

OUTCOMES OF MODERATE-INTENSITY CONTINUOUS EXERCISE ON FAT RATIO AND MAXIMAL OXYGEN CONSUMPTION IN COLLEGE STUDENTS



ORIGINAL ARTICLE
ARTIGO ORIGINAL
ARTÍCULO ORIGINAL

RESULTADOS DO EXERCÍCIO CONTÍNUO COM INTENSIDADE MODERADA SOBRE A TAXA DE GORDURA E SOBRE O CONSUMO MÁXIMO DE OXIGÊNIO EM ESTUDANTES UNIVERSITÁRIOS

RESULTADOS DEL EJERCICIO CONTINUO CON INTENSIDAD MODERADA SOBRE LA TASA DE GRASA Y EL CONSUMO MÁXIMO DE OXÍGENO EN ESTUDIANTES UNIVERSITARIOS

Su Zhifeng¹
(Physical Education Professional)
Wu Maotang²
(Physical Education Professional)

1. Guangdong Institute of Technology, Department of Physical Education, Zhaoqing, Guangdong, China.
2. Guangzhou Institute of Technology, College of Marxism (General Education), Guangzhou, Guangdong, China.

Correspondence:

Su Zhifeng
Zhaoqing, Guangdong, China.
526100.
suzhifeng_1986@163.com

ABSTRACT

Introduction: Declining physical quality, health status, and being overweight cause many college students to have physical problems. Continuous moderate-intensity exercise has become a widely used exercise method for many healthy people. **Objective:** Explore the outcome of continuous moderate-intensity exercise on college students' body fat rate and maximal oxygen uptake. **Methods:** The experiment will last for eight weeks. The control group did not practice other systematized exercises except daily physical activity and extracurricular sports. In addition to daily activities, the experimental group also performed moderate-intensity training in physical education classes. **Results:** In the training group, the average body fat rate decreased by 1.66%, the body fat content reduced by 1.21kg, and the skeletal muscle content increased by 1.44 compared to that before training. Vital capacity and maximal ventilatory capacity showed significant changes ($P < 0.05$), of which maximal ventilatory capacity changed most significantly ($P < 0.01$), from 79.63 ± 19.97 L/min before the test to 98.65 ± 26.06 L/min, with an average gain of 19.02 L/min. **Conclusion:** Moderate-intensity continuous sports can effectively improve the cardiorespiratory function of current college students, increase body oxygen uptake, reduce body fat rate, and improve physical fitness, aiming to achieve a healthier physique. **Level of evidence II; Therapeutic studies - investigating treatment outcomes.**

Keywords: Exercise; Physical Fitness; Obesity.

RESUMO

Introdução: O declínio da qualidade física, do nível de saúde e do excesso de peso fazem com que muitos estudantes universitários tenham problemas físicos. O exercício contínuo de intensidade moderada tornou-se progressivamente um método de exercício amplamente utilizado por muitas pessoas saudáveis. **Objetivo:** Explorar o resultado do exercício contínuo de intensidade moderada sobre a taxa de gordura corporal e a absorção máxima de oxigênio por parte dos estudantes universitários. **Métodos:** A experiência teve a duração de 8 semanas. O grupo de controle não praticou nenhum outro exercício físico sistematizado, exceto atividade física diária e esportes extracurriculares. Além das atividades diárias, o grupo experimental também realizou treinamento de intensidade moderada nas aulas de educação física. **Resultados:** No grupo de treinamento, a taxa média de gordura corporal decresceu 1,66%, o conteúdo de gordura corporal reduziu 1,21kg, e o conteúdo de músculo esquelético aumentou 1,44 em comparação com aquele antes do treinamento. A capacidade vital e a capacidade ventilatória máxima mostraram mudanças significativas ($P < 0,05$), das quais a capacidade ventilatória máxima alterou-se mais significativamente ($P < 0,01$), de $79,63 \pm 19,97$ L/min antes do teste para $98,65 \pm 26,06$ L/min, com um ganho médio de 19,02 L/min. **Conclusão:** Esportes contínuos de intensidade moderada podem efetivamente melhorar a função cardiorrespiratória dos estudantes universitários atuais, aumentar a absorção de oxigênio corporal, reduzir a taxa de gordura corporal, melhorar a aptidão física, visando a obtenção de um físico mais saudável. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Exercício Físico; Aptidão Física; Obesidade.

RESUMEN

Introducción: El deterioro de la calidad física, el estado de salud y el sobrepeso hacen que muchos estudiantes universitarios tengan problemas físicos. El ejercicio continuo de intensidad moderada se ha convertido progresivamente en un método de ejercicio muy utilizado por muchas personas sanas. **Objetivo:** Explorar el resultado del ejercicio continuo de intensidad moderada sobre la tasa de grasa corporal y la captación máxima de oxígeno en estudiantes universitarios. **Métodos:** El experimento tuvo duración de 8 semanas. El grupo de control no practicaba ningún otro ejercicio físico sistematizado, salvo la actividad física diaria y los deportes extraescolares. Además de las actividades diarias, el grupo experimental también realizó un entrenamiento de intensidad moderada en las clases de educación física. **Resultados:** En el grupo de entrenamiento, el índice medio de grasa corporal disminuyó en un



1,66%, el contenido de grasa corporal se redujo en 1,21 kg y el contenido de músculo esquelético aumentó en 1,44 en comparación con el de antes del entrenamiento. La capacidad vital y la capacidad ventilatoria máxima mostraron cambios significativos ($P < 0,05$), de los cuales la capacidad ventilatoria máxima cambió más significativamente ($P < 0,01$), de $79,63 \pm 19,97$ L/min antes de la prueba a $98,65 \pm 26,06$ L/min, con una ganancia media de $19,02$ L/min. **Conclusión:** El deporte continuo de intensidad moderada puede mejorar eficazmente la función cardiorrespiratoria de los estudiantes universitarios actuales, aumentar la captación de oxígeno corporal, reducir la tasa de grasa corporal, mejorar la forma física, con el objetivo de obtener un físico más saludable. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptor: Ejercicio Físico; Aptitud Física; Obesidad.

DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0737

Article received on 11/30/2022 accepted on 12/14/2022

INTRODUCTION

College students are special and are in the learning stage. They spend most of their time on courses and studies.¹ In addition, due to the influence of electronic products, it is difficult to have time to insist on regular sports. This has led to the decline of many college students' physical quality, health level, obesity and overweight.² Many studies have shown that in order to achieve the effect of fitness and weight loss, it is not only necessary to control diet, but also to match appropriate moderate intensity sports.³ Medium intensity sports can help college students improve their physical quality, control their weight, reduce body fat, and improve their ability to carry out aerobic and anaerobic metabolism.⁴ Therefore, this study chose to achieve moderate intensity aerobic exercise by controlling the heart rate, and monitored the changes of body fat rate and maximum oxygen uptake of college students.⁵ Through the analysis and research on the changes of human body composition, heart and lung functions and the test of overall sports quality indicators, we can further understand the sports status of contemporary college students, and carry out the research on sports intervention and sports adaptation mechanism, hoping that this research can bring new help and improvement to the future college students' physique assessment and the improvement of college students' physical quality and health.⁶

METHOD

Research object

In this study, 60 college students were selected as the test subjects, all of whom were ordinary students without professional and systematic sports training. The study and all the participants were reviewed and approved by Ethics Committee of Guangdong Institute of Technology (NO. GDIT21FD-065). And there is no injury or disease, the body is normal, and there is no other disease unsuitable for sports. 60 subjects were divided into experimental group and control group. Before the test, the tester has been informed of the purpose, content, exercise requirements, and some difficulties and precautions that may be encountered in the test. The testers all signed the pre experiment informed agreement to voluntarily participate in this experiment, so that the testers could better complete the test items.

Research methods

This experiment will last for 8 weeks. The 30 subjects in the control group did not take any physical exercise except daily activities and extracurricular sports. In addition to daily activities, the 30 testers in the experimental group will also carry out moderate intensity exercise intervention in physical education classes. The intervention of the whole experimental group will be completed by the same teacher. Before the test, tell the tester to complete each action as normatively as possible within the specified time. Before the test, the body composition, body shape, maximum oxygen uptake and other data values of the tester were measured in advance. After the 8-week test, the above data values

shall be measured again, collated, compared and analyzed, and the experimental results shall be obtained.

The test methods for body shape and other data are:

The body shape and body composition are tested by inbody720 composition tester. Before the test, no food, no water, no high-intensity physical labor, and no excess clothes and accessories are allowed to wear; During the test, relax and maintain a standing posture, and fully contact the electrodes with the skin of the limbs. The main test indexes included body weight, waist and hip circumference, etc.

Test the cardiopulmonary function of the tester with MONARK839E power bicycle. During the test, the tester is required to wear a heart rate belt and ride on the power bike for 6 minutes. The first 3 minutes are the preparation phase. After 3 minutes, the tester's heart rate rises, and the next 3 minutes are the formal test phase. During the test, the tester needs to ride at a constant speed, that is, the flash point displayed in front of the bike coincides with the designated mark and lasts for 3 minutes.

The change of students' athletic ability adopts the electronic stopwatch timer dedicated to Gordon track and field to test the 800m results of girls and 1000m results of boys, and time and record them respectively.

RESULTS

Effects of moderate intensity continuous exercise on body shape and composition

The influence of moderate intensity continuous exercise on the subjects is obviously reflected in the change of body shape. After 8 weeks of training, the specific changes in the three indicators of body shape of the subjects are shown in Table 1.

It can be seen from the data in Table 2 that after 8 weeks of moderate intensity continuous exercise training, the experimental group

Table 1. Changes of body shape indexes before and after training.

Test index	Group	Before training	After training	Average increase	P value
Weight (kg)	Experience group	65.87±12.55	62.92±12.07	-2.95	0.001
	Control group	66.25±13.02	66.17±14.17	-0.08	0.098
Waist hip ratio	Experience group	0.82±0.06	0.81±0.04	-0.01	0.001
	Control group	0.79±0.07	0.80±0.03	0.01	0.767
BMI	Experience group	20.36±1.77	20.11±2.03	-0.25	0.044
	Control group	20.71±2.05	21.21±1.57	0.5	0.803

Table 2. Basic information of the experimental group and the control group.

Group	Age (age)	Height (cm)	Weight (kg)	BMI	Body fat percentage
Experience group	19.13±0.45	170.75±8.61	65.87±12.55	20.36±1.77	26.58±4.89
Control group	18.57±0.60	171.33±8.24	66.25±13.02	20.71±2.05	27.01±3.67

has significant differences in weight, waist hip ratio and BMI, $P < 0.05$, especially in weight and waist hip ratio, $P < 0.01$. The body weight was changed from 65.87 ± 12.55 before the test to 62.92 ± 12.07 , with an average decrease of 2.95kg. The waist hip ratio changed from 0.82 ± 0.06 before the test to 0.81 ± 0.04 , with a mean decrease of 0.01. The BMI index changed from 20.36 ± 1.77 before training to 20.11 ± 2.03 . Compared with that before training, the range of change was small, with a mean decrease of 0.25, but there was a relatively significant difference between it and that before training. The three indexes of body shape in the control group did not change significantly ($P > 0.05$). Therefore, it can be concluded that continuous moderate intensity exercise training can significantly improve the three body shape indicators of college students, namely, weight, waist hip ratio and BMI.

After 8 weeks of training, in addition to the body shape indicators, the students' body composition indicators also have a relatively significant change. The specific data are shown in Table 3.

It can be seen from the data in Table 3 that after 8 weeks of training, the subjects' body fat rate, body fat content, visceral fat area and skeletal muscle content have relatively significant changes, that is, $P < 0.05$, of which visceral fat area has the largest change, $P < 0.01$, from 43.22 ± 19.89 before training to 35.46 ± 11.81 , with a decrease of 7.76cm². The average body fat rate decreased by 1.66%, the body fat content decreased by 1.21kg, and the skeletal muscle content increased by 1.44 compared with that before training. The indexes of the control group had little change. Therefore, in general, moderate intensity continuous exercise training can significantly improve the body fat rate, body fat content and muscle content of college students.

Effect of moderate constant intensity exercise on lung function

After 8 weeks of training, the lung function of the students also showed some changes, mainly including two parts: the maximum oxygen uptake index with obvious changes and other lung function related indexes. The maximum oxygen uptake index changes are shown in Table 4.

According to the data on the maximum oxygen uptake in Table 4, the 8-week exercise intervention has a significant impact on the absolute value of the maximum oxygen uptake of the tested students, $P < 0.01$, from 2.19 ± 0.59 L/min before training to 2.57 ± 0.57 L/min, with an average increase of 0.38L/min.

In addition, other lung function related indicators of the students were tested, mainly including vital capacity, maximum ventilation volume, respiratory exchange rate and other indicators. The specific data are shown in Table 5.

It can be seen from the test data of other lung function related indicators in Table 4 that the vital capacity and maximum ventilation of the training group showed significant changes ($P < 0.05$), of which the maximum ventilation changed most significantly ($P < 0.01$), from 79.63 ± 19.97 L/min before the test to 98.65 ± 26.06 L/min, with an average increase of 19.02L/min.

Effect of moderate intensity continuous exercise on sports ability

With the influence of intervention training on the body fat rate and cardiopulmonary function of the tested students, the overall exercise ability of the tested students also showed some changes. This paper tested the heart rate and running performance of the test subjects, including girls participating in 800m and boys participating in 1000m. The results are shown in Table 6.

At the same time, the running performance of the experimental group has been significantly improved, among which the performance of female students has been significantly improved after the sports intervention (P). It shows that continuous exercise is an effective measure to improve college students' sports awareness and sports level.

Table 3. Changes of body composition indexes before and after training.

Test index	Group	Before training	After training	Average increase	P value
Body fat percentage (%)	Experience group	26.58±4.89	24.92±3.75	-1.66	0.015
	Control group	27.01±3.67	27.07±4.16	0.06	0.093
Body fat content (kg)	Experience group	15.83±2.11	14.62±3.34	-1.21	0.040
	Control group	15.93±2.44	15.39±2.77	0.54	0.762
Area of visceral fat (cm ²)	Experience group	43.22±19.89	35.46±11.81	-7.76	0.001
	Control group	42.86±17.31	42.23±16.29	-0.63	0.803
Skeletal muscle content (kg)	Experience group	19.71±2.01	21.15±1.88	1.44	0.036
	Control group	20.01±1.76	20.07±2.07	0.06	0.125

Table 4. Changes of maximal oxygen uptake before and after training.

Maximum oxygen uptake	Group	Before training	After training	Average increase	P value
Absolute value VO ₂ max (L/min)	Experience group	2.19±0.59	2.57±0.57	0.38	0.001
	Control group	2.17±0.36	2.21±0.35	0.04	0.125
Relative value VO ₂ max/kg (ML/min/kg)	Experience group	30.68±6.97	33.24±7.88	2.56	0.087
	Control group	31.03±7.01	31.15±6.54	0.12	0.103

Table 5. Changes of pulmonary function indexes of two groups of students before and after training.

Test index	Group	Before training	After training	Average increase	P value
Vital capacity VC (L)	Experience group	2.76±0.61	3.58±0.53	0.82	0.041
	Control group	2.71±0.42	2.76±0.36	0.05	0.075
Maximum ventilation (L/min)	Experience group	79.63±19.97	98.65±26.06	19.02	0.000
	Control group	78.94±17.91	80.92±17.23	1.98	0.079
Respiratory exchange rate RER	Experience group	1.41±0.22	1.43±0.11	0.02	0.066
	Control group	1.36±0.15	1.33±0.17	-0.03	0.115

Table 6. Changes of sports ability of two groups of students before and after training.

	Group	Before training	After training	Average increase	P value
Girls 800m (min)	Experience group	4'33"±0.61"	4'12"±0.21"	-0.35	0.005
	Control group	4'31"±0.52"	4'39"±0.33"	0.13	0.102
Boys 1000m (min)	Experience group	4'39"±0.65"	4'27"±0.57"	-0.2	0.014
	Control group	4'38"±0.55"	4'37"±0.52"	-0.02	0.056
Maximum heart rate (BPM)	Experience group	158±18	169±16	11	0.067
	Control group	160±16	161±17	1	0.187

DISCUSSION

Body fat content and body fat rate are important indicators to reflect the internal fat status of the body. Too high or too low body fat rate will have more or less impact on the health of the body. It can be seen from Table 2 and Table 3 that the body fat rate of the experimental group changed significantly after exercise and maintained within the normal range. Compared with the test subjects in the experimental group, the body fat rate in the control group did not change significantly or even slightly increased. This shows that continuous moderate intensity

exercise has a significant effect on college students' fat reduction. Adhering to a long period of moderate intensity exercise can better burn fat, because the functional system of moderate intensity exercise is mainly the aerobic system of the body, so as to achieve a better effect of reducing fat. During exercise, a proper interval will also make fat consumption faster and more, because a proper interval during exercise can create an anoxic state during the recovery period. This recovery feature is also called incomplete recovery, which increases the oxygen demand of the body during the recovery period. Although the time of exercise is short, the body will be stimulated by exercise at this time, and the speed of fat decomposition will become faster. Slowly, the body will form a benign energy supply. In this way, even after the exercise, the body still maintains a high resting metabolic rate, so that it can still maintain energy consumption and thus consume body fat when not exercising. The increase of resting metabolic rate means the increase of the basic metabolic rate of the human body. In this way, while maintaining the same diet, the energy consumption of the body is increasing, so the body fat is also decreasing. To sum up, moderate intensity exercise can effectively improve body fat rate, body fat rate and skeletal muscle content.

CONCLUSION

The purpose of this experiment is to study the effect of intermittent moderate intensity training on improving college students' physical quality, body composition, cardiopulmonary function and other physical indicators, and to further explore its impact mechanism. By observing the differences between the experimental group and the control group in body composition, physical fitness status, body shape, and maximum oxygen uptake, the study analyzed the actual effects of two different modes of moderate intensity exercise, and made an effort to better help college students improve their physical fitness and physical health in the future. From this study, it can be concluded that contemporary college students should adhere to sports, improve their sports ability, improve their cardiorespiratory function, prevent and avoid some diseases caused by lack of physical exercise, maintain good health to improve their quality of life, complete their studies in a healthy and happy way, and become an important part of the future construction of the country. It also calls on college students not only to focus on their studies, but also to use their spare time to exercise more, enrich their lives, and keep themselves healthy so that they can become better themselves.

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

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. Su Zhifeng and Wu Maotang: writing and execution.

REFERENCES

1. Ballester R, Huertas F, Yuste FJ, Llorens F, Sanabria D. The relationship between regular sports participation and vigilance in male and female adolescents. *PloS One*. 2015;10(4):e0123898.
2. Kayali S, Yildirim FT. Echocardiographic assessment of children participating in regular sports training. *North Clin Istanbul*. 2018;6(3):236-41.
3. Ehrlich SF, Hedderson MM, Brown SD, Sternfeld B, Chasan-Taber L, Feng J, et al. Moderate intensity sports and exercise is associated with glycaemic control in women with gestational diabetes. *Diabetes Metab*. 2017;43(5):416-23.
4. Malik AA, Williams C, Weston K, Barker AR. Perceptual responses to high-and moderate-intensity interval exercise in adolescents. *Med Sci Sports Exerc*. 2017;50(5):1021-30.
5. van Hall G. The physiological regulation of skeletal muscle fatty acid supply and oxidation during moderate-intensity exercise. *Sports Med*. 2015;45(1):23-32.
6. Waris A, Ahmad S, Isam C, Akhtar H. Comparison among Journal Quality Indicators of Sports Science Journals. *Library Herald*. 2017;55(3):339-51.