STUDY ON PHYSICAL TRAINING IN THE LIPID METABOLISM REGULATION OF OBESE ADOLESCENTS

ESTUDO SOBRE TREINAMENTO FÍSICO NA REGULAÇÃO DO METABOLISMO LIPÍDICO EM ADOLESCENTES OBESOS

ESTUDIO SOBRE EL ENTRENAMIENTO FÍSICO EN LA REGULACIÓN DEL METABOLISMO LIPÍDICO EN ADOLESCENTES OBESOS

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ABSTRACT

Introduction: In proportion to the development of the economy, the problem of obesity among adolescents is also increasing. This abnormal lipid metabolism index can influence other physical diseases besides harming the social development of youth. Objective: Investigate physical training and the regulation of lipid metabolism in adolescents, improving the metabolic index of obese youth. Methods: 80 obese adolescents with equal numbers of both genders were randomly assigned into experimental and control groups. The experimental group received daily 80-min sports training (aerobics, walking, badminton, swimming, and other sports with low intensity and long duration) six times a week for one month, without distinction of exercise intensity or frequency for gender. A comparison method was performed between the groups before and after the intervention with indicators including body weight, BMI, fluid ratio, water measurement, waist, hip, skinfold thickness, FBG, CT, Tg, HDL - C, and LDL - C, among others. Results: Physical training can effectively improve adolescents' body shape. Blood indices and other indicators except for HDL-C positively correlate with this body shape. Physical training substantially improved lipid metabolism in obese adolescents. Conclusion: The exercise regimen of this experiment proved to be simple and manageable, offering adolescents a healthier physical and more confidence in their daily study, life, and social interaction, but also reducing several diseases caused by obesity. Due to the ease of replication, the sample size can be expanded to universal conclusions, making it feasible to popularize. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Adolescent; Obesity Management; Physical Education and Training; Lipid Metabolism.

RESUMO

Introdução: Proporcionalmente ao desenvolvimento da economia, aumenta também o problema da obesidade entre os adolescentes. Esse índice anormal no metabolismo lipídico pode influenciar outras doenças físicas além de prejudicar o desenvolvimento social na juventude. Objetivo: Investigar o treinamento físico e a regulação do metabolismo lipídico em adolescentes, melhorando o índice metabólico dos jovens obesos. Métodos: 80 adolescentes obesos com número igual de ambos os sexos foram distribuídos aleatoriamente em grupos controlados de experimento e controle. O grupo experimental recebeu treinamentos esportivos diários de 80 minutos (aeróbica, caminhada, badminton, natação e outros esportes com baixa intensidade e longa duração), seis vezes por semana durante um mês, sem distinção de intensidade ou frequência dos exercícios para os sexos. Foi realizado o método de comparação entre os grupos, antes e após a intervenção, com indicadores incluindo peso corporal, IMC, taxa de líquidos, medição de água, cintura, quadril, espessura de dobras cutâneas, FBG, CT, Tg, HDL - C, LDL - C entre outros. Resultados: O treinamento físico pode melhorar efetivamente a forma corporal dos adolescentes. Índices sanguíneos e outros indicadores com exceção do HDL-C estão positivamente correlacionados com essa forma corporal. O treinamento físico melhorou substancialmente o metabolismo lipídico de adolescentes obesos. Conclusão: O esquema de exercícios deste experimento demonstrou-se simples e viável, oferecendo aos adolescentes um físico mais saudável e mais confiança no processo de estudo diário, vida e interação social, mas também reduzir diversas doenças causadas pela obesidade. Devido a facilidade de replicação, o número de amostrar pode ser expandido para conclusões universais, viabilizando a sua popularização. ***Nível de evidência II; Estudos terapêuticos - investigação dos desfechos do tratamento.***

***Descritores*:** *Adolescente; Manejo da Obesidade; Educação e Treinamento Físico; Metabolismo dos Lipídeos.*

RESUMEN

Introducción: Proporcionalmente al desarrollo de la economía, el problema de la obesidad entre los adolescentes también aumenta. Este índice anormal en el metabolismo lipídico puede influir en otras enfermedades físicas además de perjudicar el desarrollo social en la juventud. Objetivo: Investigar el entrenamiento físico y la regulación del metabolismo lipídico en adolescentes, mejorando el índice metabólico de los jóvenes obesos. Métodos: 80 adolescentes obesos con igual número de ambos sexos fueron distribuidos aleatoriamente en los grupos de experimento y de control. El grupo experimental recibió 80 minutos diarios de entrenamiento deportivo (aeróbic, marcha, bádminton, natación y otros deportes de baja intensidad y larga duración), seis veces a la semana durante un mes, sin

distinción de intensidad o frecuencia de los ejercicios para los sexos. Se realizó un método de comparación entre los grupos, antes y después de la intervención, con indicadores que incluían el peso corporal, el IMC, la tasa de líquidos, la medición del agua, la cintura, la cadera, el grosor de los pliegues cutáneos, FBG, CT, Tg, HDL - C, LDL - C, entre otros. Resultados: El entrenamiento físico puede mejorar eficazmente la forma corporal de los adolescentes. Los índices sanguíneos y otros indicadores, excepto el HDL-C, están positivamente correlacionados con esta forma corporal. El entrenamiento físico mejoró sustancialmente el metabolismo de los lípidos en los adolescentes obesos. Conclusión: El esquema de ejercicios de este experimento demostró ser simple y factible, ofreciendo a los adolescentes un físico más saludable y más confianza en el proceso de estudio diario, la vida y la interacción social, pero también reduciendo varias enfermedades causadas por la obesidad. Debido a la facilidad de replicación, el tamaño de la muestra puede ampliarse para obtener conclusiones universales, lo que permite su popularización. ***Nivel de evidencia II; Estudios terapêuticos - investigación de los resultados del tratamiento.***

Descriptores: *Adolescente; Manejo de la Obesidad; Educación y Entrenamiento Físico; Metabolismo de los Lípidos.*

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INTRODUCTION

At present, due to the general improvement of people's living standards, the number of obese people is also gradually increasing. As everyone knows, obesity can lead to coronary heart disease, hypertension and diabetes, and other malignant diseases, and children's groups are more susceptible to diseases. Obesity will seriously affect the physical state of adolescents and children, and erode their cardiopulmonary function and respiratory system for a long time until they enter adulthood.[1] The essence of obesity is metabolic disorder syndrome. The energy intake of obese patients is greater than the energy consumption, so the excess energy will exist in the body in the form of fat and accumulate, exceeding the normal physiological needs of the human body.[2] Scientists believe that obesity is a low-grade inflammatory state. In today's society, the number of obese people is gradually increasing. It is predicted that obese patients will exceed 1.12 billion by 2030. According to the research results of medical circles, "three highs", stroke and coronary heart disease are all associated with obesity. Obesity has become a major health hazard. It is urgent to find effective methods to control weight.[3]

From the perspective of national long-term development, improving the physical quality of children and adolescents and promoting the healthy growth and development of children and adolescents is not only the responsibility of schools, society and families, but also an urgent problem to be solved. At present, the known conclusion is that physical training can effectively improve teenagers' body shape and optimize their BMI index, but there is relatively little research on the internal problem of lipid metabolism regulation, and the problem of lipid metabolism is related to a variety of complications caused by teenagers' obesity. Therefore, strengthening the research on physical training and lipid metabolism regulation can effectively improve relevant problems and improve teenagers' physique.[4]

METHOD

Research object

Since the research object is obese adolescents, after fully informing the relevant contents and index detection methods of physical training and obtaining the consent of the guardian and the adolescents themselves, 80 obese adolescents are recruited on a voluntary basis. The study and all the participants were reviewed and approved by Ethics Committee of Xi'an University of Technology (NO.2019XUTU056). Their judgment indicators refer to the classification standard of weight index value for overweight and obesity screening of Chinese school-age children and adolescents, as shown in Table 1, including 40 male obese adolescents and 40 female obese adolescents. The selected subjects are in good health and have a high degree of cooperation, which can effectively complete the relevant experiments and obtain data indicators.

Table 1. Classification criteria of obesity body mass index in adolescents.

Classification	Overweight		Obesity	
Age (years old)	Male	Female	Male	Female
8	18.1	18.1	20.3	19.9
9	18.9	19.0	21.4	21.0
10	19.6	20.0	22.5	22.1
11	20.3	21.1	23.6	23.3
12	21.0	21.9	24.7	24.5
13	21.9	22.6	25.7	25.6
14	22.6	23.0	26.4	26.3
15	23.1	23.4	26.9	26.9
16	23.5	23.7	27.4	27.4
17	23.8	23.8	27.8	27.7
18	24.0	24.0	28.0	28.0

Experimental design

In order to minimize the intervention of human factors, this paper adopts the method of comparison before and after the group to carry out sports training for one month, 6 times a week, each time for 80 minutes, including 10 minutes of warm-up exercise and 20 minutes of relaxation exercise. The sports types are mainly aerobics, walking, badminton, swimming and other sports with low intensity and long duration, Male and female obese adolescents maintained the same exercise intensity and frequency.

Data acquisition

Due to the comparison within the group and the large relationship between some indexes and gender, in the measurement of body shape changes, take men and women as the two groups and measure the indexes such as body weight, BMI, moisture rate, lean weight, waist circumference, hip circumference, scapular skinfold thickness and abdominal skinfold thickness before and after exercise training.

In terms of blood biochemical indicators of lipid metabolism, venous blood was also extracted with the help of relevant medical personnel before and after experimental training, and sent to a special testing center for testing to determine FBG, TC, TG, HDL-C, LDL-C, fins and other indicators.

Mathematical analysis

On the premise of recording the relevant index data before and after the experiment, SPSS and Excel software are used to sort out and analyze the relevant data, and the independent variance t-test is used, $P < 0.01$ shows that there is a very significant difference; $P < 0.05$, indicating significant difference; $P > 0.05$, indicating no significant difference.

RESULTS

Effect of physical training on body shape of obese adolescents

Because gender has a great impact on Teenagers' body shape, when discussing the impact of sports training on Teenagers' body shape, take male obese teenagers and female obese teenagers as different groups, and measure the weight, BMI, moisture rate, lean weight, waist circumference, hip circumference, scapular skinfold thickness, abdominal skinfold thickness and other indicators. The specific results are as follows:

As shown in Table 2, the BMI of male obese adolescents increased by (32.600 ± 1.397) kg / m2 decreased to (31.437 ± 1.138) kg / m2, P < 0.05, indicating that there was a significant difference; The body weight decreased from (102.805 ± 2.393) kg to (94.615 ± 2.708) kg before and after training (P < 0.01); The lean body weight increased from (48.004 ± 0.299) kg to (51.803 ± 1.497) kg before and after training (P < 0.01); Waist circumference decreased from (118.153 ± 1.304) cm to (107.975 ± 1.695) cm before and after training (P < 0.01); Hip circumference decreased from (116.062 ± 0.499) cm to (109.770 ± 1.304) cm before and after training (P < 0.01); The thickness of scapular skinfold decreased from (40.521 ± 1.605) mm to (27.418 ± 1.896) mm before and after training (P < 0.01); The thickness of abdominal skinfold decreased from (47.241 ± 1.396) mm to (38.223 ± 2.608) mm before and after training (P < 0.01); The water content increased from (45.509 ± 1.397)% to (46.894 ± 0.802)% before and after training, but p > 0.05, indicating that there was no significant difference.

As shown in Table 3, the weight of female obese adolescents decreased from (95.891 ± 1.201) kg to (88.911 ± 2.402) kg before and after training, P < 0.01, indicating that there was a very significant difference; The water content increased from (46.547 ± 2.603)% to (47.896 ± 2.503)% before and after training (P < 0.01); The lean body weight increased from (42.158 ± 1.396) kg to (44.232 ± 0.798) kg before and after training (P < 0.01).A comprehensive analysis of the changes of body shape of obese adolescents before and after sports training shows that sports training can effectively improve the problem of obesity, reduce the body circumference and skinfold thickness, and make the body shape more symmetrical.

Table 2. Changes of body shape of male obese adolescents before and after physical training.

Index	Before training	After training	t	P
Weight (kg)	102.805 ±2.393	94.615 ±2.708	7.9158	0.0010
BMI (kg / m^2)	32.600 ±1.397	31.437 ±1.138	2.4651	0.0301
Water moisture (%)	45.509 ±1.397	46.894 ±0.802	-2.3700	0.0639
Skin weight (kg)	48.004 ±0.299	51.803 ±1.497	-7.7545	0.0010
Waist (cm)	118.153 ±1.304	107.975 ±1.695	9.3213	0.0000
Hip circumference (cm)	116.062 ±0.499	109.770 ±1.304	9.6392	0.0000
Scapular pleat thickness (mm)	40.521 ±1.605	27.418 ±1.896	12.4950	0.0000
Abdominal pleat thickness (mm)	47.241 ±1.396	38.223 ±2.608	10.5711	0.0000

Table 3. Changes of body shape of female obese adolescents before and after physical training.

Index	Before training	After training	t	P
Weight (kg)	95.891 ±1.201	88.911 ±2.402	6.4164	0.0010
BMI (kg / m^2)	30.792 ±2.493	29.071 ±1.795	3.2465	0.0230
Water moisture (%)	46.547 ±2.603	47.896 ±2.503	-6.7435	0.0010
Skin weight (kg)	42.158 ±1.396	44.232 ±0.798	-4.0440	0.0098
Waist (cm)	102.304 ±2.603	91.824 ±2.193	24.6905	0.0000
Hip circumference (cm)	119.457 ±1.296	109.570 ±0.897	12.0040	0.0000
Scapular pleat thickness (mm)	37.775 ±1.898	23.330 ±1.982	12.1021	0.0000
Abdominal pleat thickness (mm)	43.731 ±1.201	32.602 ±1.795	20.0901	0.0000

Effect of physical training on fat metabolism in obese adolescents

Through the detection of fasting blood samples before and after physical training, the lipid metabolism indexes are as follows:

As shown in Table 4, TC (total cholesterol) decreased from (4.960 ± 1.103) mmol / L to (3.966 ± 0.912) mmol / L before and after training, P < 0.05, indicating that there was a significant difference; TG (triglyceride) decreased from (1.264 ± 0.907) mmol / L to (0.847 ± 0.429) mmol / L before and after training (P < 0.05); HDL-C (high density lipoprotein cholesterol) decreased from (1.023 ± 0.140) mmol / L to (0.947 ± 0.160) mmol / L before and after training (P < 0.05); Fins (fasting insulin) decreased from (14.719 ± 5.394) mIU / L to (10.469 ± 1.984) mIU / L before and after training (P < 0.05); FBG (fast blood glucose) decreased from (120 ± 1.142) mmol / L to (4.715 ± 0.721) mmol / L before and after training, P > 0.05, indicating that there was no significant difference; LDL-C (low density lipoprotein cholesterol) decreased from (2.956 ± 0.688) mmol / L to (2.478 ± 0.802) mmol / L before and after training, but p > 0.05, indicating that there was no significant difference. It can be seen that sports training can effectively improve the fat metabolism index of obese adolescents, so as to regulate the body's fat metabolism.

Study on the correlation between body shape and lipid metabolism indexes before and after physical training

In order to further study the effect of physical training on the regulation of lipid metabolism, this paper analyzes the correlation between body shape and lipid metabolism indexes. The research results are as follows:

As shown in Table 5, the correlation between FBG index and body weight is 0.1764, positively correlated with body fat rate is 0.1174, positively correlated with body fat rate is 0.2096, positively correlated, indicating that with the increase of body weight, body fat rate and BMI, the value of fasting blood glucose gradually increases; The correlation between TG index and body weight was 0.1627, positively correlated with body fat rate was 0.0721, positively correlated with body fat rate was 0.2315, positively correlated, indicating that the triglyceride value increased gradually with the increase of body weight, body fat rate and BMI; The correlation between fins index and body weight was 0.0609, positive correlation, positive correlation with body fat rate was 0.1113, positive correlation, positive correlation with body fat rate was 0.1202, indicating that the fasting insulin value increased gradually with the increase of body weight, body fat rate and BMI; The correlation between HDLC index and body weight was -0.2240, negatively

Table 4. Fat metabolism indexes of obese adolescents before and after physical training.

Index	Before training	After training	t	P
FBG (mmol/L)	5.120 ±1.142	4.715 ±0.721	0.8258	0.2681
TC (mmolL)	4.960 ±1.103	3.966 ±0.912	2.0972	0.0135
TG (mmol/L)	1.264 ±0.907	0.847 ±0.429	1.3236	0.0452
HDL-C (mmol/L)	1.023 ±0.140	0.947 ±0.160	0.0557	0.0358
LDL-C (mmol/L)	2.956 ±0.688	2.478 ±0.802	1.1663	0.0574
FINS (mIU/L)	14.719 ±5.394	10.469 ±1.984	7.6606	0.0198

Table 5. Correlation analysis between body shape and lipid metabolism indexes of obese adolescents before and after physical training.

Index	Weight	Fat body rate	BMI
FBG (mmol/L)	0.1764	0.1174	0.2096
TG (mmol/L)	0.1627	0.0721	0.2315
TC (mmolL)	0.1563	0.0130	0.1343
HDLC (mmol/L)	-0.2240	-0.2675	-0.2808
LDLC (mmol/L)	0.1643	0.0399	0.1483
FINS (mIU/L)	0.0609	0.1113	0.1202

correlated with body fat rate was -0.2675, negatively correlated with body fat rate was -0.2808, indicating that with the increase of body weight, body fat rate and BMI, the value of high-density lipoprotein cholesterol gradually decreased.

DISCUSSION

This study understands the effect of exercise on weight loss by analyzing the body lipid composition of obese patients after physical exercise. The results show that the concentrations of TG, TC and LDL in subjects after physical training are significantly reduced, but HDL has no significant change. Therefore, aerobic exercise can regulate blood lipid disorder and promote fat and weight loss to a certain extent. According to the experimental results, reasonable exercise can improve body shape, regulate metabolic disorder and improve insulin resistance, and can effectively prevent the development of metabolic syndrome. Exercise intervention with appropriate time and intensity can improve the body's blood lipid structure and promote the development of metabolic normalization. In addition, it can cremate the activity of lipid metabolism enzymes and secrete lipid metabolism receptors for expression, so as to promote the operation, release and decomposition of lipids. Based on the results of epidemiological research, excessive TG content will lead to the independent development of atherosclerosis, which is a risk factor, and also induce coronary heart disease, fatty liver and other diseases. LPL is secreted by skeletal muscle and adipocytes. It is a Tg degrading enzyme, which can effectively degrade excess TG components in the body. Exercise can effectively affect the activity of LPL in skeletal muscle. It was found that the expression of lipoprotein lipase gene induced by exercise was more obvious in skeletal muscle than in adipocytes. The four week exercise intervention experiment shows that the combination of diet and exercise can effectively increase the serum LPL activity of the target population of obese subjects, and fat will directly participate in the energy supply during exercise.[5]

At the same time, it can also show that skeletal muscle cells can indeed use a large amount of fat as energy resources to participate in exercise. During exercise, the excitability of human sympathetic nerve will increase, so as to increase the secretion and activity of LPL and inhibit insulin secretion. At the same time, LPL can also be eliminated by thyroid hormone and glucocorticoid. In conclusion, low and medium intensity aerobic exercise can effectively control body weight and body fat, and effectively promote the fatty acid oxidation process and LPL activity in muscle cells. The high content of TG is often expressed in the form of fatty liver in obese adolescents, and the enhanced LPL activity can effectively decompose excess TG, so as to alleviate the level of fatty liver and maintain good health.

CONCLUSION

It can be seen from this study that a certain intensity of physical training for obese adolescents can effectively improve their body shape and regulate the problem of lipid metabolism. It can not only make adolescents have a healthier physique and more confident in the process of daily study, life and social interaction, but also reduce various diseases caused by obesity, improve the physical health problems of obese adolescents and improve their physique. This experiment has good popularization significance, so we can further improve and popularize the experimental scheme in the follow-up research, expand the number of samples, and obtain more universal conclusions.

All authors declare no potential conflict of interest related to this article

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