

BODY INDEX VARIATION IN THE UNIVERSITY STUDENTS UNDER RESISTANCE TRAINING



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VARIAÇÃO DO ÍNDICE CORPORAL EM ESTUDANTES UNIVERSITÁRIOS SOB TREINAMENTO DE RESISTÊNCIA

VARIACIÓN DEL ÍNDICE CORPORAL EN ESTUDIANTES UNIVERSITARIOS BAJO ENTRENAMIENTO DE RESISTENCIA

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ABSTRACT

Introduction: Recent research on the probability of increasing physical injuries during physical activities revealed that resistance training can improve physical performance of college students, prevent sports injuries and reduce the body fat rate of its practitioners. **Objective:** Analyze the effects of resistance training on the body index of university students. **Methods:** One hundred female college students were selected as experimenters to ensure normal activities for 16 weeks. The experimenter performed resistance training for 16 weeks, three times a week on Monday, Wednesday and Friday, with three cycles each time. **Results:** After 16 weeks of experimental intervention, the average chest circumference, average waist circumference, average hip circumference, and average leg circumference of the experimental group were 83.27cm, 63.1cm, 89.95cm, 54.6cm, and 24.02%, respectively. After the experiment, the average back muscle strength of the experimental group increased by 5.11kg, and the average basal metabolism increased from 1204.4 kcal to 1260.59 kcal. **Conclusion:** Resistance training and aerobic exercise have the most significant effect on body fat rate. Resistance training can control the decline of body fat rate in college students to improve their physical quality. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Training, Endurance; Body Mass Index; Students; Universities.

RESUMO

Introdução: Pesquisas recentes sobre a preocupação na probabilidade do aumento em lesões físicas durante as atividades físicas revelaram que o treinamento de resistência pode melhorar o desempenho físico dos estudantes universitários, prevenir lesões esportivas e reduzir a taxa de gordura corporal de seus praticantes. **Objetivo:** Analisar os efeitos do treinamento de resistência física sobre o índice corporal dos estudantes universitários. **Métodos:** Cem estudantes universitárias foram selecionadas como experimentadoras para garantir atividades normais durante 16 semanas. O experimentador realizou treinamento de resistência durante 16 semanas, três vezes por semana na segunda, quarta e sexta-feira, com três ciclos de cada vez. **Resultados:** Após 16 semanas de intervenção experimental, a circunferência média do tórax, circunferência média da cintura, circunferência média do quadril e circunferência média das pernas do grupo experimental foram 83,27cm, 63,1cm, 89,95cm, 54,6cm e 24,02% respectivamente. Após o experimento, a força média dos músculos das costas do grupo experimental aumentou em 5,11kg, e o metabolismo basal médio aumentou de 1204,4kcal para 1260,59kcal. **Conclusão:** O treinamento de resistência e o exercício aeróbico têm o efeito mais significativo na taxa de gordura corporal. O treinamento de resistência pode controlar o declínio da taxa de gordura corporal dos estudantes universitários, de forma a melhorar sua qualidade física. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Treinamento de Resistência; Índice de Massa Corporal; Estudantes; Universidades.

RESUMEN

Introducción: Recientes investigaciones sobre la preocupación por la probabilidad de aumento de lesiones físicas durante las actividades físicas revelaron que el entrenamiento de resistencia puede mejorar el rendimiento físico de los estudiantes universitarios, prevenir lesiones deportivas y reducir el índice de grasa corporal de sus practicantes. **Objetivo:** Analizar los efectos del entrenamiento de resistencia física sobre el índice corporal de estudiantes universitarios. **Métodos:** Se seleccionaron cien estudiantes universitarias como experimentadoras para garantizar una actividad normal durante 16 semanas. El experimentador realizó un entrenamiento de resistencia durante 16 semanas, tres veces por semana, los lunes, miércoles y viernes, con tres ciclos cada vez. **Resultados:** Tras 16 semanas de intervención experimental, el perímetro torácico medio, el perímetro medio de la cintura, el perímetro medio de la cadera y el perímetro medio de las piernas del grupo experimental fueron de 83,27 cm, 63,1 cm, 89,95 cm, 54,6 cm y 24,02% respectivamente. Tras el experimento, la fuerza muscular media de la espalda del grupo experimental aumentó en 5,11 kg, y el metabolismo basal medio pasó de 1204,4 kcal a 1260,59 kcal. **Conclusión:** El entrenamiento de resistencia y el ejercicio aeróbico tienen el efecto más significativo sobre el índice de grasa corporal. El entrenamiento de resistencia puede controlar la disminución de la tasa de grasa corporal en los estudiantes universitarios, con el fin de mejorar su calidad física. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descritores: Entrenamiento de Resistencia; Índice de Masa Corporal; Estudantes; Universidades.



INTRODUCTION

Due to the change of life mode and the increase of the pressure of study and job search, college students have less and less time to exercise at ordinary times, which leads to the weakening of college students' health.¹ It is the training requirement of college students to introduce scientific and reasonable training methods and obtain the maximum training effect in a limited period of time.² Resistance training is a training method of resistance resistance with repeated and medium low degree. It generally consists of several strength training methods to form a cycle. College students can repeat several cycle series of exercises according to their physical quality and training stage.³ Compared with the traditional training, resistance training has the characteristics of less body burden, more repetitions, and shorter intervals. At the same time, resistance training is also a gradual resistance training, which has both the body impact effect of traditional training and the human metabolic characteristics of aerobic exercise.⁴ Therefore, resistance training is also a good choice for college students who want to reduce body fat rate and improve their physical quality.⁵ This paper will develop a 16 week resistance training for the experimenter to investigate the impact of the training program on female college students' body fat rate and health, and provide a scientific theoretical basis for the implementation of a reasonable training program.⁶

METHOD

In this paper, female college students in a university were selected as the main subjects, and 100 female college students with similar age, height and weight were selected as the main training objects. The study and all the participants were reviewed and approved by Ethics Committee of Zhejiang Police College (NO.ZJPC2018PE056). Then the experimenters were divided into 50 experimental groups and 50 control groups, respectively. Before the experiment, the relevant data of the students' bodies were checked, mainly including: human body shape, basic metabolism and muscle strength. The middle and low strength resistance experiment was conducted in the school for 16 weeks, and then divided into the experimental group and the control group. After the experiment, the relevant data were tested, the testing method remained unchanged, and the results before and after the test were compared. Finally, the relevant empirical analysis and comparative research were carried out. As can be seen from Table 1, the female college students selected in a university are 19 years old and 165cm tall, and their weight belongs to the standard category.

Research methods

In the control group, without any restriction, the normal activity of 16 weeks was guaranteed. The experimental group carried out resistance training for 16 weeks, three times a week on Monday, Wednesday and Friday, with three cycles each time. During training, in order to avoid injury, first warm up for 15 minutes, and the heart rate reaches 120~130 times/min during warm-up exercise. Each cycle is divided into strength training and pedaling power bicycle. The load range of strength exercise is 50%~60% of the maximum muscle strength. The strength exercise methods are divided into eight groups: supine leg lift, sitting position conversion, weight bearing belly rolling, sitting type dorsal muscle

Table 1. Subjects.

Basic indicators	Age (age)	Height (cm)	Weight (kg)
Experience group	19.23±1.23	166.23±1.89	50.64±8.36
Control group	19.58±0.45	164.67±1.33	52.55±7.99
T	0.273	-0.387	0.016
P	0.555	0.675	0.953

exercise, sitting position thigh flexion and extension, sitting position pull-down, butterfly chest expansion, and prone leg bending. Each group repeats 12 times, and the interval between each group is 30s. The way of pedaling power bicycle is once per cycle, 3min each time, and the maximum intensity is 65% of the heart rate intensity. The time interval of each cycle is about 2min, and the total time of each exercise is about 60min.

Test index

Input the effective data measured by the experimenter into the computer, input the data into the Microsoft Excel 2019 system for storage, establish a database, and carry out mathematical statistics in the Microsoft Excel 2019 software system. The data before and after the experiment were compared and analyzed, and the important data were analyzed by T-data. Significant difference is the evaluation of numerical difference. In general, when the experimental results are less than 0.05, the difference effect between values can be explained. For sig value, P>0.05 generally indicates no significant difference; 0.01<P<0.05 means significant difference; P<0.01 means the difference is extremely significant.

RESULTS

Changes of body fat rate of college students before and after the experiment

In the experimental intervention stage, there was no significant difference among the female college students in the control group. It can be seen from the test data before and after the experiment that there is no significant difference in body composition BMI, body fat rate, fat weight, skeletal muscle and waist hip ratio index, while there is a significant difference in the changes of BMI index and body fat rate in the experimental group before and after the experiment, as shown in Table 2.

Changes of body fat rate of college students before and after the experiment

The average waist circumference of female college students in the experimental group was 63.1 cm after high-intensity resistance training, while the average waist circumference of female college students in the control group was 65.03 cm. It can be seen from this that after resistance training, although the average waist data of female college students has decreased to a certain extent, the difference between them is not significant. The average hip circumference of female college students in the experimental group was 89.95cm after high-intensity resistance training, while that of female college students in the control group was 90.08cm. It can be seen from this that although the hip circumference of female universities after resistance training has indeed decreased to

Table 2. Comparison of Body Fat Rate of College Students before and after Resistance Training.

Index	BMI		Body fat percentage	
	Before experiment	After experiment	Before experiment	After experiment
Experience group	20.94±1.29	20.4±1.91	25.08±6.61	24.02±4.29
Control group	21.83±1.12	21.4±1.25	26.65±7.01	26.15±5.79
T	0.338	0.479	0.019	0.7102
P	0.688	0.837	1.18172	0.732
Index	Fat weight		Skeletal muscle (kg)	
	Before experiment	After experiment	Before experiment	After experiment
Experience group	12.49±6.5	11.03±5.9	13.79±2.1	13.19±1.89
Control group	11.4±7.4	10.29±5.2	12.92±1.92	12.67±2.04
T	0.476	1.134	0.812	1.024
P	1.14948	0.142	1.144	0.232

a certain extent, there is no significant difference in the improvement of hip circumference after resistance training. The average thigh circumference index of female college students in the experimental group was 54.6cm, while the average thigh circumference of female college students in the control group was 56.4cm. From this, we can see that there are significant differences in the reduction effect of resistance training on thigh circumference. After high-intensity resistance training, the average waist to hip ratio of female college students in the experimental group is 0.7, while the waist to hip ratio of female college students in the control group is 0.72. From this, it is known that the waist to hip ratio of female college students also has a significant difference. Body shape changes are shown in Table 3.

Changes of college students' sports ability before and after the experiment

As shown in Table 4, there was no significant difference between the experimental group and the control group in the test results before the experiment. But after the experiment, the average back muscle strength of the experimental group increased by 5.11kg; The average back muscle strength of the control group increased by 1.81kg, so the increase level of the average back muscle strength of the experimental group was more prominent than that of the control group, indicating that there was a highly significant difference between the experimental group and the control group. In the data of squatting ability, there was no significant difference between the experimental group and the control group before the experiment. But after the experiment, the average squatting of the experimental group increased by 12.25 kg; The average squatting of the control group increased by 13.9 kg, so the increase level of squatting in the experimental group was more prominent than that in the control group, indicating that there was a highly significant difference compared with the control group. In conclusion, there is no significant difference between the experimental group and the control group in the test results before the experiment. After the experiment, the data of the two groups were compared again. After 16 phases of experimental intervention research, there was a significant difference between the experimental group and the control group. By comparing the data of the experimental group and the control group, the data of the experimental group is obviously better than that of the control group.

Changes of college students' basic metabolism before and after the experiment

As shown in Table 5, there was no significant difference between the experimental group and the control group in the test results before the experiment. But after the experiment, the basal metabolic capacity per capita of the experimental group increased by 56.19 kcal; The basal metabolic capacity per capita of the control group increased by 2.7 kcal. Therefore, the experimental group is more prominent than the control group in terms of the improvement of basic metabolism, indicating that there is a significant difference compared with the control group.

After 16 weeks of long-term resistance training, the body shape of female college students has changed, with a significant difference;

Table 3. Comparison of college students' body shape changes before and after resistance training.

Body shape	Chest (cm)		Waist (cm)		Hip (cm)		Thigh (cm)		Waist hip ratio (%)	
	Before experiment	After experiment	Before experiment	After experiment	Before experiment	After experiment	Before experiment	After experiment	Before experiment	After experiment
Experience group	84.91±1.09	84.27±0.81	65.9±0.7	63.1±0.91	91.28±0.76	89.95±1.82	56.91±0.92	54.6±1.24	0.72±0.19	0.7±0.29
Control group	83.9±1.02	83.27±0.42	65.16±0.69	65.03±1.03	90.31±0.27	90.08±0.52	56.5±1.02	56.4±0.85	0.72±0.36	0.72±0.16
T	3.125	2.23	2.754	2.609	2.936	2.594	3.012	2.823	0.267	0.306
P	0.332	0.429	0.216	0.358	0.276	0.285	0.32	0.297	0.529	0.629

Although the training intensity is kept in a relatively stable condition, it still has a certain impact on the body, so the proportion of muscle will also rise, so people will become thinner in shape; Because long-term aerobic training has a relatively shallow impact on the body, the changes in human morphology are not obvious. Figure 1 shows that the basal metabolic rate of girls has been improved compared with that before the experiment, and there is a significant difference. The basal metabolic rate has no positive relationship with the simple height and weight, but has a large positive relationship with the body surface area. In addition to maintaining the specific tension balance of nerve cells for survival, the basic metabolic volume also provides energy requirements for the activities of brain and central nervous tissues, cardiac muscle and blood circulation, respiratory function of lungs, filtration and reabsorption function of kidneys, and maintenance of liver function. Compared with the control group, the physical health level of college students in the experimental group has been significantly improved.

Table 4. Comparison of the changes of female college students' sports ability before and after resistance training.

Project	Back muscle strength (kg)		Squat (kg)	
	Before experiment	After experiment	Before experiment	After experiment
Experience group	62.05±0.95	67.16±1.11	20.48±1.45	34.38±1.31
Control group	61.02±0.88	62.83±1.23	21.88±1.29	32.80±1.99
T	0.676	1.491	-0.586	1.018
P	0.475	0.005	0.483	0.012

Table 5. Comparison of changes in basic metabolism of female college students before and after resistance training.

Content	Basic metabolic capacity (kcal)	
	Before experiment	After experiment
Experience group	1204.4±85.1	1260.59±109.76
Control group	1259.9±112.4	1262.6±103.9
T	0.012	0.028
P	0.03	0.02

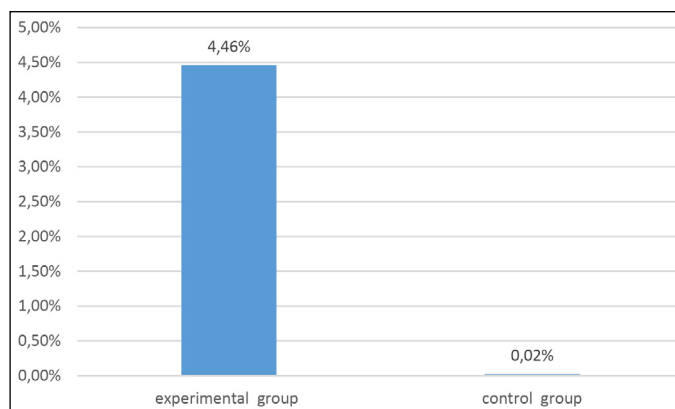


Figure 1. Comparison of muscular endurance indexes of four groups of athletes before and after training.

DISCUSSION

Resistance training refers to the active movement of the body after overcoming external obstacles, which can repair and extend muscle movement, and widely treat muscle atrophy caused by various factors. In the setting of the training prescription for resistance sports, the human body is roughly divided into five muscle groups: shoulder and arm muscle group, chest and rib muscle group, core area muscle group, upper back muscle group and hip and thigh muscle group, and each training exercises one part. In the type of muscle movement, centripetal contraction is adopted. From the perspective of independent sources, fixed instruments can be considered as the main source. Generally speaking, fixed instruments are safer than free weights, and are easier to practice and master. At the same time, they can also complete some training tasks that can not be completed by free weights. Fixed instruments can help balance muscles in training activities, control the movement balance between special joints and muscle groups, and focus on the main movement muscle groups. In the experiment, all the experimenters completed the cognitive training of relevant sports. In the aspect of sports speed, medium sports speed is adopted. The strength of resistance training is determined as 15RM, that is, the maximum number of times for a single group is 15; It is determined as 14-15 on RPE, that is, the status of the experimenter is "slightly tired". The number of training groups was three for each movement, and the rest time in the group was 1 minute. When the resistance exercise is completed, the aerobic exercise is started. The type and intensity of training are the same as

those of the aerobic exercise group, and the total exercise duration of the two groups is about 1h. The purpose is to study the difference of effectiveness between the two groups of exercise prescriptions at the same intervention time. After each exercise, guide the experimenter to do some massage and muscle pulling to avoid fatigue, thus improving the efficiency of the next exercise.

CONCLUSION

Resistance training provides a sports protection mechanism for college students to avoid injury in sports, and also actively promotes the development of students' physical quality, thus reducing the problem of the reduction of college students' sports activities and the lack of specialization in early sports. The students who give the highest priority to the exercise resistance training program are mainly those college students who lack physical strength and movement ability, including early sports professionals, college students who are not satisfied with the current sports requirements related to physical development, and college students who are overweight. After 16 weeks of resistance exercise, the sports endurance of female college students can be enhanced, thus improving the sports ability of female college students' muscle groups, effectively reducing the body fat rate of college students, improving various body shape indicators, and significantly improving their physical health.

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