

EFFECTS OF HIGH-INTENSITY GYMNASTICS ON SKELETAL MUSCLE PROTEINS

EFEITOS DA GINÁSTICA DE ALTA INTENSIDADE SOBRE AS PROTEÍNAS MUSCULARES ESQUELÉTICAS

EFFECTOS DE LA GIMNASIA DE ALTA INTENSIDAD EN LAS PROTEÍNAS MUSCULARES ESQUELÉTICAS



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Chengbo Xu¹ 
(Physical Education Professional)

1. Jilin University of Architecture
and Technology, Changchun,
Jilin, China.

Correspondence:

Chengbo Xu
Changchun, Jilin, China, 130000
xcb13504400455@163.com

ABSTRACT

Introduction: Although the current method of muscle stretching in gymnastics teaching in colleges and universities can reduce sports fatigue, it has been shown to have little effect on the well-being of athletes because it requires a long recovery time from psychological fatigue. Progressive muscle relaxation training is a method that uses the basic principle of sympathetic nerve activity to reduce the impact of negative emotions psychologically and relieve fatigue physiologically, requiring a further study of its impact on muscle protein. **Objective:** Explore the effect of high-intensity gymnastics on skeletal muscle protein and study the progressive muscle relaxation training method post-workout adjustment. **Methods:** After three weeks of training, excluding the standard deviations in the experimental data caused by the athletes' irregular movements, the athletes' blood lactate content and heart rate were counted and recorded. The collected data were analyzed using Excel software to integrate and compare the data using the T-test method. **Results:** After exercise training, the skeletal muscle function indices of the subjects increased to different degrees. From the point of view of heart rate recovery efficiency, the rate of heart rate decline of progressive relaxation training was higher than that of the two groups, and the degree of fluctuation was lower than that of the two groups, indicating that the level of recovery in heart rate of progressive relaxation training was better. **Conclusion:** The action of the high-intensity gymnastics team has a good effect on improving the athletes' skeletal muscle and skeletal muscle proteins. Post-exercise conditioning training plays an important role in athletes' physical recovery. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Gymnastics; Muscle Proteins; Techniques, Training.

RESUMO

Introdução: Embora o método de alongamento muscular atual no ensino de ginástica em faculdades e universidades consiga reduzir a fadiga esportiva, tem se mostrado pouco eficaz no bem-estar dos atletas por exigir grande tempo de recuperação da fadiga psicológica. O treinamento progressivo de relaxamento muscular é um método que usa o princípio básico da atividade nervosa simpática para reduzir o impacto das emoções negativas psicologicamente e aliviar a fadiga fisiologicamente, necessitando de mais estudos do seu impacto sobre a proteína muscular. **Objetivo:** Explorar o efeito da ginástica de alta intensidade sobre as proteínas musculares esqueléticas e estudar o método de treinamento progressivo de relaxamento muscular no ajuste pós-treino. **Métodos:** Após 3 semanas de treinamento, excluídos os desvios-padrão nos dados experimentais causados pelos movimentos irregulares dos atletas, foram contabilizados e registrados os conteúdos de lactato sanguíneo e frequência cardíaca dos atletas. Analisou-se os dados coletados, com o software Excel, para integrar e comparar os dados pelo método de teste-T. **Resultados:** Após o treinamento do exercício, os índices de função muscular esquelética dos sujeitos aumentaram em diferentes graus. Do ponto de vista da eficiência da recuperação da frequência cardíaca, a taxa de declínio da frequência cardíaca do treinamento de relaxamento progressivo foi maior do que a dos dois grupos, o grau de flutuação foi menor do que o dos dois grupos, indicando que o nível de recuperação na frequência cardíaca do treinamento de relaxamento progressivo foi melhor. **Conclusão:** A ação da equipe de ginástica de alta intensidade tem um bom efeito na melhoria do músculo esquelético e das proteínas musculares esqueléticas dos atletas. O treinamento de condicionamento pós-exercício desempenha um papel importante na recuperação física dos atletas. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Ginástica; Proteínas Musculares; Técnicas de Treino.

RESUMEN

Introducción: Aunque el método actual de elongación muscular en la enseñanza de la gimnasia en colegios y universidades consigue reducir la fatiga deportiva, se ha demostrado que tiene poco efecto en el bienestar de los atletas porque requiere un largo tiempo de recuperación de la fatiga psicológica. El entrenamiento de la relajación muscular progresiva es un método que utiliza el principio básico de la actividad nerviosa simpática para reducir el impacto de las emociones negativas desde el punto de vista psicológico y aliviar la fatiga desde el punto de vista fisiológico, lo que requiere un estudio más profundo de su impacto en la proteína muscular. **Objetivo:** Explorar el efecto de la gimnasia de alta intensidad sobre la proteína del músculo esquelético y estudiar el método de entrenamiento de relajación muscular progresiva en el ajuste posterior al entrenamiento. **Métodos:** Después de 3 semanas de entrenamiento,



excluyendo las desviaciones estándar en los datos experimentales causadas por los movimientos irregulares de los atletas, se contó y registró el contenido de lactato en sangre y la frecuencia cardíaca de los atletas. Los datos recogidos se analizaron, con el programa informático Excel, para integrar y comparar los datos mediante el método de la prueba T. Resultados: Tras el entrenamiento con ejercicios, los índices de función del músculo esquelético de los sujetos aumentaron en diferentes grados. Desde el punto de vista de la eficacia de la recuperación de la frecuencia cardíaca, el índice de disminución de la frecuencia cardíaca del entrenamiento de relajación progresiva fue mayor que el de los dos grupos, el grado de fluctuación fue menor que el de los dos grupos, lo que indica que el nivel de recuperación de la frecuencia cardíaca del entrenamiento de relajación progresiva fue mejor. Conclusión: La acción del equipo de gimnasia de alta intensidad tiene un buen efecto en la mejora del músculo esquelético y de las proteínas del músculo esquelético de los atletas. El entrenamiento de acondicionamiento posterior al ejercicio desempeña un papel importante en la recuperación física de los deportistas. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptores: Gimnasia; Proteínas Musculares; Técnica de Entrenamiento.

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INTRODUCTION

Gymnastics is a combination of strength and beauty. Athletes show flexible movements on different instruments, and combine the control of strength with dexterous, beautiful and complex movements, giving people a good visual experience. Therefore, gymnastics is a popular sport of all kinds of competitions, highly appreciative, and has a good market all over the world. China is a strong gymnastic country.¹ At present, a relatively complete gymnastic training system has been formed to continuously transport talents for various sports games. The teaching of Gymnastics Major in Colleges and universities can enable students to master a large number of theoretical academic knowledge while mastering gymnastics skills, so as to provide a large number of teachers for the optimization of gymnastics teaching system in our country.²

At present, many gymnastics teaching adopts the way of stretching and relaxation training. Although this traditional relaxation method can stretch athletes' muscles and reduce athletes' sports fatigue, it can not relieve athletes' mood. Athletes often need a long time to recover from psychological fatigue. Therefore, an effective adjustment method is needed to adjust the physical and psychological aspects of athletes. Progressive muscle relaxation training is such a method. It uses the basic principle of sympathetic nerve activity to reduce the impact of negative emotions psychologically and alleviate fatigue physiologically by fully regulating heart rate, relaxing blood vessels and reducing blood pressure.³

METHOD

In terms of the selection of experimental objects, this paper selects 27 male gymnasts majoring in Gymnastics through voluntary registration, which are divided into three groups with 9 in each group. The study and all the participants were reviewed and approved by Ethics Committee of Jilin University of Architecture and Technology (NO. 2018XJU33). After fully informing their experimental contents and experimental needs, and obtaining the knowledge and consent of the athletes, relevant experiments are carried out. First, carry out daily gymnastics training in the form of high intensity to make the athletes reach the state of fatigue. Then, the blank control group did not adjust the sitting; The traditional control group used the traditional stretching and relaxation method to relax the muscles of the body in order to obtain the effect of eliminating fatigue; The experimental group used the method of progressive relaxation training, sat in silence, first tense the muscles, and then completely relax, then slowly relax from their habitual finger tips to the forearm and biceps brachii, and then gradually complete the relaxation of the other arm from the non-habitual finger tips, and then relax the muscles of the forehead and eyes, with both arms stretching

back and forth, Relax the shoulder and back muscles, and then gradually and regularly complete the relaxation of the muscles of the whole body in the order of chest, back, waist, abdomen, thigh, calf and foot. Always pay attention to adjusting the breathing in the relaxation process, slowly relax their own muscles in relaxation, and supplement the parts that are still tired in combination with their own perception. The whole group of movements lasted more than 15 minutes. Other variables remained unchanged throughout the experiment. The experiment lasted for 3 weeks and trained 3 times a week.

After three weeks of training, the athletes have a good grasp of the progressive relaxation training method and the traditional stretching method. After eliminating the problem of data deviation of the experimental results caused by the athletes' non-standard actions, the athletes' heart rate and blood lactic acid content are counted and recorded. The recording method of heart rate is to use the heart rate meter to record the data immediately after exercise and the data of 5 minutes, 10 minutes, 15 minutes and 20 minutes after exercise, so as to have a relatively systematic understanding of the recovery of heart rate. The recording method of blood lactic acid is to use the blood lactic acid analyzer. With the cooperation of professionals, blood samples are also taken immediately, 5 minutes, 10 minutes, 15 minutes and 20 minutes after training, and the blood lactic acid content is analyzed, so as to explore the metabolism of blood lactic acid after exercise.

RESULTS

Influence of high intensity gymnastics on skeletal muscle and protein content

In order to explore the influence of high-intensity gymnastics on skeletal muscle and protein content, this paper analyzes the changes of body composition, body fat rate, skeletal muscle content and skeletal muscle function of subjects in the control group of traditional stretching method.

As shown in Figure 1, the changes of body composition of subjects before and after high-intensity gymnastics are mainly the changes of body weight and fat free body weight. It can be seen from Figure 1 that the body weight of subjects has increased slightly before and after gymnastics training, and the increase of fat free body weight is larger than that of body weight. Therefore, it can be judged that the muscle content of subjects has increased to a certain extent after sports training, Therefore, high-intensity gymnastics can promote muscle growth to a certain extent ($P < 0.05$).

Figure 2 shows the changes of body fat rate of subjects before and after high-intensity gymnastics. It can be seen from the figure that the body fat rate of 9 athletes has decreased after training ($P < 0.05$). The

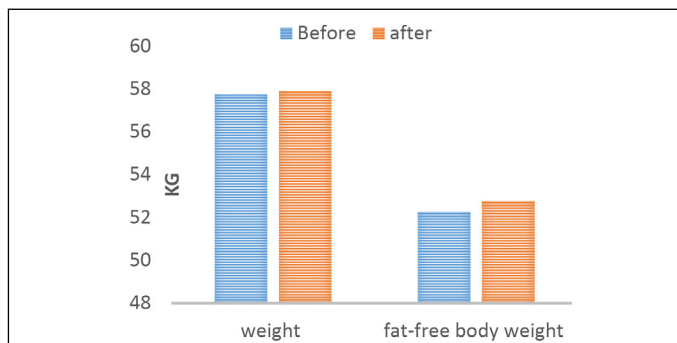


Figure 1. Changes of body composition of subjects before and after high-intensity Gymnastics.

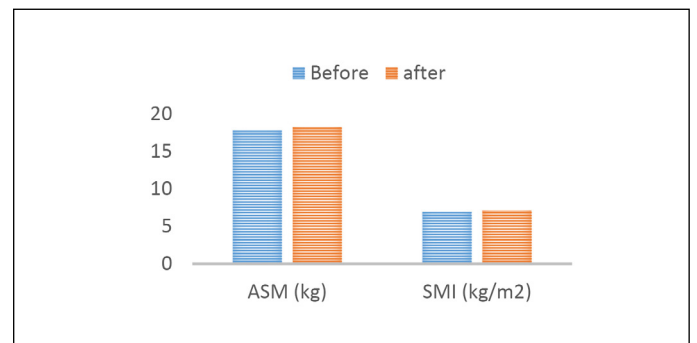


Figure 3. Changes of skeletal muscle content of subjects before and after high-intensity Gymnastics.

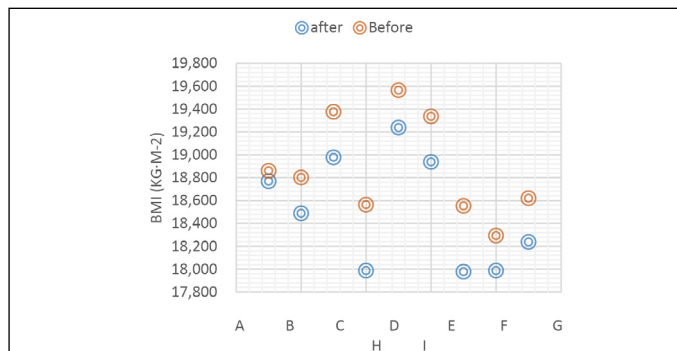


Figure 2. Changes of body fat rate of subjects before and after high-intensity Gymnastics.

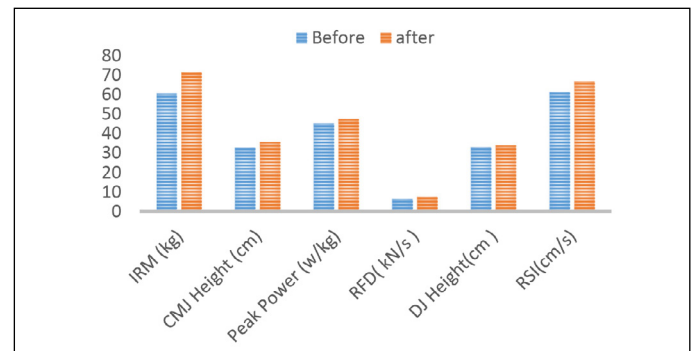


Figure 4. Changes of skeletal muscle function of subjects before and after high-intensity Gymnastics.

reduction of body fat rate of different athletes is different. After excluding the disturbing factors such as diet, work and rest, this paper believes that the reason affecting the difference of body fat rate is the proficiency of athletes in gymnastics. Because there is a certain gap in the level of volunteers in this experiment, for some high-level athletes, high-intensity gymnastics has little impact on them, while for some relatively ordinary gymnasts, high-intensity sports have a great impact on them, but the overall body fat rate shows a decreasing trend. This shows that high-intensity sports can promote the growth of skeletal muscle and play a good role in the development of athletes' muscle strength.

Figure 3 shows the two indexes of changes in skeletal muscle content of subjects before and after high-intensity gymnastics, namely ASM (skeletal muscle mass of limbs, unit kg) and SMI (skeletal muscle index of limbs, unit kg / m²). It can be seen from Figure 3 that after exercise training, the amount of limb skeletal muscle and limb skeletal muscle index increased ($P < 0.05$), which further proves that high-intensity gymnastics training can promote the development of limb skeletal muscle of subjects.

Figure 4 shows the changes of skeletal muscle function of subjects before and after high-intensity gymnastics. The situation of skeletal muscle can be judged by judging various performance indicators of athletes. Where 1RM (one rep max) refers to the maximum repetitive force at one time, CMJ (counter movement jump) refers to the reverse longitudinal jump, peak power refers to the peak power of longitudinal jump, RFD (rate of force development) refers to the force development rate, DJ (deep jump) refers to the jump depth, and RSI (reactive strength index) refers to the reaction force index. The experimental results show that after exercise training, a number of functional indexes of skeletal muscle of subjects have increased by different ranges ($P < 0.05$), which also shows that the actions of high-intensity gymnastics team can promote the development of athletes' skeletal muscle and improve skeletal muscle protein. Therefore, the amount of training should be reasonably arranged in the process of gymnastics training, so as to promote the growth of athletes' muscles and obtain better physical function conditions.

Analysis of adjustment effect after high-intensity gymnastics training

In order to analyze the effect of adjustment after exercise on Athletes' physical and mental health, and explore the advantages of progressive relaxation training after exercise, this paper sets up two control groups, including traditional relaxation control group and blank control group, so as to form a comparison between groups. To explore the changes of heart rate and blood lactate after exercise training among groups with different regulation methods.

Through the heart rate meter, the heart rate changes of different adjustment methods in groups within immediately, 5 minutes, 10 minutes, 15 minutes and 20 minutes after exercise training are measured, and the images are drawn as shown in Figure 5. As can be seen from Figure 5, the heart rate of several groups showed a downward trend after exercise training, and reached a relatively low value in about 5 minutes. In the following 15 minutes, it showed a very slow trend of gradual decline, and the fluctuation range was small. It can basically be regarded as the relevant heart rate when calm has been restored in 5 minutes. In terms of the efficiency of heart rate recovery, the heart rate recovery of the current blank control group is relatively slow and the heart rate value is high, followed by the traditional relaxation control group. The heart rate decline rate of progressive relaxation training is higher than that of the two groups, and its fluctuation degree is smaller than that of the two groups, indicating that the heart rate recovery level of progressive relaxation training is better ($P < 0.05$).

The heart rate recovery rate represents the rate of heart rate recovery. As can be seen from Figure 6, the three groups of adjustment methods show that the heart rate recovery rate gradually increases and finally approaches 1 smoothly. It can be seen from the grouping that the heart rate recovery rate of progressive relaxation training is higher than that of the traditional control group and the blank control group, and the control group of traditional relaxation mode is slightly higher than that of the blank control group. Therefore, the relaxation efficiency of heart

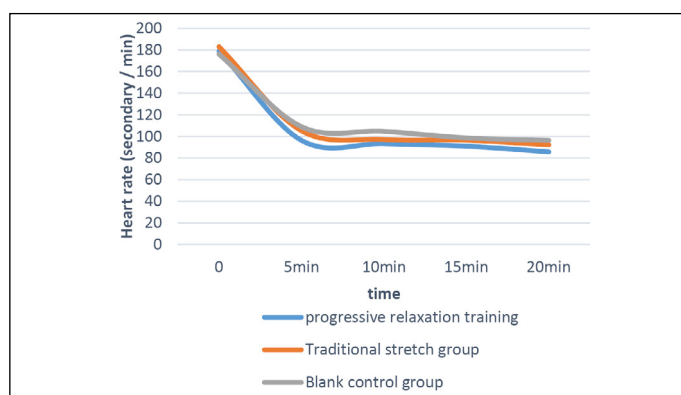


Figure 5. Changes of heart rate after exercise training among groups with different regulation modes.

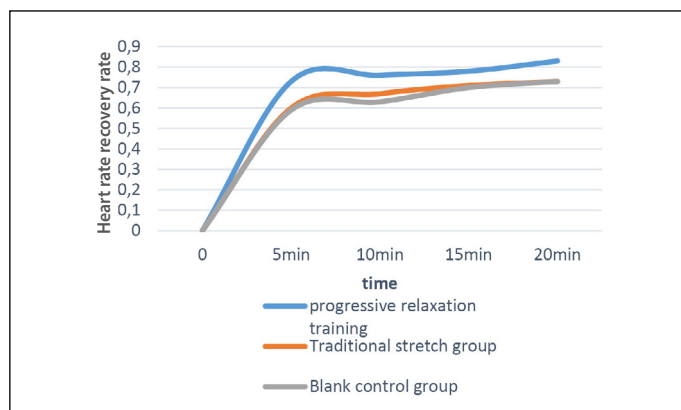


Figure 6. Heart rate recovery rate after exercise training between groups with different regulation methods.

rate recovery of progressive relaxation training is much higher than that of traditional relaxation mode and the recovery efficiency of human body itself ($P < 0.05$). This also proves the advantage of progressive relaxation training in the regulation after exercise.

DISCUSSION

In the process of exercise and daily life, if protein catabolism is enhanced or protein anabolism is weakened, the total protein in skeletal muscle will deviate, the protein level will be unbalanced, resulting in the decrease of total protein. Skeletal muscle will gradually shrink due to the lack of necessary protein, and its muscle strength and various indexes will decline. Therefore, in the process of sports, we should fully strengthen the metabolism of protein synthesis, and timely supplement the necessary nutrients, so as to improve the total amount of skeletal muscle protein, promote its orderly development, and gradually improve many indicators such as muscle strength and muscle endurance under the condition of maintaining stability, so as to provide good physical conditions for athletes' competition.⁴

High intensity gymnastics training exerts certain pressure on both physical and psychological aspects of athletes. Therefore, in the process of

adjustment after training, we must pay attention to the relief of physical sports fatigue and mental psychological fatigue, which can be carried out in the following aspects: The first is the relief of exercise-induced fatigue. In short, it is to adjust the physiological fatigue of athletes, including the recovery of heart rate, the reduction of blood lactic acid, etc.⁵ in this process, the progressive relaxation training method proposed in this experiment can be used to purposefully gradually relax their muscles and obtain physiological adjustment in the gentle relaxation process, It also regulates the psychological pressure to a certain extent, so as to make the athletes' various indicators return to the normal range as soon as possible, prevent muscle soreness caused by lactic acid accumulation, and prevent cardiovascular and cerebrovascular diseases caused by abnormal heart rate, so as to provide a good physical foundation for the next training and consolidate the training results of this training.⁶

The second is the adjustment of psychological fatigue. Athletes always maintain a state of high mental tension in the process of gymnastics training and have a strong ability to respond to any wind and grass in the external environment. In response to the tension, resistance, anxiety and other emotions of athletes, coaches should observe the mental health of athletes in time and provide them with corresponding counseling. If there are serious psychological problems, they should immediately consult a relevant professional psychologist consult.

CONCLUSION

Through the research results of this paper, it can be seen that as an anaerobic exercise, high-intensity gymnastics can effectively promote the growth of skeletal muscle and improve various indexes of muscle exercise. In the adjustment process after gymnastics training, certain methods are adopted to promote the recovery of the body. Compared with the recovery of the body's own ability, it can promote the effect of fatigue recovery, the improvement of exercise level and the relief of mood. However, the gradual relaxation training method is more beneficial than other traditional stretching methods, Through the research of this paper, it can be seen that gymnastics teachers and coaches should scientifically arrange the training plan of athletes according to the actual situation of athletes, so as to promote the growth of the body and improve the economic level. At the same time, they should reasonably arrange the way of relaxation after the process of sports training, Promote the metabolism of blood lactic acid and lay a good physical foundation for athletes' next training. Of course, there are still some defects in this experiment, which are mainly reflected in the short time selected in the research process of blood lactic acid and the failure to achieve the complete balance of blood lactic acid, resulting in some deficiencies in the experiment, In the selection of athletes, their sports level has not reached a unified standard, so that there are some differences in the training effects of different athletes, which need to be continuously improved in the follow-up research.

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