity. As an important index of pulmonary ventilation function, the value is individually different, and related to height, weight, gender, and age [8]. VC body weight index is the ratio of VC and body weight, which can objectively reflect the influence of obesity on lung function [9]. The VC of the college students in normal weight is about 2500 ml. As is seen from table 3, the average VC of obese female college students is higher than college students with normal weight, while their VC body weight index is significantly lower than college students with normal weight

$VO2_{max}$ and VT are important indicators to evaluate the aerobic work capacity of the body. Heart pump function is the central mechanism that impacts $VO2_{max}$ ability and the ability of muscle to use oxygen is the peripheral mechanism that impacts $VO2_{max}$ [10]. As the results shown in Table4, this may be because that the heart pump function is enhanced, ventricular cavity volume is increased, peripheral blood capillary is richer, the number of mitochondria is larger with increased volume, thus the ability to obtain and use oxygen by the muscle is improved.

Blood sugar means the glucose in the blood. The energy required by some organs, including brain, heart, and visual organs is from glucose. The current research has shown that obese patients are often accompanied by high blood sugar, and obesity is strongly associated with type 2 diabetes. What's more, obesity will decrease insulin sensitivity, causing insulin resistance, higher blood sugar, and excessive fat accumulation. Therefore, positive and effective exercise methods can not only help to lose weight, but has important significance to adjust the blood sugar. The decreasing capacity of combination with insulin from the skeletal muscle insulin receptor of obese patients leads to insulin resistance, increases serum insulin, and causes more fat accumulation [11].

The difference is significant shown in Table 4, with P<0.05. This means that long term aerobic LT intensive exercise enhances the activity of glucose metabolism enzyme, improves the oxidation of muscle cell to sugar, increases the body's ability to decompose and use sugar, reduces the blood sugar

level of the obese, and reduces the incidence of obesity and diabetes.

Long term high intensive LT exercise can increase the muscle cell insulin receptor, enhance the combination ability of insulin and receptor, reduced insulin resistance and thus prevent the incidence of diabetes to a certain extent. Blood fat is closely related to the health of human body. Obesity is often associated with dyslipidemia, or hyperglycemia, and hyperlipidemia is an important risk factor of atherosclerosis and CHD [12]. Low density lipoprotein has high cholesterol level, which is easy to deposit in the artery wall, and is in positive correlation with atherosclerosis and CHD. As a carrier reverse transportation of cholesterol, hdl-c can reduce cholesterol deposition, which can prevent atherosclerosis.

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