

# INFLUENCES OF ABDOMINAL CORE STRENGTHENING ON EXPLOSIVE STRENGTH IN MARTIAL ARTS ATHLETES



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INFLUÊNCIAS DO FORTALECIMENTO ABDOMINAL SOBRE A FORÇA EXPLOSIVA NOS ATLETAS DE ARTES MARCIAIS

INFLUENCIA DEL FORTALECIMIENTO ABDOMINAL EN LA FUERZA EXPLOSIVA DE ATLETAS DE ARTES MARCIALES

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## ABSTRACT

**Introduction:** Martial arts demand a high-stability from their athletes, allied to a fast speed in complex movements. These characteristics have been shown to increase in other sports with the strengthening of the abdominal core of their athletes, and it is believed that martial arts practitioners could also benefit from this additional exercise. **Objective:** Explore the influences of abdominal core strengthening on explosive strength in martial arts athletes. **Methods:** Twenty martial arts athletes were selected and randomly divided between the experimental and control group. The experimental group did abdominal core strength training associated with traditional physical training, while the control group practiced only traditional physical training. After the experiment, new physical tests were performed, comparing the pre and post results regarding peak torque, explosive strength, and impact explosive strength of martial arts athletes. **Results:** The relative strike force of the straight fist in the experimental group increased from 25.75 to 31.89 after the experiment; the relative strike force to the lower limbs increased from 37.64 to 47.00 after the experiment ( $p < 0.05$ ). **Conclusion:** After the executed strength training, the athletes' extensor peak torque and impact explosive strength indexes were significantly enhanced, evidencing the improvement of the explosive strength of martial arts athletes. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

**Keywords:** Resistance Training; Martial Arts; Abdominal Core.

## RESUMO

**Introdução:** As artes marciais exigem de seus atletas uma alta estabilidade aliada a rápida velocidade em complexos movimentos. Essas características mostraram elevarem-se em outros esportes com o fortalecimento do centro abdominal de seus atletas e acredita-se que os praticantes de artes marciais também poderiam beneficiarem-se desse exercício adicional. **Objetivo:** Explorar as influências do fortalecimento do centro abdominal sobre a força explosiva nos atletas de artes marciais. **Métodos:** Vinte atletas de artes marciais foram selecionados e divididos aleatoriamente entre grupo experimental e controle. O grupo experimental fez o treinamento da força do centro abdominal associado ao treinamento físico tradicional enquanto o grupo de controle praticou apenas o treinamento físico tradicional. Após o experimento, foram feitos novos testes físicos, comparando os resultados prévios e posteriores referentes ao torque de pico, força explosiva e força explosiva de impacto dos atletas de artes marciais. **Resultados:** A força de golpe relativa do punho reto no grupo experimental aumentou de 25,75 para 31,89 após o experimento; a força de golpe relativa aos membros inferiores aumentou de 37,64 para 47,00 após o experimento ( $p < 0.05$ ). **Conclusão:** Após o treinamento de fortalecimento executado, o torque de pico dos extensores e os índices da força explosiva de impacto dos atletas foram significativamente reforçados, evidenciando a melhora da força explosiva dos atletas de artes marciais. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

**Descritores:** Treinamento de Força; Artes Marciais; Centro Abdominal.

## RESUMEN

**Introducción:** Las artes marciales exigen de sus atletas una gran estabilidad aliada a una rápida velocidad en movimientos complejos. Se ha demostrado que estas características aumentan en otros deportes con el fortalecimiento del núcleo abdominal de sus atletas y se cree que los practicantes de artes marciales también podrían beneficiarse de este ejercicio adicional. **Objetivo:** Explorar las influencias del fortalecimiento del núcleo abdominal sobre la fuerza explosiva en atletas de artes marciales. **Métodos:** Se seleccionaron veinte atletas de artes marciales y se dividieron aleatoriamente entre el grupo experimental y el de control. El grupo experimental realizó un entrenamiento de fuerza en el núcleo abdominal asociado al entrenamiento físico tradicional, mientras que el grupo de control sólo practicó el entrenamiento físico tradicional. Tras el experimento, se realizaron más pruebas físicas comparando los resultados previos y posteriores en relación con el par máximo, la fuerza explosiva y la fuerza explosiva de impacto de los atletas de artes marciales. **Resultados:** La fuerza relativa de golpeo del puño recto en el grupo experimental aumentó de 25,75 a 31,89 después del experimento; la fuerza relativa de golpeo del miembro inferior aumentó de 37,64 a 47,00 después del experimento ( $p < 0,05$ ). **Conclusión:** Tras el entrenamiento de fortalecimiento ejecutado,



**Descriptores:** Entrenamiento de Fuerza; Artes Marciales; Núcleo Abdominal.

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## INTRODUCTION

The martial arts movement has gone to the world. It has the characteristics of fast speed, strong strength and great difficulty.<sup>1</sup> Therefore, the martial arts athletes must have very good physical quality and physical mechanism, and also need to be able to control their bodies well. At present, the development of martial arts is constantly making breakthroughs and innovations, so the physical fitness requirements of martial arts athletes are very high.<sup>2</sup> All the martial arts training arrangements are based on the physical training of athletes. The continuous improvement of physical fitness can help athletes to better complete difficult movements and ensure the standard of action. Therefore, Wushu athletes need more professional physical training to meet the increasingly competitive competition needs.<sup>3</sup> At present, the physical training contains many contents, which can be divided into the strength, speed, endurance, balance, coordination and other aspects of the athletes. Among them, the strength training of athletes is the key factor that directly affects the performance of martial arts competitions.<sup>4</sup> At the same time, strength is also an important guarantee for the full play of other physical qualities. The ability of speed, balance and coordination of athletes can only be improved on the basis of sufficient strength, which plays a vital role in the overall quality of athletes. The core strength training is an important supplement to the traditional martial arts sports training.<sup>5</sup> This training method mainly focuses on the contraction and extension of the muscles and ligaments in the core area, mainly in an unstable state, and can strengthen the muscle training in multiple angles and dimensions.<sup>6</sup> This kind of training can involve the deep muscle group ignored by traditional physical training in the process of training, and strengthen the ability of nerve to control muscle. The core strength training method emphasizes that multiple muscles should be trained as a whole, rather than a single muscle group or joint.<sup>7</sup> This training method can improve the stability and coordination of the body as much as possible, especially the explosive force, provide sufficient strength support for the whole body, and reduce the burden on the joints as much as possible during the exercise.<sup>8</sup> Core strength is not a single strength training method, but can focus on the central muscle group of the body, coordinate the muscle group strength of the upper and lower limbs for overall strength. For martial arts athletes, the promotion of core strength can effectively improve the overall strength quality of athletes, and help athletes complete martial arts movements more standardized and effectively.<sup>9</sup> Based on the characteristics of martial arts, this paper conducts core strength training on the core muscles of martial arts athletes, aiming to help athletes enhance their explosive power through targeted core strength training, and further improve the quality and training effect of martial arts movements.

## METHOD

### Subject of experiment

In this paper, 20 Wushu athletes were selected to participate in the experiment, and all the athletes were randomly divided into 10 experimental groups and 10 control groups. The study and all the participants were reviewed and approved by Ethics Committee of China University of Political Science and Law(NO.2020CUPSW-079). The age, height, weight and training years of all subjects were analyzed. The specific data results are shown in Table 1.

## Experimental methods

Before the experiment, the athletes of the two groups were tested on three kinds of indicators. The test contents were as follows: first, the peak torque included the peak torque and relative peak torque of the flexor and extensor muscles at 60 °/s; second, the explosive force of the movement included the left, right and cross running of the side throwing solid ball; third, the explosive force of the attack included the hitting force and relative hitting force of the straight fist and whip leg. All test indexes were tested with the same instrument on the two groups of athletes.

## RESULTS

### Core muscle force peak torque test results

Before and after the experiment, all subjects were tested for the peak torque of the flexor and extensor muscles at 60 degrees per second, and the test results reflected the maximum muscle strength level of martial arts athletes. The pre and post test results of subjects in the experimental group and the control group are shown in Table 2. After the core strength training proposed in this experiment, the peak torque of 60 °/s extensor and the relative peak torque of 60 °/s extensor in the experimental group showed significant difference ( $p < 0.05$ ).

### Test Results of Explosive Force Index of Wushu Athletes

Before and after the experiment, the left and right side throw solid ball performance and cross direction change run of the two groups of athletes were tested. Through data analysis, it can be seen that after the core strength training, the difference in sports explosive force between

**Table 1.** Analysis of the basic situation of the two groups of athletes.

| Test index             | Experimental group (n=10) | Control group (r=10) | T value | P value |
|------------------------|---------------------------|----------------------|---------|---------|
| Age (age)              | 18.96 ±1.589              | 18.44 ±1.610         | 0.3648  | 0.7225  |
| Height (cm)            | 174.74 ±6.344             | 177.13 ±5.405        | -0.3527 | 0.7461  |
| Weight (kg)            | 66.36 ±7.376              | 66.36 ±5.478         | -0.1812 | 0.8834  |
| Training years (years) | 4.92 ±0.499               | 5.12 ±1.245          | -0.2231 | 0.8180  |

**Table 2.** Influence of Core Strength Training on Peak Moment of Wushu Athletes.

| Option   | Experience group | Control group  | t       | p      |
|--|------------------|----------------|---------|--------|
| Before 60 °/s flexor peak torque test                    | 143.77 ±14.205   | 149.37 ±9.029  | -0.4341 | 0.6825 |
| After 60 °/s flexor peak torque test                     | 169.22 ±19.421   | 159.96 ±25.457 | -2.1665 | 0.0855 |
| Before 60 °/s extensor peak torque test                  | 220.83 ±55.408   | 225.31 ±47.259 | -0.4499 | 0.6938 |
| After 60 °/s extensor peak torque test                   | 282.68 ±27.840   | 244.72 ±34.289 | -2.7101 | 0.0425 |
| Before the 60 °/s flexor relative peak torque experiment | 2.14 ±0.214      | 2.25 ±0.143    | -0.4427 | 0.7010 |
| After 60 °/s flexor relative peak torque experiment      | 2.56 ±0.286      | 2.36 ±0.372    | -2.1665 | 0.0838 |
| Before the 60°/s extensor relative peak torque test      | 3.29 ±0.834      | 3.39 ±0.728    | -0.4530 | 0.6803 |
| After 60°/s extensor relative peak torque test           | 4.28 ±0.419      | 3.61 ±0.514    | -2.7452 | 0.0429 |

the two groups of athletes is not significant. The specific results are shown in Table 3. After data analysis, it can be seen that there is no significant difference among the above three test indicators ( $p>0.05$ ).

Before and after the experiment, the indexes of attack explosive force of martial arts athletes were tested. According to the data comparison in Table 4, there was no significant difference between the four kinds of test results of attack explosive force before the experiment. After the experiment, there were significant differences, among which, the straight punch striking force and the relative striking force showed very significant differences, and the whip leg striking force and the relative striking force showed significant differences.

## DISCUSSION

### Analysis of peak torque change of core muscle strength

Through the test results, it can be seen that the training method proposed in this paper has achieved the goal of increasing the muscle strength of the athlete's trunk core. The comprehensive experimental results show that the core strength training method can improve the maximum muscle strength of the athletes' extensors, and help athletes improve the explosive force through the coordination and mutual support of the core muscles. The core muscle group is not a single structure, nor is it carried out in a one-dimensional space, which requires that the core muscle group can meet the strength requirements of various body movements, especially explosive force, to provide athletes with muscle flexion, extension and rotation support during training and competition.

**Table 3.** The influence of core strength training on the explosive power of wushu athletes.

| Option  | Experience group | Control group | t       | p      |
|---|------------------|---------------|---------|--------|
| Side throw solid ball left side before experiment       | 9.77 ±1.994      | 9.68 ±2.037   | 0.0090  | 0.9909 |
| Throw solid ball on the left side after the experiment  | 15.27 ±3.951     | 14.72 ±3.783  | 0.4462  | 0.6728 |
| Side throw solid ball right before experiment           | 10.11 ±2.214     | 9.96 ±2.075   | 0.0631  | 0.9746 |
| Throw solid ball on the right side after the experiment | 15.63 ±4.059     | 14.93 ±3.685  | 0.5306  | 0.5947 |
| Before the cross run experiment                         | 11.09 ±0.604     | 11.25 ±0.582  | -0.2337 | 0.8424 |
| After the cross run experiment                          | 11.22 ±0.620     | 11.22 ±0.591  | -0.3185 | 0.7524 |

**Table 4.** The Influence of Core Strength Training on the Attack Explosive Force of Wushu Athletes.

| Option   | Experience group | Control group    | t       | p      |
|--|------------------|------------------|---------|--------|
| Before the straight punch test                                       | 1713.01 ±176.523 | 1761.69 ±260.738 | -2.8729 | 0.1349 |
| After the straight blow test   | 2120.55 ±254.505 | 1981.41 ±200.153 | -1.9736 | 0.0089 |
| Before the experiment on the relative hitting force of straight fist | 25.75 ±2.603     | 26.23 ±3.922     | -2.9101 | 0.1359 |
| After the experiment on the relative hitting force of straight fist  | 31.89 ±3.722     | 29.50 ±2.894     | -1.9736 | 0.0057 |
| Before the whip leg hitting force test                               | 2502.59 ±395.095 | 2611.09 ±369.044 | -3.3083 | 0.2236 |
| After the whip leg hitting force experiment                          | 3125.84 ±398.832 | 2799.13 ±282.438 | 0.8943  | 0.0131 |
| Before the experiment of whiplash leg relative hitting force         | 37.64 ±5.868     | 38.88 ±5.493     | -3.3083 | 0.2231 |
| After the experiment of whiplash leg relative hitting force          | 47.00 ±6.057     | 41.67 ±4.129     | -0.9059 | 0.0131 |

The peak torque and relative peak torque of extensors of athletes have increased significantly, which can be seen that the muscles have increased to a certain extent, and the control ability of nerves on muscles has also been strengthened. This experiment designed various core strength training of athletes in stable and unstable states, which can mobilize the core muscle group vitality of the body to a higher extent, and conduct unbalanced strength training in three-dimensional space, in order to achieve the effect of improving the explosive power of athletes. After such experimental training, the coordination of the core muscle group will be improved, and the speed and intensity of the nervous system's control of the muscle will also be improved.

Combined with the core strength training proposed in this experiment, it can be concluded that the traditional physical training can generally meet the muscle strength training in one-dimensional space, such as sit ups. Although it can also increase the muscle strength of the muscle extensors, compared with the core strength training, the muscle training should coordinate each muscle group to practice in three-dimensional space. In particular, the difficult movements of martial arts require the athletes' bodies to complete without support. Therefore, core strength training can stimulate multiple muscle groups and improve the control and coordination of the nervous system on the core muscle groups. Therefore, the experimental results show that the peak torque and relative peak torque of the extensors have significantly improved after training, indicating that core strength training is conducive to the enhancement of athletes' explosive force.

### Analysis of changes in explosive power of Wushu athletes

After the core strength training, there was no significant difference in the test results of the left and right side throw solid ball and the cross direction change run. However, by comparing the results before and after the experiment, it can be seen that except for the decline in the cross direction change run of the control group, other test results have improved to a certain extent. During the experiment, the experimental group conducted core strength training, and the control group conducted traditional physical training. Both types of training have weight bearing or resistance exercises, which can increase the maximum muscle strength of muscles. Weight bearing or resistance exercises have certain requirements on the stability of the body. This kind of exercise can also stimulate part of the core muscle group to participate in it, so as to ensure the stability of the body. The increase of core muscle strength helps improve the performance of left and right side throwing solid ball. Comparing the results of the side throw solid ball between the experimental group and the control group, it can be seen that the experimental group has more room for improvement, which means that the core strength training method is more conducive to the improvement of athletes' performance than the traditional physical training method. Core strength training can enhance the coordination and stability between various muscle groups, and then enhance the explosive power of athletes. The side throw solid ball requires the strength of upper and lower limbs and the strength of left and right rotation of the trunk to complete the side throw action. The training method proposed in this paper not only makes the explosive force of martial arts athletes have been significantly strengthened, but also improves the coordination ability between various muscle groups of athletes.

After the core strength training, the test results of the hitting power and relative hitting power of straight fist and whip leg show a significant difference. At the same time, the comparison between the experimental group and the control group shows that the performance of the experimental group is higher than that of the control group. Comprehensive experimental results show that core strength training has a positive effect on the completion of athletes' technical movements. The strength of

the core muscle group can provide the basis for the athletes to hit and deliver force, and the core muscle group is also an important support point for the upper and lower limb muscle groups to deliver force, so the size of the core strength can directly affect the effect of the athletes' upper and lower limbs. Through the results of this experiment, we can see that core strength training not only increases the hitting power of athletes' upper and lower limbs, but also improves the explosive power of athletes' hitting, and also strengthens the strength of core muscles to a certain extent.

## CONCLUSION

The enhancement of core strength is an important factor to ensure the balance of the human body in an unstable state. Therefore, the training of core strength can improve the control ability of Wushu athletes' nerves to muscles, and thus enhance the explosive power of athletes.

The training mode of core strength is to stimulate the deep muscle group and emphasize the control and coordination ability of core strength on the basis of the control ability of the nervous system to the muscle. This kind of training method can provide support for the strength of upper and lower limbs of martial arts athletes, and promote the cooperation of various muscle groups of the athletes to work together. It can be seen from the experimental results that compared with the traditional physical training methods, the core strength training is more conducive to the athletes to enhance the explosive force, especially the strike explosive force. From this, it can be seen that the core strength training is an important training content for martial arts athletes to achieve better training effects and competition results.

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All authors declare no potential conflict of interest related to this article

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**AUTHORS' CONTRIBUTIONS:** The author has completed the writing of the article or the critical review of its knowledge content. This paper can be used as the final draft of the manuscript. Every author has made an important contribution to this manuscript. Pang Haifan: writing and execution. Jia Haixiang and Ge Qi: data analysis and article reviews.

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