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# Impacts of long-term aerobic exercise on the blood sugar, blood fat, and bodyweight of obese adolescents.

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## Abstract

**Objective: This research was aimed to investigate the effects of long-term aerobic exercise on the blood sugar, blood fat, and bodyweight of the obese adolescents.**
**Methods: The study involved 120 obese adolescents with irregular exercise and body fat over 30%. After entering the camp, all participants had to receive five weeks' closed nutrient and exercise interventions. They took two hours' aerobic exercise every morning and afternoon respectively, six days a week. And they need get 10 min warm-up before exercise and 15 min cool-down after it.**
**Results: After five weeks aerobic exercise, the heterosexual participants got some weight loss; their blood sugar indexes also reduced, and their abnormal blood sugar returned to the normal level.**
**Conclusion: Long-term aerobic exercise can validly decrease blood sugar and the risk of diabetes; meanwhile, it also plays a positive role in abating blood fat level of the obese teenagers.**

**Keywords:** Long-term aerobic exercise, Obese adolescents, Blood sugar, Blood fat, Body weight

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## Introduction

Currently, with the gradual improvement of material life level, the number of overweight and obese adolescents has increasingly risen [1], which lowers their physiological functions and physical quality and elevates the incidence of metabolic diseases such as hypertension and dyslipidemia little by little [2-5]. For the teens, obesity may have an influence on their mental, and the incidence of the disease described above is higher than the normal teenagers [6,7]. Consequently, a reliable and safe method will be found to strengthen the constitution of the obese adolescents and lessen the incidence of metabolic diseases, which is significant for their current and feature health and attracts more and more attentions, being a focus of study [8-10].

## Objects and Methods

### *Objects*

A total of 120 obese adolescents with irregular exercise and body fat over 30%, who decided to participate in the summer camp for weight loss, got involved in the study. Among them, 60 are males and 60 are females aged from 13 to 20 y old. The participants underwent physical examination and exercise tolerance test firstly. If they were discovered with cardiovascular dysfunction, they wouldn't be ineligible for the study. They all volunteered to join in the study, and were assigned into male group and female group in the light of their sex. Their general data were shown in Table 1.

*Table 1. General data of the participants.*

| Sex | Numbers | Age (y) | Height/cm | Bodyweight/kg | BMI |
|---|---|---|---|---|---|
| Male | 60 | 16.3 ± 2.6 | 173 ± 7.76 | 104.4 ± 16.2 | 35.88 ± 5.22 |
| Female | 60 | 17.8 ± 2.9 | 161.2 ± 8.27 | 88.05 ± 19.91 | 35.74 ± 10.93 |
| Overall | 120 | 17.2 ± 2.7 | 167.3 ± 7.57 | 95.37 ± 17.23 | 35.81 ± 8.25 |

### *Exercise scheme*

All participants received five weeks closed nutrient and exercise interventions in the camp. Dietitians arranged the teens' diet based on their Basal Metabolic Rate (BMR). We determined their exercise intensity according to the participants' healthy conditions and the results of exercise tolerance test, formulating personalized exercise schemes for various individuals. The modes of exercise mainly included several indoor and outdoor activities such as swimming, jogging, brisk walking, and aerobics. All participants took two hours' aerobic exercise each morning and afternoon respectively, 10 min warm-up before exercise and 15 min cool-down after exercise, six days a week. During the exercise, they all would have three short breaks. When doing exercise, the participants were supervised by coaches and monitored by health care providers.

### Measurement of the body shape indexes

Before the adolescents entered the summer camp and got five weeks exercise later, we measured the participants' body shape indexes like height, body weight, fat mass, waist circumference, hip circumference, body fat, and Lean Body Mass (LBM), and then calculated their Body Mass Index (BMI) based on the measuring findings. Height, bodyweight, body fat, and fat mass were tested using a human body-component analyzer provided by a Japanese company, and the waist circumference was measured with a tape measure, so did the hip circumference. All measurements for the body shape indexes were conducted by one person.

In the process of testing the waist circumference, the teens were asked to be in natural stance with feet closing. The tape measure was wrapped around their waist at the level of the navel. When they completed expiration, the value was what we wanted. When measuring the hip circumference, we selected to estimate the girth at the level of the apex of gluteus maximus.

### Measurement of blood sugar and blood fat

On the second day and the last but one day of the camp morning, the participants under fasting were collected 5 ml venous blood with special use anticoagulative tubes for plasma renin-angiotensin-aldosterone test and disposable negative venous blood sample collectors. The blood samples were centrifugated at 3,000 r/min for 10 min. The plasma was collected from the tube and serums were gathered with the collectors, stored at -80°C, which were sent to a medical test center for detections.

The indexes of test mainly involved blood fat indexes and blood sugar indexes. The blood fat indexes included High Density Lipoprotein cholesterol (HDL-c), Low Density Lipoprotein cholesterol(LDL-c), Total Cholesterol (TG), and Triglyceride (TG), which were tested by enzyme methods. The blood sugar indexes commonly comprised Fasting Blood Glucose (FPG), 2 h Postprandial Glucose (2 h PG), glycated hemoglobin (HbAIC), which were examined using glucose oxidase methods.

### Statistical analysis

All data were analysed by software SPSS 18.0 and expressed with mean ± SEM ($\bar{x} \pm SD$). The data of each group between and after the experiment were compared using paired t test. $P<0.05$ was defined as significance, while $P<0.01$ was considered as extremely significant difference.

## Results

### Impacts of long-term aerobic exercise on body shape and bodyweight of the obese adolescents

Table 2 showed that the changes of the body shape and bodyweight of the obese adolescents after five weeks' aerobic exercise. According to the Table 2, after five weeks' exercise, the height of obese adolescents had risen to an extent compared with before exercise, but without statistical difference ($P>0.05$); their bodyweight, BMI, waist circumference, hip circumference, body fat, and fat mass were much lower than that before exercise ($P<0.01$); there into, the bodyweight of male participants reduced 10.66%, fat mass decreased 11.5%, and LBM declined 0.95%. In the female participants, bodyweight reduced 5.84%, fat mass decreased 6.97%, and LBM declined 1.24 %. On the basis of the finding mentioned above, it was known that in the male, the extent of weight loss and fat mass loss was higher than that in the female, but the LBM loss was less than that in the female.

### Impact of long-term aerobic exercise on the blood sugar of the obese adolescents

Table 3 represented that the changes of the blood sugar of the obese adolescents after five weeks' aerobic exercise. According to the Table 3, after five weeks' aerobic exercise, the FPG level of heterosexual obese adolescents reduced more than that before exercise, with an extremely significant difference, $P<0.01$; the 2 h PG level decrease fewer, but without statistical difference, $P>0.05$; HbAIC lessened much more, $P<0.05$.

***Table 2.*** *The changes of the body shape and bodyweight of the obese adolescents after five weeks' aerobic exercise.*

| Indexes | Male | | Female | |
|---|---|---|---|---|
| | Before aerobic exercise | After aerobic exercise | Before aerobic exercise | After aerobic exercise |
| Height/cm | 173 ± 7.76 | 173.4 ± 7.77 | 161.2 ± 8.27 | 162.3 ± 8.19 |
| Body Weight (BW)/kg | 104.4 ± 16.1 | 94.9 ± 14.84** | 88.05 ± 19.92 | 83.28 ± 19.69** |
| BMI | 35.88 ± 5.21 | 32.51 ± 3.55** | 35.74 ± 10.92 | 33.42 ± 10.81** |
| Waist circumference/cm | 102.4 ± 17.98 | 96.23 ± 16.47** | 83.79 ± 48.66 | 78.17 ± 45.71** |
| Hip circumference /cm | 110.2 ± 13.67 | 104.1 ± 14.75** | 85.26 ± 51.73 | 80.11 ± 49.18** |
| Body fat/% | 41.07 ± 5.92 | 35.29 ± 4.18** | 44.94 ± 7.94 | 39.23 ± 6.45** |
| Fat Mass (FM)/kg | 45.01 ± 12.2 | 34.7 ± 10.12** | 45.89 ± 18.73 | 39.04 ± 17.72** |

| | | | | |
|---|---|---|---|---|
| Lean Body Mass (LBM)/kg | 60.44 ± 8.16 | 61.28 ± 7.02 | 44.22 ± 7.55 | 45.35 ± 7.83** |
| Change rate of BW/% | 10.66 ± 3.08 | 5.84 ± 1.77 | | |
| Change rate of FM/% | 11.5 ± 4.73 | 6.97 ± 2.64 | | |
| Change rate of LBM/% | 0.95 ± 20.8 | 1.24 ± 1.79 | | |

Note: *Represents that compared with before long-term exercise, there was significant difference, $P<0.05$; **Compared with before long-term exercise, there was extremely significant difference, $P<0.01$.

***Table 3.*** *The changes of the blood sugar of the obese adolescents after five weeks' aerobic exercise.*

| Indexes | Male | | Female | |
|---|---|---|---|---|
| | Before aerobic exercise | After aerobic exercise | Before aerobic exercise | After aerobic exercise |
| FPG/(nmol•L$^{-1}$) | 8.74 ± 0.89 7. | 79 ± 1.43** | 8.76 ± 0.89** | 7.72 ± 1.51** |
| 2 h PG/(nmol•L$^{-1}$) | 13.14 ± 1.27 | 12.53 ± 2.34 | 13.19 ± 1.28 | 12.33 ± 2.65* |
| HbAIC/% | 8.14 ± 0.81 | 7.33 ± 1.41* | 8.17 ± 0.82* | 7.36 ± 1.57* |

Note: *Represents that compared with before long-term exercise, there was significant difference, $P<0.05$; **Compared with before long-term exercise, there was extremely significant difference, $P<0.01$.

### *Impact of long-term aerobic exercise on the blood fat of the obese adolescents*

Table 4 pointed out that the changes of the blood fat of the obese adolescents after five weeks' aerobic exercise. From Tables 1-4, they described the changes of TC, LDL-C, TG, and HDL-C in the participants before and after long-term exercise, respectively.

***Table 4.*** *The changes of the blood fat of the obese adolescents after five weeks' aerobic exercise.*

| Indexes | Male | | Female | |
|---|---|---|---|---|
| | Before | After | Before | After |
| TG/(mmol•L$^{-1}$ ) | 1.6 ± 2.1 | 0.8 ± 0.6** | 1.3 ± 0.6 | 1.2 ± 0.3** |
| TC/(mmol•L$^{-1}$ ) | 5.8 ± 1.2 | 3.7 ± 1.5* | 3.8 ± 0.6 | 3.7 ± 2.0.6** |
| HDL-C/(mmol•L$^{-1}$ ) | 1.4 ± 0.4 | 1.3 ± 0.4 | 1.7 ± 0.4 | 1.4 ± 0.3 |
| LDL-C/(mmol•L$^{-1}$ ) | 3.1 ± 0.8 | 2.2 ± 0.6** | 3.2 ± 0.7 | 2.4 ± 0.5** |

Note: *Represents that compared with before long-term exercise, there was significant difference, $P<0.05$; **Compared with before long-term exercise, there was extremely significant difference, $P<0.01$.

In the light of Table 4, we suggested that, after five weeks' aerobic exercise, in the male participants, the TG and LDL-c levels were much lower than that before exercise, $P<0.01$; the TC level lessened much, $P<0.05$; but the HDL-c level had no difference, $p>0.05$; in the female participants, the levels of TG, TC, LDL-c decreased much more than that before exercise, while the level of HDL-c got no difference.

Table 5 pictured the comparison findings on the number of the adolescent with abnormal blood fat and blood sugar indexes before and after long-term aerobic exercise.

***Table 5.*** *Comparison on the number of the adolescent with abnormal blood fat and blood sugar indexes before and after long-term aerobic exercise.*

| Indexes | Male | | Female | |
|---|---|---|---|---|
| | Before | After | Before | After |
| FPG | 0 | 0 | 3 | 0 |
| 2 h PG | 2 | 0 | 1 | 0 |
| HbAIC | 3 | 0 | 1 | 1 |
| TG | 5 | 1 | 1 | 1 |
| TC | 7 | 0 | 3 | 0 |
| HDL-C | 1 | 0 | 1 | 0 |
| LDL-C | 1 | 0 | 0 | 0 |

After analyzing Table 5, it was known that the number of abnormal blood fat and blood sugar in the male and female participants reduced from 19 and 9 to 0 and 1, separately.

## Discussion

With analyzing the effect of long-term aerobic exercise on the body shape and weight of the obese adolescents, we believe that both of their body shape and weight has reduced after five weeks' exercise, indicating that it can selectively mobilize the fat *in vivo*, abdominal fat first and coxal fat second. Therefore, long-term aerobic exercise is able to effectively reduce the obese adolescents' fat and their weight.

According to the analysis on the impacts of long-term aerobic exercise on the blood sugar of the obese teenagers, we find that, after five weeks' exercise, their blood sugar indexes has lessened, and the blood sugar level in the participants with abnormity has returned to normal, proving that it can validly lower blood sugar level and cut down on the risk of diabetes, being essential for their constitution polished up.

On the basis of the impacts of long-term aerobic exercise on the blood fat of the obese adolescents, it is known that it has a positive effect on the improvement of the teens' blood fat level.

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