INFLUENCE OF SQUAT TRAINING ON LOWER LIMB MUSCULAR STRENGTH IN KUNG FU ATHLETES

INFLUÊNCIA DO TREINAMENTO DE AGACHAMENTO SOBRE A FORÇA MUSCULAR DOS MEMBROS INFERIORES EM ATLETAS DE KUNG FU

INFLUENCIA DEL ENTRENAMIENTO DE SENTADILLAS EN LA FUERZA MUSCULAR DE LOS MIEMBROS INFERIORES EN ATLETAS DE KUNG FU

Original Article
Artigo Original
Artículo Original

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ABSTRACT

Introduction: Aerobic and anaerobic skills are essential characteristics in Kung Fu competitions. Research concerning their repercussions on athletes' body composition has gained emphasis due to increased sports competitiveness. Squat training is used in martial arts, but there are no reports about the results in kung fu practitioners. Objective: Investigate the effects of squat training on lower limb strength in Kung Fu athletes. Methods: 18 martial arts athletes were randomly divided into dynamic preparation activities with stretching (control), squat and half-squat exercises. Results: The paired T-test result of the control subjects was P=0.578, and the paired squat test result, relative to the control group, before and after the experiment was P=0.164. The power gain in the body posture trained with squat was 24.14 z 9.81KG, and in the half squat was 23.10±11.75KG. The strength gain in the body posture with half squat is 29.75±10.79KG versus 20.59±12.59KG in the squat test. Conclusion: After six weeks of training, both the squat and half squat groups significantly improved the maximum results of the lower limb strength tests. The muscular strength of athletes is improved throughout the range of motion, reducing the injury risk on the athletes. ***Evidence Level II; Therapeutic Studies - Investigating the result.***

Keywords: Resistance Training; Martial Arts; Muscle Strength.

RESUMO

Introdução: Habilidades aeróbicas e anaeróbicas são características importantes nas competições de Kung Fu. A investigação sobre suas repercussões na composição corporal dos atletas tem ganhado ênfase devido ao aumento da competitividade esportiva. O treino de agachamento é utilizado em artes marciais, porém não há relatos sobre os resultados em praticantes de kung fu. Objetivo: Investigar quais são os efeitos do treino de agachamento repercutidos sobre a força dos membros inferiores em praticantes de Kung Fu. Métodos: 18 atletas de artes marciais foram divididos aleatoriamente em grupos para atividades dinâmicas de preparação com alongamento (controle), para exercícios de agachamento e para exercícios de meio agachamento, com força máxima. Resultados: O resultado do teste T emparelhado dos sujeitos de controle foi P=0,578 e o resultado do teste de agachamento emparelhado, em relação ao grupo controle, antes e depois do experimento foi P=0,164. O ganho de potência na postura corporal treinada com agachamento foi de 24,14 z 9,81KG, e no meio agachamento foi de 23,10±11,75KG. O ganho de força na postura corporal com meio agachamento é de 29,75±10,79KG contra 20,59±12,59KG no teste de agachamento. Conclusão: Após seis semanas de treino, tanto o grupo de agachamento e meio agachamento melhoraram significativamente os resultados máximos dos testes de força nos membros inferiores. A força muscular dos atletas é aprimorada em toda a amplitude de movimento, reduzindo o risco de lesões para os atletas. ***Nível de evidência II; Estudos Terapêuticos - Investigação de Resultados.***

Descritores: *Treinamento de Força; Artes Marciais; Força Muscular.*

RESUMEN

Introducción: Las capacidades aeróbicas y anaeróbicas son características importantes en las competiciones de Kung Fu. La investigación sobre su repercusión en la composición corporal de los atletas ha ido ganando énfasis debido al aumento de la competitividad deportiva. El entrenamiento de sentadillas se utiliza en las artes marciales, pero no hay informes sobre los resultados en los practicantes de kung fu. Objetivo: Investigar cuáles son los efectos del entrenamiento de agachamiento sobre la fuerza de las extremidades inferiores en los practicantes de Kung Fu. Métodos: 18 atletas de artes marciales fueron divididos aleatoriamente en grupos para actividades de preparación dinámica con estiramientos (control), para ejercicios de sentadilla y para ejercicios de media sentadilla, con fuerza máxima. Resultados: El resultado de la prueba T emparejada de los sujetos de control fue de P=0,578 y el resultado de la prueba de sentadillas emparejada en comparación con el grupo de control antes y después del experimento fue de P=0,164. La ganancia de potencia en la postura corporal entrenada con sentadilla fue de 24,14 z 9,81KG, y en la media sentadilla fue de 23,10±11,75KG. La ganancia de fuerza en la postura corporal con media sentadilla es de 29,75±10,79KG frente a 20,59±12,59KG en la prueba de sentadilla. Conclusión: Tras seis semanas de entrenamiento,

tanto el grupo de sentadillas como el de medias sentadillas mejoraron significativamente los resultados máximos de las pruebas de fuerza de las extremidades inferiores. La fuerza muscular de los atletas mejora en toda la gama de movimientos, lo que reduce el riesgo de lesiones para los atletas. ***Nivel de evidencia II; Estudios terapéuticos - Investigación de resultados.***

Descriptores: *Entrenamiento de Fuerza; Artes Marciales; Fuerza Muscular.*

DOI: http://dx.doi.org/10.1590/1517-8692202228062022_0074 Article received on 01/06/2022 accepted on 02/18/2022

INTRODUCTION

Aerobic and anaerobic abilities are important characteristics in Wushu competitions. The martial arts athletes called the youth martial arts team performed more than 30 jumps and 7-10 meter high-speed runs at most in a martial arts competition. Therefore, the explosive power and jumping ability of legs have become the key to winning the competition, whether it is the confrontation martial arts or the performance of simple martial arts routines. Similarly, in Wushu competition, 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 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 change ability of jumping and running.[2] Based on the current research, this paper puts forward the maximum strength test of deep squat and half squat for Wushu athletes. The experiment shows that the maximum strength test results of lower limbs in squat training group and semi squat training group have been significantly improved after six weeks of weight-bearing squat or semi squat training.[3]

METHOD

Research object

18 male Wushu athletes were selected as the subjects, who were healthy and had no disease of restricting the movement of upper and lower limbs. All subjects had a clear understanding of the purpose, specific plan and possible dangers of the experiment before the beginning of the experiment. Because one subject failed to complete all the tests due to personal reasons during the experiment, 17 subjects finally completed all the experiments in this experiment. The subjects were randomly divided into 3 groups. One group was squat training group, 6 people; One group is half squat training group, 5 people. One group is the blank control group, 6 people. The blank control group did not carry out any strength training during the experiment.[4,5]

Experimental steps

The subjects performed dynamic stretching preparation activities and performed squat and half squat maximum strength tests. After the test, the squat training group and half squat training group will have strength training for six weeks. The training time was arranged in the special class, and all subjects carried out dynamic stretching preparation activities. Then, the squatting training group and the semi squatting training group carried out weight-bearing squatting or semi squatting training respectively in the comprehensive training hall. At the end of six weeks, the subjects underwent the maximum strength test of deep squat and half squat again.[6]

Test scheme

Before the test, the test process and relevant requirements shall be explained in detail to the subjects, and pre-test shall be carried out to make the subjects fully familiar with the test action and specific process. The subjects shall not perform strenuous physical activities within 48 hours before the test, so as not to affect the test state. All subjects underwent squat and squat maximum strength test before and after the experiment.[7]

Mathematical statistics

All experimental data were processed by SPSS statistical software and expressed as "mean ± standard deviation" (x ± SD). SPSS software is used to statistically analyze the data of each test index before and after the experiment. Through the homogeneity analysis of variance test of the data, different data adopt different statistical processing methods, analyze the relationship between the data, and explore the impact of back squat training on the leg strength of Wushu athletes.

RESULTS

Results and analysis of lower limb maximum strength test of subjects in the blank control group

The comparison results of the test results of the maximum strength of lower limbs of the subjects in the blank control group before and after the experiment are shown in Table 1. Through statistical test, the paired t-test result of the test results of the subjects in the blank control group before and after the experiment is $p = 0.578$; The results of paired t-test of deep squat test in the blank control group before and after the experiment were $p = 0.164$. The results showed that there was no statistically significant difference in the test results of lower limb maximum strength before and after the experiment in the blank control group ($P > 0.05$).

Results and analysis of maximum strength test of half squat training group and deep squat training group

After six weeks of weight-bearing squat or half squat training, the comparison results of the maximum strength test results of lower limbs of the squat training group and the half squat training group before and after the experiment are shown in Table 2. Through statistical test, the paired t-test results of the half squat test results of the squat training group before and after the experiment have statistically significant differences ($P < 0.01$). The results of paired t-test of squat test before and after the experiment in squat training group were statistically significant ($P < 0.01$). The results of paired t-test of semi squat test before and after the experiment in the

Table 1. Comparison results of lower limb maximum strength test results of blank control group before and after experiment.

Test name	Before experiment	After test	P value
Half squat test results	129.23±14.79	126.04±8.92	0.578
Deep Squat test results	95.87±12.73	99.06±11.29	0.164

Table 2. Comparison results of lower limb maximum strength test results of blank control group before and after experiment.

	Test name	Before experiment	After test
Deep squat training group	Half squat test results	128.83±4.56	151.74±15.30
	Deep Squat test results	103.54±10.16	127.96±16.32
Half squat training group	Half squat test results	118.48±20.66	148.94±20.78
	Deep Squat test results	94.54±18.15	115.34±15.79

semi squat training group were statistically significant ($P < 0.01$). The results of paired t-test of squat test before and after the experiment in the semi squat training group had statistically significant difference ($P < 0.05$). It shows that the maximum strength test results of lower limbs in the squat training group and the semi squat training group have been significantly improved after six weeks of weight-bearing squat or semi squat training.[8]

There was no significant difference between six weeks of weight-bearing squat and half squat training in improving the strength of basketball players' lower limbs, but the strength gain of the two experimental groups at different knee positions after six weeks of weight-bearing squat training was different (Figure 1 and 2). For the subjects in the squat training group, they carried out weight-bearing squat training at the maximum knee flexion angle, and their strength gain was almost the same in the squat and half squat tests (Figure 1). The strength gain in the trained body posture (squat) was 24.14 ± 9.81kg, and the strength gain in the half squat test was 23.10 ± 11.75kg. For the subjects in the half squat training group, they carried out weight-bearing half squat training under the knee joint partial flexion angle, and their strength gain was low for the small joint angle (squat test) (Figure 2). In the half squat training group, the strength gain in the trained body posture (half squat) was 29.75 ± 10.79kg, while it was only increased by 20.59 ± 12.59kg in the squat test. Compared with the squat training group, the strength gain of the semi squat training group is larger, but the strength gain in the untrained position is smaller. According to the research, compared with deep squat training, weight-bearing semi squat training has relatively low gluteal muscle activity due to the small squat range. Strength training in the squat position is more exciting for the quadriceps femoris. Compared with the squatting position, the quadriceps femoris is not fully elongated and is in the partially shortened position during the semi squatting.[9]

DISCUSSION

Wushu sports technology requires athletes' knee joint to be in the position of semi flexion. The formation of this action feature has its internal reasons. In the semi flexion position of knee joint, the muscles of human lower limbs involved in knee extension are the most. The semi flexion position of patella knee joint can make the lower limb obtain the maximum knee extension torque of quadriceps femoris and maximize

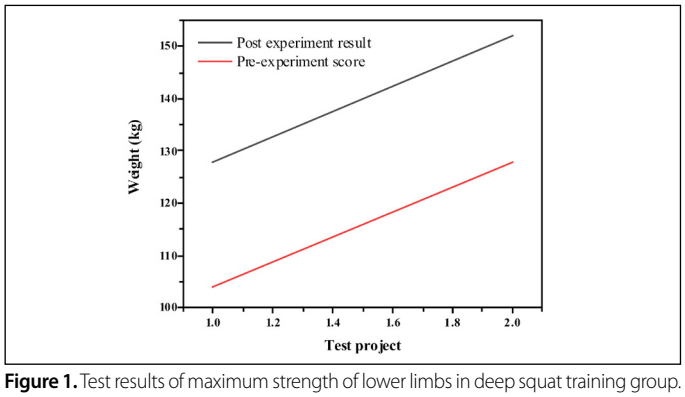

Figure 1. Test results of maximum strength of lower limbs in deep squat training group.

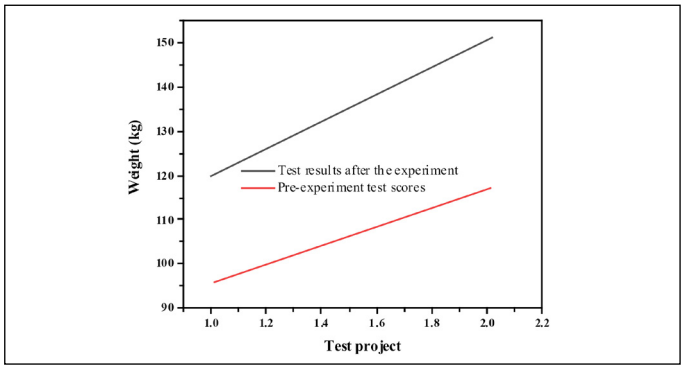

Figure 2. Test results of maximum strength of lower limbs in half squat training group.

the mechanical benefit of quadriceps femoris. When the knee joint is in the semi flexion position, the knee ligament is in a relatively relaxed state, allowing the knee joint to do internal and external rotation, which is the sudden change of direction ability of athletes in rapid movement. In addition, when the human body is in the semi knee bending position, the center of gravity is reduced, the stability is improved, and the athletes' ability to fight on the field is enhanced. In addition, the braking angle and starting angle of human movement formed by the included angle between the inner side of the front and rear feet and the ground become smaller, which is conducive to the athletes' braking in fast running and fast starting in static state, so as to improve the flexibility of footstep movement. Knee flexion can not only increase the flexibility of basketball players, but also reduce the stability of knee joint. Frequent braking, acceleration, direction change and rotation under the condition of knee joint instability are the main reasons for the high risk of knee joint injury in basketball.[10]

CONCLUSION

This paper proposes to study the impact of post squat training on the leg strength of wushu athletes. After research, it shows that the large knee Angle is conducive to the lower limb push and achieve the purpose of technical action. The good delivery effect of weight-bearing squat training in the range of other knee movements helps to improve the muscle strength of athletes in the whole squat range, and reduce the risk of injury for athletes to exercise in a state of high knee flexion. Special movements such as sudden direction and side cutting and jump movements are smaller, so compared with weight-bearing squat training, weight-bearing semi-squat training is closer to specialization for these technical movements. According to the specific situation of the athletes should be targeted to choose the weight-bearing squat or semi-squat training, in order to comprehensively improve the strength and quality of the athletes. In the future, we can further explore the most suitable vibration frequency for developing the special quality of martial arts, and we can help to apply the vibration training to the martial arts training practice more scientifically.

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

AUTHORS' CONTRIBUTIONS: The author made significant contributions to this manuscript. WT: writing and performing surgeries; data analysis and performing surgeries; article review and intellectual concept of the article.

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