TESTING AND EVALUATION OF LOWER LIMB STRENGTH IN KUNG FU ATHLETES

TESTE E AVALIAÇÃO DE FORÇA DOS MEMBROS INFERIORES EM ATLETAS DE KUNG FU

PRUEBA Y EVALUACIÓN DE LA FUERZA DE LAS EXTREMIDADES INFERIORES EN ATLETAS DE KUNG FU

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ABSTRACT

Introduction: "Popularization and improvement" has been a solid guideline for developing kung fu in China for decades. Objective: Test and evaluate the lower limb strength in juvenile kung fu athletes. Methods: 10 young volunteer athletes were selected, including six males and four females. A three-dimensional dynamometer and a multifunctional jumping system measure the F-T curves of different bounces. Explosive force, reaction force, and proprioceptive capacity of the lower limbs were evaluated, measured, and statistically treated. Results: In the experiment, the athletes in the experimental and control groups showed no increase in muscle volume or lower limb circumference, and there were no significant changes in other body lengths and thicknesses ($P > 0.05$). However, the relative peak power of the experimental group and the control group showed statistically remarkable differences ($P < 0.05$). Conclusion: Young kung fu athletes should pay attention to the combination of strength and proprioception training while performing dedicated and technical training. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Martial Arts; Muscle Strength; Adolescent.

RESUMO

Introdução: A "popularização e aprimoramento" é uma diretriz sólida para o desenvolvimento de kung fu na China durante décadas. Objetivo: Testar e avaliar a força nos membros inferiores dos atletas juvenis de kung fu. Métodos: 10 jovens atletas voluntários foram selecionados, incluindo 6 homens e 4 mulheres. Um dinamômetro tridimensional e um sistema de salto multifuncional são utilizados para mensurar para as curvas F-T de diferentes ressaltos. A força explosiva, a força de reação e a capacidade proprioceptiva dos membros inferiores foram avaliadas, mensuradas e tratadas estatisticamente. Resultados: No experimento, os atletas do grupo experimental e do grupo de controle não apresentaram aumento no volume muscular nem no perímetro dos membros inferiores, não houve mudanças significativas em outros comprimentos e espessuras corporais ($P > 0,05$). Entretanto, a potência de pico relativa do grupo experimental e do grupo controle evidenciaram diferenças estatisticamente notáveis ($P<0,05$). Conclusão: Os jovens atletas de kung fu devem prestar atenção à combinação de treinamento de força e treinamento de propriocepção enquanto realizam o treinamento dedicado e o treinamento técnico. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Artes Marciais; Força Muscular; Adolescente.*

RESUMEN

Introducción: "La popularización y la mejora" es una sólida directriz para el desarrollo del kung fu en China durante décadas. Objetivo: Probar y evaluar la fuerza de las extremidades inferiores en atletas juveniles de kung fu. Métodos: Se seleccionaron 10 jóvenes atletas voluntarios, de los cuales 6 eran hombres y 4 mujeres. Se utiliza un dinamómetro tridimensional y un sistema de salto multifuncional para medir las curvas F-T de diferentes rebotes. Se evaluaron, midieron y trataron estadísticamente la fuerza explosiva, la fuerza de reacción y la capacidad propioceptiva de los miembros inferiores. Resultados: En el experimento, los atletas del grupo experimental y del grupo de control no mostraron un aumento del volumen muscular ni de la circunferencia de las extremidades inferiores, no hubo cambios significativos en otras longitudes y espesores corporales ($P > 0,05$). Sin embargo, la potencia máxima relativa del grupo experimental y del grupo de control mostró diferencias estadísticamente notables ($P<0,05$). Conclusión: Los jóvenes atletas de kung fu deben prestar atención a la combinación del entrenamiento de fuerza y el entrenamiento de propiocepción mientras realizan un entrenamiento dedicado y un entrenamiento técnico. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Artes Marciales; Fuerza Muscular; Adolescente.*

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INTRODUCTION

The Wushu Athletes of the youth wushu team performed more than 30 jumps and 7-10 meter high-speed runs at most in a Wushu competition. Therefore, the key to the success of Wushu is the ability of fighting and jumping. Similarly, in martial arts competitions, jumping performance can also be considered as the decisive factor of physical fitness requirements.[1] It is reported that as a test of Wushu athletes, the height of squat jump and deep jump can reach 48.4 cm and 74.8 cm respectively. In many cases, Wushu athletes are faster, more powerful and more explosive than those who try. In addition, for muscles or muscle tissues that appropriately increase strength, acceleration and speed are the key to improve martial arts skills, such as the peak value and direction changing ability of jumping and running. It is reported that resistance training promotes the increase of short-term peak power, while muscle contraction speed seems to be less sensitive to training. The second maximum load is 60-90% of the maximum dynamic strength, repeated 8-12 times to enhance muscle quality and improve muscle anaerobic capacity. In fact, the physiological adaptation of resistance training depends on the type, duration and intensity of contraction used in the project. There are several types of strength training, including isometric training, dynamic constant external resistance training, enhanced training or isokinetic training. However, speed specific training has also been shown to maximize athletes' strength and strength gain. Resistance training has the potential to improve sports performance, reduce sports injury rate and recovery time after injury.[2]

Experimental subjects and methods

There are 10 athletes in the Wushu team, including 6 males and 4 females. 4-10 years of special training; The average age was 16 3 ± 2.5 years old; The average height was 165.8 ± 3.2 am; Weight: 58.8 ± 4.6 kg.

Experimental method

(1) Test content

The athletes complete the in-situ vertical jump in turn: half squat jump. Autonomous deep jump "straight knee" reverse jump: take the initiative to jump down, try not to cushion and straighten the knee, and actively reverse jump with foot and ankle strength. Involuntary deep jump and rebound: the turnover device suddenly turns over, the human body falls freely, and rebound as soon as possible after touching the ground. In this process, the impact of the ground stimulates the subject, and then actively bounces back to make a responsive response. The force measuring platform measures the F-T curves of different rebound.[3]

(2) Evaluation ideas

1. Athletes' proprioceptive response ability: at present, there is no ready-made method for proprioceptive measurement in human movement. In this study, it is theoretically feasible to indirectly evaluate the proprioception ability of athletes by using the characteristics of the F-T curve of the action form of involuntary falling and rebound of the force measuring platform. Evaluation index: the proprioceptive ability of athletes is evaluated by the time from the moment of touchdown to the beginning of forced pedaling and stretching. The ratio of the time to the maximum force and the total time is the proprioceptive response index. These two aspects reflect the degree of responsiveness made by the human body through proprioception after being suddenly stimulated, and reflect the proprioception ability of the human body.[4]

2. Ankle stiffness test of athletes: Fall autonomously at a certain height and try to jump straight knee as fast as possible. The movement of human body straight knee jump mainly depends on ankle muscle force and plantar muscle force. The duration of this action process and its rebound ability are related to the above muscle force. At the same time, the stiffness characteristics of foot arch have a direct impact on the effect of this force. The idea of this test is: Fall actively at a certain height, and try your best to bounce back. When testing the strength of the foot and ankle, it reflects the hardness characteristics of the arch of the foot.[5]

3. Evaluation method: the ratio of the relative maximum force value of autonomous falling straight knee rebound to the total landing time is used as the evaluation index.

The explosive force test takes the half squat jump test strength as the main evaluation index.

Mathematical Statistics

Spss11.0 statistical software package was used for data processing. The results were expressed by mean ± standard deviation. The statistical methods were Independent-Samplet test and Pearson correlation, and $P < 0.05$ was taken as the significance level of the difference.[6]

Experimental results

The subject stands on the platform with the height of 35 cm of the turnover device, the platform suddenly turns over, the subject falls on the force measuring platform involuntarily, and jumps back as soon as possible after landing on the ground. From the recorded F-T curve, the action duration from touchdown to forced pedaling and stretching was measured as the proprioceptive response time of the subject. The test results show that the reaction time of female juvenile Wushu athletes is 0.149 ± 5.49e-02s and that of men is 0.318 ± 3.27e-02. From the test data, women are faster than men, but there is no statistical difference. The ratio of the time when the subject jumped back to the maximum force to the total time of pedaling and stretching was used as the proprioception index. Experimental results: female juvenile athletes are 0.307 ± 0.162 and male juvenile athletes are 0.514 ± 0.161. The gender index is consistent, indicating that there is no gender difference in proprioception and proprioception response ability of juvenile Wushu athletes. (Table 1)

The subjects stood on the 35cm high platform of the turnover device and fell autonomously. The subjects were required to try their best to reach the ground with straight knees and forepaws, and jump back with straight knees as quickly as possible after touching the ground.[7] The measured ankle stiffness index was 9.327 ± 0.546 for female juvenile athletes and 12.230 ± 10.24 for male juvenile athletes. The statistical difference in gender was significant at the level of 0.05. (Table 2)

Semi squat jump reflects the athlete's dry hair pedaling and stretching ability of lower limbs, especially the martial arts special athlete. In situ take-off is an important special ability. In this study, the in-situ vertical jump ability of young Wushu athletes is tested.[8] The results show that the in-situ take-off strength of male young Wushu athletes is greater than that of female athletes, but there is no significant difference in statistics. The relative force and explosive force index are basically close. (Table 3)

It can be seen from Figure 1 that before and after the experiment, the dot line diagram of the standing long jump performance of the experimental group fluctuated significantly up and down, and the

Table 1. List of proprioceptive reaction time and index of athletes in this study.

Group	Proprioceptive reaction time (s)	Proprioceptive response index
Female	0.158±5.47E-02	0.307±0.162
Male	0.318±3.27E-02	0.514±0.161

Table 2. List of ankle stiffness index of athletes in this study.

Group	Relative strength of foot and ankle (kg)	Pedal extension time (s)	Ankle stiffness index
Female	23.161±1. 73E-02	0.24±4.43E-02	9.327±0.546
Male	28.078±13. 51E-02	0.27±0. 12	12.230±10.24*

Table 3. List of athletes' relative strength and explosive power index.

Group	Pedal extension force F (kg)	Relative force value (F / W)	Explosive power index
Female	149.840±14.90E-02	2.7590±0.19E-02	8.4590±1.82E-02
Male	187.790±12.73E-02	2.1840±0.13E-02	8.6700±1.68E-02

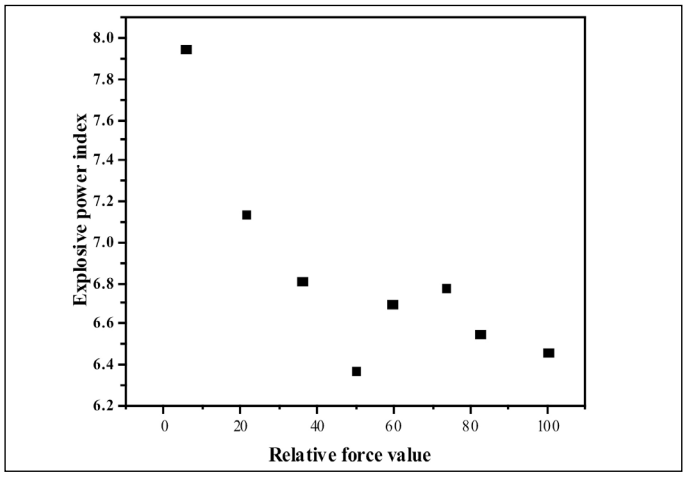

Figure 1. Comparison of the three groups of test results.

performance increased significantly after the experiment.[9] Compared with the original dot line diagram, the athletes' performance was obviously prominent, the two dot line diagrams did not tend to coincide, and the dot line diagram after the experiment was in an upward trend. After the experiment, the results of the control group were compared and analyzed. The experimental data showed that the results of the control group were improved, but not as obvious as those of the experimental group. The two dot line diagrams of the control group almost tended to coincide.[10,11] The t-test of the experimental group and the control group showed that the score of the experimental group was 1.96 ± 0.21 before and 2.23 ± 0.17 after the experiment, $P < 0.01$; The score of the control group before the experiment was 1.99 ± 0.21 and that of the control group after the experiment was 2.12 ± 0.23, $P < 0.05$.

There is no need for a code of ethics for this type of study.

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Pingdingshan Vocational and Technical College following all guidelines, regulations, legal, and ethical standards as required for humans or animals

CONCLUSION

The principle of fast strength training method of lower limbs of young Wushu athletes is: according to the characteristics of speed sensitive period of young athletes, first pay attention to "speed" practice, including reaction speed, action speed and displacement speed. Short distance high-intensity training is adopted, twice a week. At the same time, according to the characteristics of muscle growth and development of young athletes, barbell exercises with small strength and fast-paced weight-bearing or no weight-bearing are adopted, 2-3 times a week. At the same time, barbell exercises with maximum weight are arranged once a week to improve the explosive power of muscles, and the load is 80% - 90% of the body weight. The force characteristics, movement direction and range of training methods should be close to the special technical characteristics. Only a reasonable combination of a variety of training meth.

The author declare no potential conflict of interest related to this article

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