

IMPACTS OF MUSCULAR STRENGTH TRAINING ON BOXERS' ENDURANCE



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IMPACTOS DO TREINAMENTO DE FORÇA MUSCULAR NA RESISTÊNCIA DE BOXEADORES

IMPACTO DEL ENTRENAMIENTO DE LA FUERZA MUSCULAR EN LA RESISTENCIA DE LOS BOXEADORES

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ABSTRACT

Introduction: Strength and endurance training of boxers are the main parts to pay attention to in the training protocol due to the particularities of Chinese boxing. **Objective:** Study the effect of strength training on the muscles and endurance of Chinese boxing athletes. **Methods:** This paper adopts experimental control. The control group practiced the traditional martial arts training while in the experimental group, other daily training properly protocolled was added. One class was selected for strength training on Monday, Tuesday, and Friday of each week. Before the experiment began, the physiological data of the athletes were evaluated and recorded. After the experiment, the data was again acquired and compared. By comparing the data, the effectiveness of the training can be analyzed. **Results:** After strength training, the experimental group's results were significantly higher than those of the control group. **Conclusion:** Adopting properly targeted special strength training can increase the effectiveness and anaerobic endurance of Chinese boxers, increasing the chances of exploiting their maximum potential in combat. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Resistance Training; Boxing; Muscle Strength.

RESUMO

Introdução: O treino de força e de resistência dos boxeadores são as principais partes a se prestar atenção no protocolo de treinamento devido às particularidades do boxe chinês. **Objetivo:** Estudar o efeito do treinamento de força sobre os músculos e a resistência dos atletas de boxe chinês. **Métodos:** Este trabalho adota o controle experimental. O grupo de controle pratica o tradicional treino das artes marciais enquanto ao grupo experimental, acrescentou-se outros treinamentos diários devidamente protocolados. Nas segundas, terças e sextas-feiras de cada semana, uma classe foi selecionada para o treinamento de força. Antes do início do experimento, os dados fisiológicos dos atletas foram avaliados e registrados. Após o experimento, os dados novamente foram adquiridos e comparados. Através da comparação dos dados, a eficácia do treinamento pode ser analisada. **Resultados:** Após o treinamento de força, os resultados do grupo experimental foram significativamente maiores do que os do grupo de controle. **Conclusão:** A adoção de treinamento de força especial devidamente direcionado pode aumentar a eficácia e resistência anaeróbica dos boxeadores chineses, aumentando as chances de explorar o seu máximo potencial em combate. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Treinamento de Força; Boxe; Força Muscular.

RESUMEN

Introducción: El entrenamiento de la fuerza y la resistencia de los boxeadores son las partes principales a las que hay que prestar atención en el protocolo de entrenamiento debido a las particularidades del boxeo chino. **Objetivo:** Estudiar el efecto del entrenamiento de fuerza en los músculos y la resistencia de los atletas chinos de boxeo. **Métodos:** Este trabajo adopta el control experimental. El grupo de control practica el entrenamiento tradicional de artes marciales mientras que al grupo experimental se le añadió otro entrenamiento diario debidamente protocolizado. Los lunes, martes y viernes de cada semana, se seleccionó una clase para el entrenamiento de fuerza. Antes de comenzar el experimento, se evaluaron y registraron los datos fisiológicos de los atletas. Tras el experimento, se volvieron a adquirir los datos y se compararon. La comparación de los datos permite analizar la eficacia de la formación. **Resultados:** Tras el entrenamiento de fuerza, los resultados del grupo experimental fueron significativamente superiores a los del grupo de control. **Conclusión:** La adopción de un entrenamiento de fuerza especial adecuadamente dirigido puede aumentar la eficacia y la resistencia anaeróbica de los boxeadores chinos, incrementando las posibilidades de explotar su máximo potencial en el combate. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptorios: Entrenamiento de Fuerza; Boxeo; Fuerza Muscular.



INTRODUCTION

Sanda is a competitive sport developed from traditional Wushu. Wushu Sanda has a strong competitive antagonism, and both sides need to have better fighting ability. Therefore, Wushu Sanda has higher requirements for the overall quality of athletes.¹ Due to the particularity of the event, the strength training and endurance training of athletes are the main parts that need to be paid attention to in the training link. The importance of strength to athletes can be clearly reflected through various competitions and athlete ability rating and assessment.² Strength is also at the core of the comprehensive ability and quality rating standard of Wushu Sanda. With the development of modern academic research, it has become one of the conventional means to analyze the principle of project movement through kinematics.³ On the basis of research, we can quickly update the advanced scientific training system. How to most effectively and quickly improve the strength of athletes is also a problem that has always been studied. Strength projects are also the most important breakthrough to break through athletes' abilities. With the continuous development of the project, various strength training methods have been developed for Wushu Sanda in the international sports field. Moreover, through scientific research, training methods and methods are constantly updated.⁴ Through the research on the athletes' various abilities, it is found that under the cultivation of modern scientific training methods and diet management, the physical function data of modern athletes have long been better than those of the first-generation athletes in the early stage of project development.⁵ The essence of strength training is to increase muscle mass and muscle density. During the training, the endurance of muscles and the endurance of athletes themselves were also improved.⁶ In depth study of the specific impact of strength training on the muscles and endurance of Wushu Sanda athletes will provide reference for athletes to formulate daily training plans and improve their skills. Finally, the goal of achieving the athletes' performance and refreshing the athletes' body side records is achieved.⁷

METHOD

According to the principle of voluntariness, 40 physical education students of Wushu Sanda specialty in the first year of a university were selected as the research objects in this experiment. The study and all the participants were reviewed and approved by Ethics Committee of Shandong Sport University (NO. 21SDSU079-EP). The basic information is shown in Table 1. The p between the two is greater than 0.05, which indicates that the selection of personnel in the experimental group and the control group will not cause too much interference to the experimental results.

This paper adopts the form of control experiment. The experimental group and the control group carry out different training programs according to the same exercise frequency in the same exercise cycle. In addition to the different training schemes of the two groups during the training period, the daily training, accommodation, diet, course arrangement, etc. of the two groups are almost the same at other times, so as to minimize the interference of non experimental factors and make the experimental results more accurate.

In terms of experimental design, the control group chose the traditional martial arts training teaching, including but not limited to the

Table 1. Analysis of the basic situation of the athletes in the experimental group and the control group.

| Basic situation | Control group | Experimental group |
|-----------------|---------------|--------------------|
| Age | 18.639±0.945 | 18.839±0.987 |
| Height | 173.984±3.034 | 173.785±3.442 |
| Weight | 63.466±4.814 | 64.234±5.023 |
| Training period | 5.981±0.666 | 5.981±0.658 |

practice of martial arts movements, basic physical fitness and strength training represented by running and push ups, which are also frequently used in the daily teaching of martial arts students. The experimental group maintained the same martial arts training teaching as the control group in other daily training, and on Mondays, Tuesdays and Fridays of each week, one class would be selected for special strength training. The training includes upper limb strength training, trunk strength training and lower limb strength training.

Before the experiment, multiple data of athletes were tested and recorded as initial data for subsequent comparison. After the experiment, the relevant data are measured again. Through the comparison of the data, the effectiveness of the relevant training can be analyzed.

RESULTS

Effect of strength training on muscle strength of Wushu Sanda Athletes

When judging the muscle strength of Wushu Sanda athletes, the most intuitive is their striking force and relative maximum strength when they punch and kick. Therefore, when discussing the impact of strength training on the muscle strength of Wushu Sanda athletes, these options were selected. The specific results are shown in Table 2.

Through the intra group comparison and analysis, it can be seen that the relevant hitting power and the relative maximum strength of the experimental group and the control group have been improved before and after the sports training, which shows that the traditional martial arts training and the strength training designed in this paper can improve the muscle strength of Wushu Sanda athletes. Through the comparison between the groups, it can be seen that the improvement range of the experimental group in the impact force of straight punches and the relative maximum strength of straight punches is far greater than that of the control group. In terms of the improvement of the whip leg striking force and the relative maximum force of the whip leg, the experimental group and the control group had little difference, only slightly improved. This can show that the experimental scheme of the experimental group also has certain advantages over the traditional Wushu training in terms of improving muscle strength. However, from the perspective of the experimental group itself, in the current strength

Table 2. Effect of strength training on muscle strength of Wushu Sanda Athletes.

| Option | Before | After | T | P |
|--|-------------------|-------------------|---------|--------|
| Experimental team straight fist strike power (N) | 1,538.927±400.214 | 1,817.719±380.879 | -3.2590 | 0.0223 |
| Control group straight boxing strike power (N) | 1,540.593±177.161 | 1,641.684±275.041 | -1.1184 | 0.2267 |
| Experimental group whip leg strike power (N) | 2,544.040±584.007 | 2,691.852±588.368 | -3.2383 | 0.1867 |
| The control group whip leg blow power (N) | 2,547.337±647.972 | 2,671.011±492.944 | -1.4141 | 0.3302 |
| The experimental group straight fist is relatively maximum strength (N/kg) | 23.996±6.199 | 28.937±5.381 | -3.0274 | 0.0308 |
| Comparison group straight punch is relatively maximum (N/kg) | 24.068±3.577 | 25.667±6.779 | -1.2733 | 0.2690 |
| Compared with the maximum strength of the experimental group whip leg (N/kg) | 39.757±10.420 | 42.527±10.183 | -3.2750 | 0.1890 |
| Compared with the maximum strength of the control group whip leg (N/kg) | 39.475±9.916 | 41.565±10.782 | -1.7596 | 0.2415 |

training effect, the results of straight fist training are far higher than those of whip leg training. Therefore, in the follow-up improvement, it is necessary to strengthen the training of leg strength, so as to make the sports effect more balanced.

Influence of strength training on endurance of Wushu Sanda Athletes

Table 3 shows the effect of strength training on the general endurance of Wushu Sanda athletes. It can be seen from the table that in terms of the average level of the whole exercise, the average anaerobic power of the experimental group increased from (584.786 ± 59.431) w to (674.308 ± 674.308) W, and the average anaerobic power of the control group increased from (564.001 ± 69.707) w to (605.955 ± 45.300) W. In terms of explosive confrontation at the peak of exercise, the maximum anaerobic power of the experimental group increased from (784.283 ± 97.878) w to (904.923 ± 72.439) W, and the maximum anaerobic power of the control group increased from (748.434 ± 126.928) w to (775.441 ± 127.627) W. In terms of the research on the fast peak time, the peak time of the experimental group increased from (7.489 ± 1.827) s to (6.057 ± 0.774) s, and the peak time of the control group increased from (7.921 ± 1.661) s to (6.603 ± 1.793) s. It can be seen that the two existing training methods can improve the general endurance of Wushu Sanda athletes, including increasing the average anaerobic power and the maximum anaerobic power, and shortening the time for athletes to reach the peak, so that athletes can reach the peak state as soon as possible in a short time and obtain better competitive results. From the comparison between groups, it can be seen that the improvement effect of the experimental group is better than that of the control group, and the improvement range is larger, which indicates that the general endurance of Wushu athletes can be better improved by using special strength training, so that they can better enter the competitive state on the field.

As shown in Table 4, the impact of strength training on special endurance is analyzed according to the sports characteristics of Wushu Sanda athletes. In the study of the individual hitting frequency of the legs, the number of whiplash hitting sandbags in the experimental group increased from (59.386 ± 4.619) to (65.671 ± 2.512) about 30 seconds, and the number of whiplash hitting sandbags in the control group increased from (57.575 ± 4.190) to (61.312 ± 4.173) about 30 seconds. In the output frequency of combined actions, the experimental group's 30 second fast hitting mixed target increased from (20.525 ± 2.979) group to (25.497 ± 2.527) group, and the control group's 30 second fast hitting mixed target increased from (20.290 ± 1.851) group to (22.927 ± 1.253) group.

DISCUSSION

Most modern Wushu Sanda athletes use scientific weight-bearing training methods to improve their strength attributes. And use high-load training means to train the explosive power of muscles. Individual athletes will also cooperate with low-load training to combine the two. In the competition, we can also give play to the results of strength training. The training mode of combining high and low loads can effectively help athletes improve their muscle explosive power. Secondly, by means of instruments. With the continuous development of ergonomics and advanced training equipment, the special training of athletes in the training link is more pure. The muscle tissues mainly involved in power generation are clearer. Compared with the past, in strength training, some muscles of athletes will borrow strength during special training to share the load for the main training muscle groups, so that the efficiency of training cannot be achieved. Therefore,

Table 3. Effect of strength training on general endurance of Wushu Sanda Athletes.

| Option | Before | After | T | P |
|---|-----------------|-----------------|---------|--------|
| Average anaerobic power of the experimental group (w) | 584.786±59.431 | 674.308±674.308 | -3.4039 | 0.0192 |
| Average anaerobic power of the control group (w) | 564.001±69.707 | 605.955±45.300 | -1.6707 | 0.1504 |
| The maximum anaerobic power of the experimental group (w) | 784.283±97.878 | 904.923±72.439 | -3.8711 | 0.0129 |
| The maximum anaerobic power of the control group (w) | 748.434±126.928 | 775.441±127.627 | -2.3440 | 0.0699 |
| Experimental group reaches peak time (s) | 7.489±1.827 | 6.057±0.774 | 1.5937 | 0.0685 |
| The control group reaches the peak time (s) | 7.921±1.661 | 6.603±1.793 | 2.3400 | 0.0703 |

Table 4. Effect of strength training on special endurance of Wushu Sanda Athletes.

| Option | Before | After | T | P |
|---|--------------|--------------|----------|--------|
| The experimental group hit the sandbag in about 30 seconds (unit) | 59.386±4.619 | 65.671±2.512 | -3.5499 | 0.0162 |
| The control group is about 30 seconds of whip legs hit the sandbag (unit) | 57.575±4.190 | 61.312±4.173 | -5.4210 | 0.0030 |
| The experimental group quickly hit the mixed target (group) | 20.525±2.979 | 25.497±2.527 | -10.7094 | 0.0000 |
| The control group quickly hit the mixed target for 30 seconds (group) | 20.290±1.851 | 22.927±1.253 | -4.5300 | 0.0071 |

strength training can effectively improve training efficiency with the help of instruments. There are two forms of muscle contraction: isometric and isotonic. The forms of muscle strength are also divided into two types according to dynamic and static properties. According to the characteristics of Wushu Sanda, the corresponding training plan should be formulated. Gradually increase the muscle load during training. Step by step, avoid rushing for success, and muscle strength will be steadily and continuously improved. Heavy load training is the main method to improve the maximum value of muscle strength. The load training with small weight can obviously help to increase the muscle dimension and the muscle resistance of athletes. At the same time, daily strength training can increase the contraction speed of muscles, which can make athletes' technical movements more rapid and efficient. It is found that muscle strength is mainly determined by muscle strength, distance of muscle strength and explosive force. Strength training can effectively improve the two related variables of muscle strength and explosive force. Therefore, strength training has many positive effects on muscles.

CONCLUSION

For Sanda athletes, who can enter the peak state faster in the field, hit higher frequency in a short time, and exert greater strength, can control the other side faster, so as to win the whole game. Therefore, the research scheme proposed in this paper is aimed at the endurance and muscle strength that athletes currently need. The results of this study show that the use of more targeted special strength training can better improve the anaerobic power and anaerobic endurance of Wushu Sanda athletes, so that they have a higher chance of winning in the field. However, the experiment in this paper also has some problems. Through

the comparative analysis of Table 2 and table 4, it can be seen that the experiment in this paper has achieved good results in the strength of the upper limbs, but it is far from enough in the improvement of the relevant data of the lower limbs. Therefore, it is necessary to further improve the experimental scheme in the follow-up to strengthen the exercise of

the strength of the lower limbs, so as to promote the development of athletes in all aspects in a more balanced way.

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