IMPACTS OF AEROBIC EXERCISE ON THE OBESITY OF ADOLESCENTS AND THEIR LIPID METABOLISM

IMPACTOS DO EXERCÍCIO AERÓBICO SOBRE A OBESIDADE JUVENIL E SEU METABOLISMO LIPÍDICO

IMPACTOS DEL EJERCICIO AERÓBICO EN LA OBESIDAD JUVENIL Y SU METABOLISMO LIPÍDICO

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ABSTRACT

Introduction: The obesity rate of Chinese adolescents has reached an alarming level, where about 11% of Chinese children are overweight, making them more prone to diseases such as hypertension, abnormal physiological metabolism, and high joint wear of the lower limbs. This public health problem can be alleviated with healthy habits, including aerobic exercise. Objective: Study the effect of aerobic exercise on obesity and lipid metabolism in adolescents. Methods: In this randomized controlled trial, 40 young volunteers were equally allocated into experimental and control groups. The control group received no intervention, while the experimental group was trained according to a professionally designed aerobic exercise protocol for 28 days. Training data were recorded before, during, and after the exercises. The information was processed, compared, and analyzed. Results: The control group failed to reduce body fat effectively; an aerobic exercise in the experimental group showed better effects in reducing body weight, body fat, waist-to-hip ratio, and weight loss; compared to the control group. Immediately after the intervention, the HDL level of the experimental group showed an upward trend, while the TC, TG, and LDL indices showed a downward trend. Conclusion: Aerobic exercise can effectively increase muscle mass and basal calorie and fat intake, reducing youth obesity. ***Level of evidence II; Therapeutic studies - investigating treatment outcomes.***

Keywords: Adolescent; Aerobic Exercise; Obesity Management.

RESUMO

Introdução: A taxa de obesidade de adolescentes chineses atingiu um nível alarmante onde cerca de 11% das crianças chinesas estão acima do peso, tornando-se mais propensas a adquirirem doenças como hipertensão arterial, metabolismo fisiológico anormal e elevados desgastes articulares dos membros inferiores. Esse problema de saúde pública pode ser amenizado com hábitos saudáveis, incluindo o exercício aeróbico. Objetivo: Estudar o efeito do exercício aeróbico sobre obesidade e o metabolismo lipídico dos adolescentes. Métodos: Nesse ensaio clínico randomizado controlado, 40 jovens voluntários foram igualmente alocados em grupos experimental e controle. O grupo controle não recebeu intervenção alguma enquanto o grupo experimental foi treinado segundo um protocolo de exercícios aeróbicos elaborado por profissionais durante 28 dias. Foram registrados os dados de treinamento, antes durante e após os exercícios. As informações foram tratadas, comparadas e analisadas. Resultados: O grupo controle não conseguiu reduzir efetivamente a gordura corporal, o exercício aeróbico no grupo experimental apresentou melhores efeitos na redução do peso corporal, gordura corporal, relação cintura-quadril e perda de peso; em comparação com o grupo controle. Imediatamente após a intervenção, o nível de HDL do grupo experimental mostrou uma tendência de alta, enquanto os índices TC, TG e LDL apresentaram tendência de queda. Conclusão: O exercício aeróbico pode efetivamente aumentar a massa muscular, o consumo basal de calorias e gordura, alcançando a redução eficaz da obesidade juvenil. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Adolescente; Exercício aeróbico; Manejo da obesidade.*

RESUMEN

Introducción: La tasa de obesidad de los adolescentes chinos ha alcanzado un nivel alarmante en el que cerca del 11% de los niños chinos tienen sobrepeso, siendo más propensos a adquirir enfermedades como la hipertensión, un metabolismo fisiológico anormal y un elevado desgaste articular de las extremidades inferiores. Este problema de salud pública puede paliarse con hábitos saludables, entre ellos el ejercicio aeróbico. Objetivo: Estudiar el efecto del ejercicio aeróbico sobre la obesidad y el metabolismo lipídico en adolescentes. Métodos: En este ensayo controlado y aleatorizado, 40 jóvenes voluntarios fueron asignados por igual a los grupos experimental y de control. El grupo de control no recibió ninguna intervención, mientras que el grupo experimental fue entrenado según un protocolo de ejercicio aeróbico diseñado por profesionales durante 28 días. Los datos del entrenamiento se registraron antes, durante y después de los ejercicios. La información fue procesada, comparada y analizada. Resultados: El grupo de control no logró reducir eficazmente la grasa corporal, el ejercicio aeróbico en el grupo experimental mostró mejores efectos en la reducción del peso corporal, la grasa corporal, la relación cintura-cadera y la pérdida de peso; en comparación con el grupo de control. Inmediatamente después de la intervención, el nivel de HDL del grupo experimental mostró una tendencia

al alza, mientras que los índices de TC, TG y LDL mostraron una tendencia a la baja. Conclusión: El ejercicio aeróbico puede aumentar eficazmente la masa muscular, la ingesta calórica basal y las grasas, logrando una reducción efectiva de la obesidad juvenil. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Adolescente; Ejercicio Aeróbico; Manejo de la Obesidad.*

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INTRODUCTION

In the current social and economic development of China, the obesity rate of teenagers is rising year after year. This phenomenon does not only appear in China. A survey conducted by the relevant department of health management in the United States shows that the proportion of obesity among teenagers and children has doubled in the United States, which has attracted the attention of the country. The obesity rate of Chinese teenagers has reached an alarming level. After investigation, it is found that about 11% of children in China are overweight, especially in big cities such as Beijing and Shanghai. 16% - 20% of teenagers are still obese. In the United States, China, Japan and other countries, with the economic development and the improvement of living standards, the population is rapidly becoming obese.[1]

Aerobic exercise in the traditional sense is that the human body has sufficient oxygen in the sports, that is, the oxygen inhaled by the human body during exercise to achieve physiological balance.[2] Common aerobic exercises include walking, running, skating, swimming, outing, pedal exercises, aerobics, mountaineering machines, sports equipment, elliptical machines, etc. Principle of aerobic exercise to lose weight: simple aerobic exercise can directly affect the volume of fat cells through physical exercise and have a significant impact on fat metabolism in the body. When people are doing aerobic exercise, the heat provided by sugar in the body is far from meeting the needs of the human body. Fat is mainly oxidized and decomposed by supplying oxygen, so as to produce the heat energy required by the human body. Therefore, aerobic exercise to lose weight mainly uses fat combustion to obtain energy and promote body consumption, so as to reduce fat synthesis and achieve the effect of weight loss. Therefore, aerobic exercise is a scientific and reasonable way to lose weight. It has good effect and is not easy to rebound.[3]

On the current global situation, obesity has become a global concern. The research direction of many experts is how to lose weight scientifically. Compared with normal people, obese people are more likely to lead to diseases such as hypertension and abnormal physiological metabolism, causing great pressure on lower limbs, and long-term activities are easy to cause joint wear. Therefore, we need to find more reasonable and effective training methods to solve the problem of obesity in practical research. Therefore, through the exercise of fitness and weight loss, it is found that aerobic exercise has a more obvious effect on the weight loss of obese teenagers.[4,5]

METHOD

Data collection

Consulting and interviewing scholars who have rich experience and have been engaged in physical education teaching and weight loss research for many years, giving opinions on the content, method and purpose of this research, understanding their views on aerobic exercise weight loss, and clarifying the idea and framework of this research through interview and discussion.

This experiment adopts the experimental mode of "experimental group + control group". According to the experimental needs, 40 subjects are divided into two groups according to (gender, age, height, weight, etc.), one of which is the experimental group and the other is the control group. The study and all the participants were reviewed and approved by Ethics Committee of Southwest Minzu University (NO. 2019SMU-FD045). The experimental group did aerobic exercise, while the control group did not do any action. All subjects stayed in the same place, had meals and rest at the same time, and exercised in the morning and afternoon of each week. At 8:00 every morning, the weight was weighed barefoot on an empty stomach and recorded by the trainer. After 4 weeks of closed training, according to the post-test results of the experimental group and the control group, the effects of the two methods on the evaluation of obese adolescents were discussed. The sample information of specific subjects is shown in Table 1, which shows that:

Table 1 test data shows that there is no significant difference between the two groups in height, weight, age and other indicators ($P > 0.05$). In addition, the subjects' questionnaire survey, physical fitness monitoring and physical examination are within the conventional framework, and the experiment can be carried out if they meet the experimental requirements.

The exercise mode of the experimental group is shown in Table 2:

Test indicators: Body shape recognition: the tester used in this experiment is the Tanita component tester of the fitness center. The tester is produced by a company and is mainly used for human body composition test.

The test contents of this experiment include: basic indicators: height, weight, body fat rate, BMI, waist hip ratio and various blood lipids.

Test method: Physical analysis test method: the student's physical analysis test is carried out by the Tanita physical analysis tester in the fitness center. After entering the participant number, ask the participant to take off their shoes and stand on the test bench. Decorations, metal or hard objects are not allowed during the test. The subjects held their hands on the two handles of the instrument, kept silent during the test, and their bodies should not tremble. At the same time, measure

Table 1. Independent sample t-test for height, weight and age of obese adolescents in the two groups.

Group	Height(cm)	Weight (kg)	Age (n)
Control	174.0±6.41	98.70±12.71	15±1.12
Test	173.5±6.85	99.10±13.86	15±1.08
T	0.2929	0.3762	0.1287
P	0.7373	0.7029	0.9108

Table 2. Exercise patterns of aerobic exercise in the experimental group.

	Aerobic exercise
Exercise time	Ten chop of warmth, joint activities and dynamic stretching ten minutes. It is then 40 minutes of aerobic exercise, forty minutes of sports games (including rest), and finally 20 minutes of flexibility practice and relaxation. According to the student's situation, adjust the runtime of each link accordingly to achieve the effect of damaging fat.
Sports content	Treadmill, dynamic bicycle, outing, pedal, aerobics, mountaineering, power car, elliptical machine, swimming, field run, etc.
Sports intensity	Starting 60% to 80% Vmax, according to the students themselves, adjust the exercise load and strength appropriately.

the height, weight and body fat percentage of the subjects, and finally record the data again.

After disinfection, venous blood was collected from the elbow vein and placed in the blood collection vessel anticoagulated by EDTA. The serum was then collected by centrifugation at 3000g for 5 minutes and then tested at 4°C. The levels of serum triglyceride (TG), total cholesterol (TC), low density lipoprotein (LDL) and high-density lipoprotein (HDL) were measured by automatic life analyzer. TC, TG, LDL and HDL test kits were purchased from elabscience. The specific working steps of the experimental test were carried out in strict accordance with the kit instructions.

Data analysis

This paper adopts SPSS17 0 statistical input and analysis of experimental data. Paired sample t-test was used for the comparison before and after the same group, and independent sample t-test was used for the comparison between the two groups. The results were expressed as mean and variance (M ± SD), and the statistical significance was expressed as $P < 0.05$.

RESULTS

The effect of body fat percentage

Weight is the body weight measured naked or wearing work clothes of known weight. After the subjects in the control group and the experimental group completed the closed training of different exercise modes for 4 weeks, it can be seen from the data in Table 3 that the weight of the subjects in both groups decreased significantly. From the results of weight changes of the two groups after the experiment, the average weight of the subjects in the control group decreased from 100.5kg to 98.68kg, a decrease of 1.82kg, with a great difference ($s < 0.01$). The average weight of subjects in the experimental group decreased from 99.7kg to 92.1kg, with a decrease of 7.6kg ($P < 0.01$). In contrast, the average weight of the subjects in the experimental group decreased by 5.78 kg compared with the control group ($P < 0.05$). According to the weight loss data, when the exercise time, exercise facilities, housing and diet are consistent, the weight loss effect without aerobic exercise is significantly lower than that of aerobic exercise. It shows that the weight loss effect of aerobic exercise is obvious.

Body fat rate refers to the percentage of body fat relative to body weight. Body fat rate is an important index to measure a person's obesity. It can be seen from table 4 that the percentage of body fat of all subjects in the control group and the experimental group decreased after 4 weeks of closed training. In the control group, the percentage of body fat decreased from 40% to 39.8% before and after the experiment, with a decrease of only 0.2% ($P < 0.01$). The body fat rate of the subjects in the experimental group decreased from 40.2% to 35.8% before and after the experiment, and decreased by 4.4% ($P < 0.01$). In contrast, the experimental group decreased by 4.2% more than the control group ($P < 0.05$). After the experiment, by comparing the percentage of body fat, it is concluded that aerobic exercise has a significant impact on the fat content of obese adolescents.

Table 3. Effect of aerobic exercise on body weight.

Group	Stage	Weight (kg)	T	P
Test group	Forecast	99.7±11.2	18.53	<0.01
	Post test	92.1±10.3		
Control group	Forecast	100.5±14.2	15.32	<0.01
	Post test	98.68±13.8		
Comparison	Experimental group post test	92.1±10.3	2.68	0.036
	Control group post-test	98.68±13.8		

Table 4. Effect of aerobic exercise on body fat rate.

Group	Stage	Body fat rate (%)	T	P
Test group	Forecast	40.2±5.89	8.38	<0.01
	Post test	35.8±5.16		
Control group	Forecast	40.4±6.25	7.77	<0.01
	Post test	39.8±6.15		
Comparison	Experimental group post test	35.8±5.16	1.93	0.046
	Control group post-test	39.8±6.15		

Changes in lipid metabolism indicators

Compared with the control group, although there was no significant difference in various indexes ($P > 0.05$), high-density lipoprotein (HDL), total cholesterol (TC), triglyceride (TG) and low-density lipids were significantly increased in this experiment. The level of protein index (LDL) decreased significantly, with a good development trend. This shows that aerobic exercise plays a key role in improving blood lipid metabolism and regulating blood lipid metabolism of obese adolescents. The changes of aerobic exercise on total cholesterol indicators are shown in Figure 1:

The effect of aerobic exercise on triglyceride index is shown in Figure 2:

DISCUSSION

Positive effects of aerobic exercise on adolescent obesity

Measured by the body shape changes in 4 weeks before and after exercise intervention, the impact of exercise intervention on body shape changes is positive, which also shows the effectiveness of exercise intervention on obese adolescents. Its main performance is the reduction of body fat rate, but the effect is not particularly obvious. The reason may be that the body is in a period of rapid growth and all parts of the body are developing. Although the percentage of body fat decreased after 4 weeks of exercise intervention, it did not increase significantly. On the contrary, these changes showed a trend of increasing sebum thickness in the control group of obese adolescents. The waist circumference of

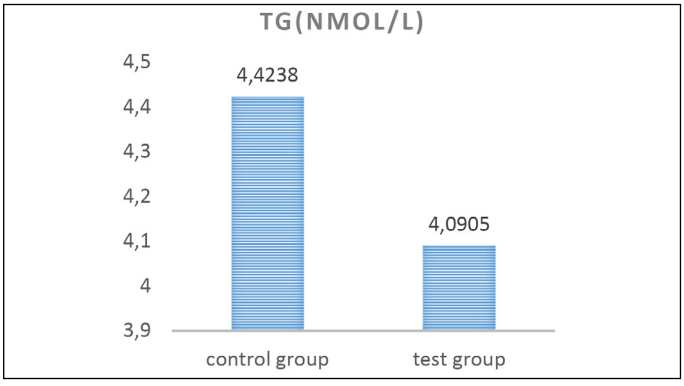

Figure 1. Effect of aerobic exercise on total cholesterol index.

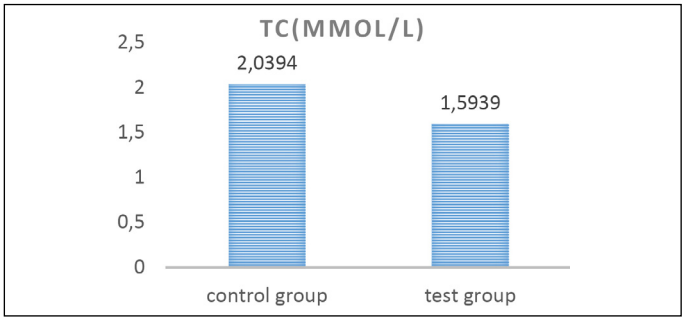

Figure 2. Effect of aerobic exercise on triglyceride index.

the subjects in the control group did not decrease significantly before and after the experiment, indicating that no aerobic exercise has no alleviating effect on obese young people. The body circumference index of obese adolescents in the experimental group decreased sharply after aerobic exercise intervention, indicating that aerobic exercise has a significant impact on the waist hip ratio of adolescents, which also reflects its alleviating effect on obesity.

Regulating effect of aerobic exercise on blood lipid metabolism

The analysis of the experimental results shows that 4 weeks of aerobic exercise can reduce TG, TC and LDL in the serum of obese adolescents, and promote the development of HDL through aerobic intervention. Studies in the literature show that moderate aerobic exercise for more than 6 weeks can effectively reduce TG, TC and LDL in rat blood lipid, increase HDL and protect blood. Experiments show that aerobic exercise can improve animal blood lipid to a certain extent. This experiment is consistent with its results. The main reasons for the no significant difference are as follows: first, the 4-week experimental intervention time is limited by the service cycle of experimental equipment and laboratory, and the time is short, which can not achieve the ideal effect of intervention. Second, due to the living conditions of individual subjects, it is difficult to maintain the same exercise frequency and effect of all people. The relatively low intervention frequency is also an important reason for the unsatisfactory intervention effect. Third, due to the great differences in personal physical condition, exposure history and skill level of obese people, most of them rarely participate in special sports, so it takes a long time to learn aerobic exercise. At the same time, it is necessary to take care of the mastery of most subjects during practice. As a result, the amount and intensity of aerobic exercise intervention are different from those envisaged and designed for some subjects. Fourth, some obese subjects did not carry out all necessary exercise intervention or adjust their diet structure according to the instructions during the study, which affected the intervention effect to a certain extent. However, the analysis of the experimental results shows that long-term moderate intensity aerobic exercise can effectively use body fat, decompose triglycerides into FFA, reduce the density of total cholesterol, triglycerides and leptin, and increase the high-density lipoprotein that can protect cardiovascular and cerebrovascular vessels. It is believed that if this trend continues, the experimental results will reach an ideal state.[6]

CONCLUSION

People's quality of life is still rising, and obesity has become a serious hidden danger to human health in the 21st century. Today, the obesity rate in some developing countries is rising sharply, especially in Asia and some Pacific Island countries, especially teenagers. In the long run, a large number of obese people in the future are teenagers. Accordingly, these will become risk factors and hide in people's physique. In recent years, the research on adolescent obesity has attracted more and more attention. This study uses aerobic exercise to test the effects of aerobic exercise on weight, fat content and body fat metabolism of obese adolescents, and analyzes the effects of aerobic exercise on blood lipid regulation of young obese adolescents, hoping to be helpful to obese adolescents.

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REFERENCES

1. Qasim A, Turcotte M, de Souza RJ, Samaan MC, Champredon D, Dushoff J, et al. On the origin of obesity: identifying the biological, environmental and cultural drivers of genetic risk among human populations. Obes Rev. 2018;19(2):121-49.
2. Barazzoni R, Bischoff S, Boirie Y, Busetto L, Cederholm T, Dicker D, et al. Sarcopenic obesity: time to meet the challenge. Obes Facts. 2018;11(6):294-305.
3. Wittels P, Mansfield L. Weight stigma, fat pedagogy and rediscovering the pleasures of movement: Experiencing physical activity and fatness in a public health weight management programme. Qual Res Sport Exerc Health. 2021;13(2):342-59.
4. Michalsky MP, Inge TH, Simmons M, Jenkins TM, Buncher R, Helmrath M, et al. Cardiovascular Risk Factors in Severely Obese Adolescents: The Teen Longitudinal Assessment of Bariatric Surgery (Teen-LABS) Study. JAMA Pediatr. 2015;169(5):438-44.
5. DRI. Dietary Reference Intakes: Application in dietary assessment Washington. National Academic Press; 2000.
6. Castro JA, Nunes HE, Silva DA. Prevalence of abdominal obesity in adolescents: association between sociodemographic factors and lifestyle. Rev Paul Pediatr. 2016;34(3):343-51.