ENDURANCE TRAINING ASSOCIATED WITH A HYPOCALORIC DIET IN OBESE UNIVERSITY STUDENTS

TREINO AERÓBICO ASSOCIADO A DIETA HIPOCALÓRICA EM UNIVERSITÁRIOS OBESOS

ENTRENAMIENTO AERÓBICO ASOCIADO A DIETA HIPOCALÓRICA EN UNIVERSITARIOS OBESOS

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Qi Zhou[1]
(Physical Education Professional)
Pengwei Shi[1]
(Physical Education Professional)

1. Hunan University of Arts and Sciences, School of Music and Dance, Changde, Hunan, China.

Correspondence:
Qi Zhou
Changde, Hunan, China. 415000.
zxm771982@126.com

ABSTRACT

Introduction: The long-term energy imbalance between intake and consumption is the main reason for obesity in college students. Therefore, weight loss should also combine an inversely proportional intervention. Based on this premise, a growing number of studies combine physical training and diet to restore physical health in this population group. Objective: Study the impacts of endurance training associated with a low-calorie diet on the constitution and metabolism of obese college students. Methods: Through a questionnaire survey and a 4-week experimental endurance training program and hypocaloric diet, 20 obese college students volunteered for the intervention project. The exercise protocol for the training composition and the diet menu followed the updated recommendations in the scientific literature. At the end of the experiment, the relevant data collected were statistically analyzed and discussed. Results: After the diet intervention associated with endurance training, the BMI index of college students reduced from 28,075 to 26,378; the basal metabolic rate increased from 1581,046 kcal to 1681,317 kcal. Conclusion: Endurance training associated with a hypocaloric diet significantly reduced fat in obese college students. The efficacy of this association promoted a better joint effect on the outcome, compared to individual weight loss plans. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Endurance Training; Diet, Calorie Restricted; Students; Obesity.

RESUMO

Introdução: O desequilíbrio energético entre ingestão e consumo a longo prazo é o principal motivo da obesidade nos universitários, portanto, a perda de peso também deve combinar uma intervenção inversamente proporcional. Valendo-se dessa premissa, são crescentes os estudos que combinam treinos físicos e dietas com o propósito de restaurar a saúde física nessa parcela da população. Objetivo: Estudar os impactos do treino aeróbico associado a dieta hipocalórica sobre a constituição e o metabolismo de estudantes universitários obesos. Métodos: Através de uma pesquisa por questionário e um programa experimental com duração total de 4 semanas de treino aeróbico e dieta hipocalórica, 20 universitários obesos voluntariaram-se para o projeto de intervenção. O protocolo de exercícios para a composição do treino e o cardápio da dieta seguiram as recomendações atualizadas da literatura científica. Ao final do experimento, os dados relevantes coletados foram analisados estatisticamente e discutidos. Resultados: Após a intervenção da dieta associada ao treino aeróbico, o índice IMC de estudantes universitários reduziu de 28.075 para 26.378; o índice metabólico basal aumentou de 1581.046 kcal para 1681.317 kcal. Conclusão: O treino aeróbico associado à dieta hipocalórica demonstrou um efeito significativo na diminuição da gordura dos universitários obesos. A eficácia dessa associação promoveu um melhor efeito conjunto no resultado, em comparação a planos individuais de emagrecimento. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Treino Aeróbico; Dieta Hipocalórica; Estudantes; Obesidade.*

RESUMEN

Introducción: El desequilibrio energético entre la ingesta y el consumo a largo plazo es la razón principal de la obesidad en los estudiantes universitarios, por lo tanto, la pérdida de peso también debe combinar una intervención inversamente proporcional. Aprovechando esta premisa, cada vez son más los estudios que combinan entrenamiento físico y dietas con el fin de restablecer la salud física en esta parte de la población. Objetivo: Estudiar los impactos del entrenamiento aeróbico asociado a dieta hipocalórica sobre la constitución y el metabolismo de estudiantes universitarios obesos. Métodos: Mediante una encuesta con cuestionario y un programa experimental con una duración total de 4 semanas de entrenamiento aeróbico y dieta hipocalórica, 20 estudiantes universitarios obesos se presentaron como voluntarios para el proyecto de intervención. El protocolo de ejercicios para la composición del entrenamiento y el menú dietético siguieron las recomendaciones actualizadas de la literatura científica. Al final del experimento, se analizaron y discutieron estadísticamente los datos pertinentes recogidos. Resultados: Tras la intervención dietética asociada al entrenamiento aeróbico, el índice de IMC de los estudiantes universitarios se redujo de 28,075 a 26,378; el índice metabólico basal aumentó de 1581,046 kcal a 1681,317 kcal. Conclusión: El entrenamiento aeróbico asociado

a una dieta hipocalórica mostró un efecto significativo en la reducción de grasa en estudiantes universitarios obesos. La eficacia de esta asociación promovió un mejor efecto conjunto sobre el resultado en comparación con los planes individuales de pérdida de peso. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Entrenamiento Aeróbico; Dieta Restringida en Calorías; Estudiantes; Obesidad.*

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INTRODUCTION

With the gradual change of eating habits, more and more high sugar, high fat and high energy foods are produced and consumed.[1] At the same time, the improvement of urbanization has brought about a variety and convenience of transportation modes, leading to a gradual decrease in physical activity. The pressure of study and work, the lack of sports awareness and other various reasons make the proportion of obese people in the world increasing.[2] According to statistics, the global obese or overweight population shows a trend of youth and severity. Obesity not only affects the growth and development of the body, but also adversely affects the development of intelligence and other body systems.[3] Obesity is not only an independent metabolic disease, but also a risk factor for a series of diseases, increasing the possibility of various diseases. Long term imbalance of energy intake and consumption is the main reason for obesity, so it is necessary to achieve the goal of weight loss by achieving negative energy balance, mainly including exercise, diet, medicine, environmental intervention and other intervention methods.[4] The adjustment of diet structure and scientific exercise mode are effective ways to achieve negative energy balance.[5] Although dietary intervention can achieve weight loss more efficiently than physical exercise by taking in less energy, if energy intake decreases rapidly, malnutrition will occur. It may even lead to the loss of lean weight and the decrease of basal metabolic rate, which will have a negative impact on college students at the critical stage.[6] Therefore, the combination of reasonable diet intervention and exercise intervention mode is the main plan for college students to reduce weight scientifically and avoid obesity.[7] Based on this, this paper explores the influence of diet combined with exercise intervention on the physical metabolism and physical health of college students, and has a positive reference significance for the guidance of obesity college students to lose weight and the improvement of metabolic level.[8]

METHOD

Research object

According to the research purpose of this paper, combined with the reality of the obesity problem of college students at this stage, this paper selected 20 college students from a university in a certain place as the research object through a questionnaire survey, including 10 male and 10 female students, all of whom are freshmen and sophomores, all of whom have different degrees of overweight, obesity and other metabolic excess. The study and all the participants were reviewed and approved by Ethics Committee of Hunan University of Arts and Sciences(NO.21HUAS-PE107). At the same time, the students did not have injuries, diseases, abnormal cardiopulmonary function and any other basic diseases not suitable for participating in physical training, which met the requirements of this experiment. The experimental intervention lasted for one month, and there was no quitter. The basic information of the subjects is shown in Table 1.

Research methods

Before the experiment, a student questionnaire was designed based on the physical status of obese college students. The questionnaire mainly includes the inducement of obesity, the cognition of their own physique, the harm of obesity, the habits and attitudes related to exercise and diet, etc., which are used to formulate the intervention prescription for this experiment. At the same time, a teacher questionnaire was designed to understand the current PE teachers' cognition on the causes of obesity of obese college students, the physique of obese students and the harm of obesity, which was used to study the next step of the strategic recommendations in this paper. The repeated test proves that the reliability of the questionnaire selected in this paper is high, reaching 0.89, which can assist the experiment.

Table 1. Basic information of the research object.

	Before experiment
Weight (kg)	75.851±9.005
BMI	28.075±2.312
Body fat percentage (%)	34.693±8.254
Waist circumference (cm)	94.493±7.247
Waist hip ratio	0.874±0.051

In the process of experimental intervention, the experimental program of aerobic endurance training and diet intervention was designed for 4 weeks by means of guidance and encouragement according to the physical characteristics and sports preferences of the selected students. In this experiment, the forms of aerobic endurance exercise are mainly jogging, fast walking and resistance training. The number of training times per week is 5, and the total time of each training is 1.2 hours. In case of special weather, take the indoor treadmill 65% VO_{2max} jogging mode.

Test method of experimental indicators

The body shape test of obese college students mainly includes weight, BMI, body fat rate, waist circumference and waist hip ratio. The weight test method requires the students to wear light clothes before measurement, stand in the center of the electronic weight scale barefoot, and keep their bodies stable without shaking. The weight measurement is in kilogram (kg). The body fat was measured with a sebum thickness gauge at the abdomen and thigh. Each position shall be measured twice. If the error is less than 2mm, the second measurement data can be recorded. Finally, the sum of skin fold test thickness of two positions shall be taken.

The physical quality of obese college students mainly includes four indexes: 50m, standing long jump, 800m and step index. The step test adopts 30cm high wooden steps, 96bpm metronome and electronic timer. Set the beat frequency as 96 times/min and the test time as 3 minutes. The students were asked to keep their knees straight when stepping on it.

At the beginning of this experiment and after the training, the relevant indicators of the students need to be measured for comparison and analysis of the later experimental results. Therefore, during the experiment, special personnel should be assigned to record and analyze the physical fitness monitoring data of college students by professional software, so as to minimize the errors in data collection and analysis.

RESULTS

Changes in body shape of obese college students

After 4 weeks of aerobic endurance training and diet intervention, the subject college students first changed significantly in body shape, and each index had significant changes in varying degrees compared with that before training. The specific changes are shown in Table 2.

Through the analysis of the data shown in Table 2, it can be concluded that after four weeks of aerobic endurance training, the tested college students' weight, BMI, waist circumference and waist hip ratio have changed significantly (P<0.01), and the body fat rate has changed significantly (P<0.05). The five indexes showed a downward trend, and the weight decreased from 75.851 ± 9.005kg before training to 74.904 ± 8.062kg after training; BMI decreased from 28.075 ± 2.312 before training to 26.378 ± 2.223 after training; Waist circumference decreased from 94.493 ± 7.247cm before training to 90.047 ± 5.552cm after training; The waist hip ratio decreased from 0.874 ± 0.051 before training to 0.840 ± 0.041 after training. Compared with the lower body fat rate, the change range is small, from 34.693 ± 8.254% before training to 32.324 ± 9.173% after training.

Changes in physical fitness of obese college students

In addition to the obvious changes in body shape, the physical fitness of obese college students has also improved significantly after four weeks of experiments. The four indicators of 50m, standing long jump, 800m and step index have all improved significantly. The specific data are shown in Table 3.

It can be seen from Table 3 that the physical quality indicators of the students before and after the experiment show very significant changes (P<0.01), and the four indicators have been improved to varying degrees. Among them, 50 meters increased from 9.957 ± 0.699s before training to 9.731 ± 0.612s after training; The standing long jump increased from 160.071 ± 14.699cm before training to 166.416 ± 12.515cm after training; 800m increased from 3.578 ± 0.039min before training to 3.416 ± 0.050min after training; The step index increased from 55.876 ± 8.965 before training to 59.127 ± 9.000 after training. The indexes of 50 meters, standing long jump, 800 meters and step index all reflect the physical ability related qualities of the tested students, such as muscle endurance and physical coordination level, to a certain extent. Therefore, the significant improvement of the four indexes indicates that aerobic endurance training combined with dietary intervention can effectively improve the physical quality of obese college students, which can improve their overall sports quality on the basis of promoting individual health, So as to further increase the enthusiasm of obese college students and reduce the difficulty of sports.

Table 2. Effect of aerobic endurance training combined with diet intervention on body shape of obese college students.

	Before experiment	After experiment	P
Weight (kg)	75.851±9.005	74.904±8.062	P<0.01
BMI	28.075±2.312	26.378±2.223	P<0.01
Body fat percentage (%)	34.693±8.254	32.324±9.173	P<0.05
Waist circumference (cm)	94.493±7.247	90.047±5.552	P<0.01
Waist hip ratio	0.874±0.051	0.840±0.041	P<0.01

Table 3. Effect of aerobic endurance training combined with diet intervention on physical fitness of obese college students.

	Before experiment	After experiment	P
50 m (s)	9.957±0.699	9.731±0.612	P<0.01
Standing long jump (cm)	160.071±14.699	166.416±12.515	P<0.01
800m (min)	3.578±0.039	3.416±0.050	P<0.01
Step index	55.876±8.965	59.127±9.000	P<0.01

Changes of metabolic indicators in obese college students

Finally, the metabolic indicators of the students were measured, and the results are shown in Table 4.

The data in Table 4 prove that VCO2, MFO and basal metabolism in the metabolic indicators of the college students before and after the experiment show very significant changes (P<0.01), and VO2 indicators also show significant changes (P<0.05). The amount of O2 inhaled per minute increased from 1.284 ± 0.663L before training to 1.346 ± 0.658L; The amount of CO2 exhaled per minute increased from 1.074 ± 0.603L before training to 1.142 ± 0.632L, proving the improvement of cardiopulmonary function. The maximum fat oxidation rate decreased from 0.408 ± 0.182g/min before training to 0.277 ± 0.060g/min. Among them, the change range of basic metabolic index was large, from 1581.046 ± 193.217 kcal before training to 1681.317 ± 209.395 kcal.

DISCUSSION

Weight can be divided into lean weight and fat weight according to different physiological functions. The reasonable proportion of body composition can ensure the exercise of normal physiological functions of the human body, especially reduce the possibility of a series of obesity related diseases. In competitive sports, the excellent performance of competitive ability is closely related to the reasonable proportion of body composition, which can stimulate the spirit of sports competition and create better sports performance. The degree of human obesity is reflected by body weight to some extent. This study concluded that exercise intervention improved pancreatic islets α, β The ability of cells to secrete glucagon and insulin can reduce body fat rate by accelerating fat decomposition. In addition, the energy intake of the subjects was controlled in the experiment to limit the accumulation of excess fat caused by energy surplus. Therefore, 4-week exercise combined with diet intervention can positively improve the body shape and composition of obese adolescents.

This aerobic endurance training not only achieved the expected goal of weight loss, improved the physical circumference and composition proportion of experimental obese college students, but also significantly improved the physical fitness level of college students. Muscle strength and endurance are the basic abilities of the muscle system to work effectively. They mainly evaluate the speed, flexibility, balance, sensitivity, coordination and explosive force of the muscle. In general, the following items are used to test the muscle strength and endurance: 50 m and 800 m sprints test the time to complete muscle contraction in unit time; The standing long jump tests the maximum strength produced by a single contraction; Step test the lasting time for the muscle to maintain a single fixed force state. Previous studies have shown that the combination of endurance training and aerobic exercise can increase muscle strength more significantly than single aerobic exercise; Endurance training can indeed improve muscle type, enhance muscle strength, and has a unique role. Therefore, the data in Table 3 of this paper prove that aerobic endurance training improves the physical fitness and sports ability of the students, and reveals the effect of aerobic endurance training on muscle strength and endurance.

Table 4. Effect of aerobic endurance training combined with diet intervention on metabolic indexes of obese college students.

	Before experiment	After experiment	P
VO_2(L/min)	1.284±0.663	1.346±0.658	P<0.05
VCO_2(L/min)	1.074±0.603	1.142±0.632	P<0.01
MFO(g/min)	0.408±0.182	0.277±0.060	P<0.01
Basic metabolism (kcal)	1581.046±193.217	1681.317±209.395	P<0.01

Previous studies have shown that aerobic exercise can activate the fat intake system of skeletal muscle cells and β Oxidation pathway, accelerate energy consumption and reduce body fat content. Therefore, appropriate aerobic endurance training can increase the muscle strength level, improve the basic metabolism of the body and the proportion of lean weight. The study indicated that the proportion of lean body weight is closely related to the basal metabolic rate at rest. When the basal metabolic rate increases by 1% - 2%, it can play an important role in regulating body weight. After 2-3 days of strength training, the basic metabolic rate of the human body can basically increase by 6% or more. Therefore, the combination of fast walking, jogging and resistance training adopted in the exercise intervention process in this paper can not only activate fat metabolism, improve the proportion of lean body weight and the basic metabolic rate (about 6%) of college students in the resting state, but also mobilize fat, so that free fatty acids can fully participate in the metabolism of the body, promote fat consumption, and achieve significant weight loss.

CONCLUSION

Physical training has a good effect on improving the obesity symptoms of students in school and a wide range of teenagers, especially aerobic exercise has a significant effect on improving the physique of obese students. Exercise intervention can consume energy through physical exercise, and combine with reasonable diet intervention. Generally, the effect of weight loss is more significant, and the actual effect is more consistent with the expected result, making obese people more acceptable. Maintaining the good habit of moderate exercise and reasonable diet can ensure the normal growth and health of the population. By investigating the obesity status and physical health of college students, and analyzing the causes of obesity status of college students, this study discussed the intervention effect of aerobic exercise and diet intervention on obese college students, with the purpose of improving obesity and ultimately reducing the obesity rate of college students. The experimental results of this paper show that the combination of diet intervention and aerobic exercise is one of the best ways to scientifically and effectively improve the situation of obese college students.

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AUTHORS' CONTRIBUTIONS: The author has completed the writing of the article or the critical review of its knowledge content. This paper can be used as the final draft of the manuscript. Every author has made an important contribution to this manuscript. Qi Zhou and Pengwei Shi: writing and execution.

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