IMPACTS OF MUSCLE TRAINING LOADS ON COLLEGE STUDENTS' PHYSICAL FITNESS

IMPACTOS DE CARGAS NO TREINAMENTO MUSCULAR SOBRE A APTIDÃO FÍSICA DOS ESTUDANTES UNIVERSITÁRIOS

IMPACTO DE CARGAS EN EL ENTRENAMIENTO MUSCULAR SOBRE LA APTITUD FÍSICA DE LOS ESTUDIANTES UNIVERSITARIOS

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ABSTRACT

Introduction: Due to the excessive value of contemporary intellectual education, the physical fitness of college students has become precarious. This gradual deficit requires innovative solutions to inhibit the negative impacts on the physical quality that inevitably impact students' learning ability. Objective: Verify the impacts of varied loads in muscular strength exercise on college students and their practical repercussions on the diversified development of physical education classes. Methods: We selected 90 non-sporting college students, sedentary and without physical diseases, divided into experimental group 1 with medium intensity load, experimental group 2 with a low-intensity load, and a control group. Before and after the experiment, the relevant fitness indicators were evaluated, and finally, the data were statistically integrated and analyzed. Results: Group 1 increased from 52.25 ± 5.57kg before training to 54.56 ± 6.02kg, with a very significant change; experimental group 2 increased from 53.32 ± 4.89kg before training to 54.21 ± 5.22kg, showing a very significant change as well. Conclusion: Establishing the intensity of load muscle training scientifically and rationally can improve college students' physical quality and muscle strength, and promote the healthy and coordinated development of their psychological and physical quality. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Exercise; Physical Fitness; Exercise Program, Weight- Bearing.

RESUMO

Introdução: Em detrimento da supervalorização da educação intelectual contemporânea, o condicionamento físico dos estudantes universitários tem se tornado precário. Este déficit gradual requer soluções inovadoras visando inibir os impactos negativos à qualidade física que inevitavelmente repercutiram sobre a capacidade de aprendizagem dos estudantes. Objetivo: Verificar os impactos de cargas variadas no exercício de força muscular sobre os estudantes universitários e sua repercussão prática sobre o desenvolvimento diversificado das aulas de educação física. Métodos: Foram selecionados 90 estudantes universitários de áreas não esportivas, sedentários e sem doenças físicas, divididos em grupo experimental 1 com carga de média intensidade, grupo experimental 2 com carga de baixa intensidade e grupo de controle. Antes e depois do experimento, os indicadores de aptidão física relevantes foram avaliados, e finalmente os dados foram integrados estatisticamente e analisados. Resultados: O grupo 1 aumentou de 52,25 ± 5,57kg antes do treinamento para 54,56 ± 6,02kg, com uma mudança muito significativa; o grupo experimental 2 aumentou de 53,32 ± 4,89kg antes do treinamento para 54,21 ± 5,22kg, apresentando alteração também muito significativa. Conclusão: Estabelecer a intensidade do treinamento muscular de carga no treinamento muscular de forma científica e racional pode melhorar a qualidade física e a força muscular dos estudantes universitários, além de promover o desenvolvimento sadio e coordenado da qualidade psicológica e física desses estudantes. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Exercício Físico; Aptidão Física; Programa de Fortalecimento por Carga de Peso.*

RESUMEN

Introducción: En detrimento de la sobrevaloración de la formación intelectual contemporánea, la forma física de los universitarios se ha vuelto precaria. Este déficit gradual requiere soluciones innovadoras destinadas a inhibir los impactos negativos sobre la calidad física, que inevitablemente repercuten en la capacidad de aprendizaje de los alumnos. Objetivo: Verificar los impactos de cargas variadas en ejercicios de fuerza muscular en estudiantes universitarios y su repercusión práctica en el desarrollo diversificado de las clases de educación física. Métodos: Se seleccionaron 90 estudiantes universitarios de áreas no deportivas, sedentarios y sin enfermedades físicas, divididos en grupo experimental 1 con carga de intensidad media, grupo experimental 2 con carga de intensidad baja y grupo control. Antes y después del experimento, se evaluaron los indicadores de aptitud pertinentes y, por último, se integraron y analizaron estadísticamente los datos. Resultados: El grupo 1 aumentó de 52,25 ± 5,57 kg antes del entrenamiento a 54,56 ± 6,02 kg, con un cambio muy significativo; el grupo experimental 2 aumentó de 53,32 ± 4,89 kg antes del entrenamiento a 54,21 ± 5,22 kg, mostrando también un cambio muy significativo. Conclusión:

Establecer la intensidad del entrenamiento muscular de carga de forma científica y racional puede mejorar la calidad física y la fuerza muscular de los estudiantes universitarios, así como promover el desarrollo saludable y coordinado de su calidad psicológica y física. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Ejercicio Físico; Aptitud Física; Programa de Fortalecimiento Soportando Peso.*

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INTRODUCTION

Education is not only a simple knowledge learning, but also a part of education, which is the basis for professional learning.[1] Without a healthy body and good spirit, it is difficult to carry out long-term mental work, and the learning effect can not be guaranteed. Compared with the physical quality education and healthy growth of college students, schools and families tend to pay more attention to students' test results and learning ability.[2] As a result, the physical function and health level of college students are declining year by year. The level of college students' physical ability is not only related to their own healthy growth, but also closely related to the future of the country and the nation.[3] As the future of the country, it is very necessary and important for college students to exercise and strengthen their physical quality, especially the muscle strength training.[4] When carrying out muscle strength training, the size of training load is related to the actual effect of muscle strength training under the consistent state of scientific and systematic training methods.[5] In general, the training load is related to the weight of training equipment, the total training time, the rest time between groups, the number of repetitive training groups, and the training frequency.[6] Only according to the different physical conditions of different subjects in training, according to scientific and systematic training methods, with reasonable and appropriate training load, specific muscle training is carried out for muscles that need to be strengthened, can the comprehensive and balanced development of body muscles be comprehensively improved, the body muscle content of college students be improved, and their healthy body and sound spirit be cultivated.[7]

METHOD

Research objects

Through searching and researching the existing authoritative literature, this paper summarizes the muscle strength level and development needs of adults. The study and all the participants were reviewed and approved by Ethics Committee of North University of China (NO.21N-THU-103CO). At the same time, according to this experiment, many training methods of load muscle training have been selected, which makes the research process of this paper more specific and the cognition of load muscle training more scientific. After the design of the specific experimental scheme, we used the methods of interview and questionnaire to carry out intellectual interaction with the professional scholars studying sports, experts in sports rehabilitation and muscle dynamics, and the current physical education teachers who are teaching at the university. We further refined, supplemented and improved the experimental scheme, and finally determined the experimental scheme. With the unanimous consent of the head teacher and guardians of the tested students, among the freshmen and sophomores of non sports majors, there are 90 college students who have no hypertension, cardiovascular disease, bone and joint disease, and have not undergone professional muscle strength training within one year, and they volunteer to participate in this load muscle training experiment. The 90 college students were equally divided into three groups: experiment group 1, experiment group 2 and control group. Their age, height and weight are shown in Table 1.

Research methods

The muscle load training experiment lasted for 8 weeks, twice a week. The experimental group received muscle training. One group had 10 consecutive repetitive movements. The rest time between the groups was 1-2 minutes according to individual differences. A total of 15 groups were trained. The three groups were a large group, and the rest time between the large groups was 5 minutes. In order to reduce the influence of irrelevant factors on the accuracy of the experiment, during the experiment of muscle load training, each subject's daily diet structure, eating time and work and rest rules were consistent. Before and after the experiment, the subjects carried out body composition indicators, ultrasonic testing and muscle electrical signal measurement respectively. After the experiment, the data obtained were integrated and further analyzed.

RESULTS

Effects of muscle training with different loads on body muscles

After 8 weeks of weight bearing muscle training, the changes of students' upper limb muscle quality are shown in Table 2.

It can be seen from the data in Table 2 that, on the whole, the upper arm circumference of the two experimental groups changed significantly before and after training, P<0.01. The upper arm relaxation circumference and forearm circumference of the experimental group 1 had the

Table 1. Basic information of the experimental group and the control group.

Group	Number of people	Age (age)	Height (cm)	Weight (kg)
Experiment 1 Group	30	19.38±0.47	175.76±8.04	66.85±11.53
Experiment 2 Group	30	19.56±0.82	174.38±7.71	67.22±12.02
Control group	30	19.32±0.74	173.87±8.61	66.87±10.88

Table 2. Changes of upper limbs of students before and after training.

Index	Group	Before training	After training	t	P
Upper arm tension circumference (cm)	Experiment 1 Group	32.57±1.08	34.92±1.03	2.632	0.013
	Experiment 2 Group	33.03±1.27	33.76±1.16	0.284	0.033
	Control group	32.77±1.02	32.07±0.92	-0.123	0.145
Relaxed circumference of upper arm (cm)	Experiment 1 Group	28.83±3.11	30.62±3.34	3.062	0.007
	Experiment 2 Group	27.93±2.44	28.09±2.06	0.151	0.042
	Control group	27.02±2.15	27.12±1.78	-0.115	0.089
Forearm circumference (cm)	Experiment 1 Group	27.22±1.89	27.67±2.11	1.251	0.008
	Experiment 2 Group	27.06±1.31	27.78±1.90	-2.223	0.038
	Control group	26.98±2.01	27.01±1.87	-3.274	0.076

most significant changes (P<0.01). The upper arm relaxation circumference increased from 28.83 ± 3.11cm before training to 30.62 ± 3.34cm, and the forearm circumference increased from 27.22 ± 1.89cm before training to 27.67 ± 2.11cm. Relatively speaking, the upper arm tension circumference of experimental group 1 changed slightly, from 32.57 ± 1.08cm before training to 34.92 ± 1.03cm, but there was still a significant difference from that before training. The three indexes of experiment group 2 also changed significantly, in which the upper arm tension circumference changed from 33.03 ± 1.27cm before training to 33.76 ± 1.16, the increase amplitude was smaller than that of training group 1, but the difference was significant compared with that before training. The changes of three indexes in the control group were not significant. It is proved that the medium load muscle training has a significant impact on the upper limb, and the small load muscle training also has a certain impact on the upper limb muscle, but compared with the medium load muscle training, the impact is more significant.

The data in Table 3 shows that after 8 weeks of training, the changes in calf circumference and thigh circumference of Group 1 with moderate load muscle training are relatively significant (P<0.05), in which the calf circumference increases from 37.57 ± 3.08cm to 38.15 ± 2.78, and the thigh circumference increases from 55.01 ± 3.77cm to 55.62 ± 3.28cm, indicating that moderate load muscle training has a significant impact on the growth of lower limb muscles and the changes in leg circumference. In contrast, the two groups of experiment with low load muscle training had no significant changes in two indicators, P>0.05, but the overall growth was slight. The circumference of the lower leg changed from 36.73 ± 2.25cm to 37.02 ± 2.16cm, and the circumference of the thigh changed from 56.02 ± 3.41cm to 56.39 ± 2.06cm. This shows that compared with moderate load muscle training, the impact of low load training on the lower limb muscles was weak, which is related to the training methods and training duration. There was no significant change in the control group (P>0.05).

Impact of load muscle training on cardiopulmonary function

The influence of different load muscle training on cardiopulmonary endurance is shown in Table 4.

Compared with the data before training, it can be seen from the results in Table 4 that the indexes of heart rate and vital capacity of Group 1 and Group 2 have relatively significant changes (P<0.05). The frequency of heart rate showed a certain downward trend. The frequency of heart rate in Group 1 decreased from 67.09 ± 8.59b/min before training to 62.51 ± 5.57b/min, and the frequency of heart rate in Group 2 decreased from 66.91 ± 7.16b/min before training to 62.03 ± 6.35b/min. There was no significant change in the control group, but it also showed a downward trend, from 66.63 ± 6.61b/min before training to 64.12 ± 6.01b/min. Generally speaking, the heart function of athletes is strong, so the heart rate will be lower than that of ordinary people. After 8 weeks of regular exercise, the heart rate of the tested students also tends to be more gentle, indicating that moderate and low load muscle training can improve the heart function of students to a certain extent. At the same time, the vital capacity of the experimental group and the control group showed significant changes. The vital capacity of the experimental group 1 increased from 2.86 ± 0.83L before training to 3.25 ± 0.62L, the vital capacity of the experimental group 2 increased from 2.81 ± 0.49L before training to 3.11 ± 0.17L, and the vital capacity of the control group increased from 2.79 ± 0.52L before training to 2.95 ± 0.67L.

Table 3. Changes of lower limbs of students before and after training.

Index	Group	Before training	After training	t	P
Calf circumference (cm)	Experiment 1 Group	37.57±3.08	38.15±2.78	-2.632	0.000
	Experiment 2 Group	36.73±2.25	37.02±2.16	0.284	0.067
	Control group	37.21±3.11	37.17±2.68	-0.258	0.088
Thigh circumference (cm)	Experiment 1 Group	55.01±3.77	55.62±3.28	-4.025	0.025
	Experiment 2 Group	56.02±3.41	56.39±2.06	4.062	0.054
	Control group	55.16±2.36	55.12±2.08	-2.250	0.0127

Effect of load muscle training on physical fitness

The change of body muscle will further affect the improvement of college students' physical quality. As shown in Table 5, the physical quality of the tested college students before and after the training shows a different degree of change.

As shown in Table 5, the weight, BMI, body fat rate and muscle mass of the students showed significant changes before and after participating in the load muscle training, of which the change of muscle mass was the most obvious, P<0.01. The experimental group 1 increased from 52.25 ±

Table 4. Changes of students' cardiopulmonary function before and after training.

Index	Group	Before training	After training	t	P
Heart rate HR (b/min)	Experiment 1 Group	67.09±8.59	62.51±5.57	-2.689	0.014
	Experiment 2 Group	66.91±7.16	62.03±6.35	-3.023	0.045
	Control group	66.63±6.61	64.12±6.01	-2.541	0.052
Vital capacity VC (L)	Experiment 1 Group	2.86±0.83	3.25±0.62	2.527	0.041
	Experiment 2 Group	2.81±0.49	3.11±0.17	2.350	0.012
	Control group	2.79±0.52	2.95±0.67	5.527	0.044

Table 5. Changes of students' physical quality before and after training.

Option	Group	Before training	After training	t	P
Weight (kg)	Experiment 1 Group	66.85±11.53	66.77±10.88	-2.217	0.066
	Experiment 2 Group	67.22±12.02	66.97±11.23	-2.362	0.038
	Control group	66.87±10.88	66.72±11.01	-1.234	0.142
BMI	Experiment 1 Group	21.89±2.01	19.87±1.57	-0.531	0.021
	Experiment 2 Group	22.15±1.08	19.52±1.23	-4.523	0.044
	Control group	22.07±1.12	20.69±1.77	-3.022	0.086
Body fat percentage (%)	Experiment 1 Group	15.56±5.89	12.57±4.87	-1.057	0.027
	Experiment 2 Group	16.02±4.87	13.25±5.02	-5.351	0.035
	Control group	15.89±5.02	15.02±5.21	1.284	0.048
Muscle volume (kg)	Experiment 1 Group	52.25±5.57	54.56±6.02	4.351	0.000
	Experiment 2 Group	53.32±4.89	54.21±5.22	2.782	0.007
	Control group	52.65±5.87	52.23±4.01	3.083	0.124

5.57kg before training to 54.56 ± 6.02kg, with a very significant change; Group 2 increased from 53.32 ± 4.89kg before training to

54.21 ± 5.22kg, the change is also very significant. At the same time, the change of muscle mass in the control group is small and shows a certain degree of reduction, which shows that the scientific muscles have a significant impact on improving the muscle mass of college students, while daily exercise has no obvious effect on the growth of muscle mass because of more aerobic exercise.

DISCUSSION

After eight weeks of training, the body composition structure of the three groups of subjects changed to varying degrees. After systematic and regular muscle training, the body mass index and body fat rate of the subjects decreased significantly. When the total amount of muscle increased, the muscle strength also increased. At the same time, after a long time of muscle load training, the muscle strength and cardiopulmonary function also improved. During the 8-week muscle load training, the muscles of the upper and lower limbs of the subjects were significantly improved by medium intensity large load, low intensity medium load and ordinary routine training. From the specific experimental data, the strength training of low intensity and medium load muscles in the experimental group 2 has a significant effect on the muscle strength of the college students, while the strength training of high intensity and large load muscles in the experimental group 1 has a more significant effect on the muscle strength of the college students. In addition, it can be seen from the data in Table 5 that both load muscle training and daily physical exercise have a certain effect on the reduction of students' body fat rate, in which the muscle training process has a very significant effect on the improvement of muscle mass, but the moderate load muscle training has no significant effect on weight reduction, while the low load muscle training has a significant effect on weight reduction. In contrast, daily sports activities have little effect on improving muscle mass, but they will still reduce body fat and students' weight to a large extent. Because muscle training includes aerobic and anaerobic exercise, it will burn fat first and then increase muscle content during training, so it has little impact on weight change. However, since the training lasts only eight weeks, small load muscle training and daily physical exercise are effectively burning fat, so the impact on weight is more obvious than heavy load muscle training.

CONCLUSION

In recent years, people pay more attention to the effect of muscle training under different loads and the impact of training on body composition structure. Many colleges and universities also pay more attention to the muscle strength level and body muscle training that affect the healthy development of students' physique. Based on the purpose of students' physical exercise, this paper studies the changes of students' muscle and physical fitness and other indicators under different load muscle training, and concludes that load muscle training will have a certain degree of impact on the increase of students' muscle mass and cardiopulmonary function.

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REFERENCES

1. Hofstein A, Mamlok-Naaman R. The laboratory in science education: the state of the art. Chem Educ Res Pract. 2007;8(2):105-7.
2. Masek A, Yamin S. The effect of problem based learning on critical thinking ability: a theoretical and empirical review. Int Rev Soc Sci Humanit. 2011;2(1):215-21.
3. Beck AQ, Clasey JL, Yates JW, Koebke NC, Palmer TG, Abel MG. Relationship of physical fitness measures vs. occupational physical ability in campus law enforcement officers. J Strength Cond Res. 2015;29(8):2340-50.
4. Suchomel TJ, Nimphius S, Bellon CR, Stone MH. The importance of muscular strength: training considerations. Sports Med. 2018;48(4):765-85.
5. Mayer F, Scharhag-Rosenberger F, Carlsohn A, Cassel M, Müller S, Scharhag J. The intensity and effects of strength training in the elderly. Dtsch Arztebl Int. 2011;108(21):359-64.
6. Schoenfeld BJ, Ogborn D, Krieger JW. Effects of resistance training frequency on measures of muscle hypertrophy: a systematic review and meta-analysis. Sports Med. 2016;46(11):1689-97.
7. Kwon HR, Han KA, Ku YH, Ahn HJ, Koo BK, Kim HC, et al. The effects of resistance training on muscle and body fat mass and muscle strength in type 2 diabetic women. Korean Diabetes J. 2010;34(2):101-10.