Pisco Med Publishing

Original Research Article

The Experimental Research on the Influence of Core Strength Training on Special Athletic Ability of Wushu Forms Athletes

Huidi Zhao[1,*], Dexiang Gu[2]

1.School of Physical Education, Changzhou University, JiangSu,Changzhou, 213164, China

2.Changzhou University Huaide College, JiangSu, Jingjiang, 214500 China

Abstract: The core strength training is one of the important prerequisites to improve the athletic level in Wushu forms training. it is an important link in the whole Wushu forms technology power chain, and it is an indispensable part of physical training. The paper, adopting the methods of literature review and controlled experiments, compared the respective influence of core strength training and traditional training on 20 subjects of male and female players of Wushu forms from Jiangsu Wushu forms team. According to the result, 16 weeks of core strength training has improved the muscle groups in their core body part in terms of strength, stability as well as the controllability on body. Besides, these athletes' special abilities have been enhanced. It mainly reflected in improving the special mobile ability, upper limbs and lumbar muscles group of lower limbs explosive strength and endurance, the onset of coordination and sensitive quality.

Keywords: Wushu forms athletes; Core strength; Experimental research; Special ability

1 Introduction

As the rapid development of modern information technology and big-data era has gradually enhanced people's understanding of practical training, competitive sports training has become more of an integrative discipline with its concept changing from developing an athlete's single quality and ability into developing his systemic-functional ability[1]. As a research subject popular at home and broad, core strength training concentrates on the strength, stability and balance of core muscle groups in the core body part. Initially, it belonged to the strength training program in rehabilitation training. Here "core" means "the central part of body", namely the area between shoulder joints and hip joints where muscle groups are key to the entire body strength and junctions in the body since they play a role in keeping a balance and transferring strength[2]. Wushu is composed of two sub-disciplines: Sparring and Forms. The latter, unique to Chinese martial arts, is a combination of offensive and defensive movements. Founded on the movements of sparring, Forms is an exercise routine referring to the rules of such paradoxical movements featuring "offensive and defensive", "dynamic and static" and "hard and soft". May movements of Forms, in comparison of those of Sparring, have experienced changes in technical specifications and ranges, but still have maintained the original styles. Although some movements excluding attacking and defending are added for the sake of continuity and linkage, the whole routine features kicking, punching, wrestling, catching, beating and stabbing[3]. Generally speaking, Forms is the essence and art reproduction of Sparring. In other words, it, derived from and superior to Sparring, is the highest expression of Wushu.

Thus we added core strength training to teenage strength training program. After 16 weeks of training, these teenage athletes have improved the muscle groups in their core body part in terms of strength, stability as well as the controllability on body.

2 Research subject and methods

2.1. Research subject

This thesis selects 20 Wushu routine athletes from Changzhou Youth Amateur Sports School as research subjects. There are 12 male athletes and 8 female athletes respectively, with an average age of 11 and a training period of 3 years. They are randomly divided into two even groups; Group A is the experimental group and Group B is the control group.

2.2 Research methods

2.2.1. Literature review method

The author consults a great deal of literature and references concerned about Wushu, strength training, special strength training and core strength training at home and abroad. Therefore, the research theoretical and methodological basis is established by classifying, inducting and summarizing the previous valuable results.

2.2.2. Expert interview

With the help of the sports administrative departments, the author arranges the interviews with coaches and experts who engaged in sports competition theory and training research, talking about the feasibility and methodology when introducing the core strength training into the strength training of teenage Wushu forms athletes. This paper discusses the methods and existing problems in core

doi: 10.18282/l-e.v10i1.2173

strength training which provides the theoretical basis for improving athletes' sports skills.

2.2.3. Experiment

The experiment lasts 16 weeks, testing the respective number of Supine up from Both Ends(30 seconds), Forward Front Kick in Place(10 seconds), Crescent Kick in Place(10 seconds), Front Kick In Motion(10 seconds), Crescent Kick In Motion(10 seconds), Success Rate of Whirlwind Kick 540°--Horse Stance(10 times) and Success Rate of Outward Lotus Kick 540°– Horse Stance(10 times) as well as Duration of Single-leg Front Lever. By comparing all the data mentioned above, we find that the statistics for two groups show no statistical difference. Then, the two groups carry out core strength training and traditional strength training respectively for 16 weeks. After that, we test these items again with the same method.

Tests	Experimental group	Control group	t	P
Supine up from Both Ends 30s (X±S)	21.20±1.40	21.10±1.60	0.15	P＞0.05
Forward Front Kick in Place 10s (Total)(X±S)	23.90±1.37	23.80±2.25	0.12	P ＞0.05
Crescent Kick in Place 10s (Total) (X±S)	21.90±1.97	21.70±1.25	0.27	P＞0.05
Front Kick In Motion 10s (Total)(X±S)	11.10±1.10	10.90±1.20	0.39	P＞0.05
Crescent Kick In Motion 10s (Total) (X±S)	10.20±0.92	10.10±0.99	0.23	P＞0.05
Duration of Single-leg Front Lever (X±S)	10.10±1.60	9.80±0.92	0.52	P＞0.05
Success Rate of Whirlwind Kick 540°--Horse Stance 10 times	4.00±0.67	3.90±0.74	0.32	P＞0.05
Success Rate of Outward Lotus Kick 540°– Horse Stance 10 times	4.30±0.95	3.90±0.57	1.14	P＞0.05

Table 1 Core Strength of Experimental Group and Control Group before Tests

2.2.3.1. Workouts of the experimental group

Sixteen weeks' core strength training is designed for the experimental group in two phases. Basic core strength training is used for 4 weeks in the first phase which includes Hip Thrust, Lying Leg Raise and Abdominal Curl, Single Elbow Push-up and Abdominal Curl, and Lateral Prop on the Side. As the initial period of the workout, the first phase focuses on the isometric training to lay a foundation for the second phase, a more complex one.

A 12-week core strength training program is aimed at consolidating and increasing strength in the second phase where dynamic exercises and dynamic-static exercises such as Lying Raise from Both ends with Swiss Ball between Feet, Lying Rotate with Swiss Ball between Feet, Push-ups on Swiss Ball and Ball Rotation, Squatting on a Balance Ball with One Foot and Closed Eyes, Resistance Swing leg from Inside and Outside. The movements should be done properly with right inhalation and exhalation. Also, the nervous system and the mind are trained so that the athletes are healthier physically and mentally.

2.2.3.2. Workouts of the control group

Traditional strength training is carried out on the athletes in the control group. Its contents are as follows. Table 2.

Group	Experimental group	Control group
	Workouts	
	Hip Thrust	Ribs for lifting legs
	Lying Leg Raise and Abdominal Curl	Sit-ups
	Lateral Prop on the Side	Weight-bearing Squat
	Lying Raise from Both ends with Swiss Ball between Feet	Jump over the Box Horse
	Lying Rotate with Swiss Ball between Feet	Horse Stances
	Push-ups on Swiss Ball and Ball Rotation	Supine up from Both Ends
	Squatting on a Balance Ball with One Foot and Closed Eyes	Resistance Stretch Knee
	Resistance Swing leg from Inside and Outside	Bench press

Table2 Workouts of Experimental Group and Control Group

2.2.3.3. Experimental control

First, inform the coach of the essentials and requirements of the movements. Every time their supervision is trained, their movements must meet the requirements with the intensity and frequency increasing gradually. The two tests are carried out under the same conditions including the weather and the physical condition of the tested subjects.

2.2.3.4. Experimental evaluation

We have referred to relevant literature at home and abroad. Considering the characteristics of teenage Wushu forms athletes and the limitation of experimental conditions, we have indirectly evaluated the core strength through the change of stability and balance of the athletes before and after the experiment to study its change.

2. 2.4. Mathematical statistics

The effective data of all experiments should be analyzed by SPSS11.0 statistical software. The data should be expressed by mean number ± standard deviation. The T test between groups is used. $P<0.05$ means significant difference, and $P<0.01$ means greatly significant difference.

3 Results and analysis

3.1. The evaluation of the core strength of teenage Wushu forms athletes

The core refers to an integral whole composed of waist, pelvis and hip joint, including the pelvic region from shoulder joint to hip joint, which contains back muscles, abdominal muscles and all muscles that constitute the pelvis[4]. The core of Wushu Forms athletes includes abdominal muscles such as musculus rectus abdominis, external oblique muscles and internal oblique muscles, back muscles like erector spinae, and pelvic floor muscles, quadriceps femoris, biceps femoris, adductor magnus and so on[5].

Strength quality refers to the ability of body-muscle system to overcome the resistance, and the strength quality of human body is determined by many factors. In various projects, strength quality takes different forms, including maximum strength, fast

strength, strength endurance[6].Strength quality, an aggregative index, should be evaluated from different perspectives. Testing and evaluating core strength training scientifically is the premise of training monitoring as well as the sign of high-level development of modern training. At present, the main evaluation methods are core strength site tests, core stability measurements[7],electromyogram measurements and intra-abdominal pressure measurements[8]. Due to limited conditions, the stability and balance of athletes are usually evaluated indirectly now[9]. Based on literature at home and abroad, and in consideration of the characteristics of teenage Wushu forms athletes, we take the changes of athletes' stability and balance after the experiment to make an indirect evaluation of core strength, so as to study the changes of their core strength.

The thesis takes as the evaluation indexes the points of 30-second Supine up from Both Ends as well as the respective points of Forward Front Kick in Place, Crescent Kick in Place, Front Kick In Motion and Crescent Kick In Motion within 10 seconds, with importance attached to the changes of speed strength and strength endurance after the experiment. Finishing Whirlwind Kick 540°—Horse Stance 10 times, Outward Lotus Kick 540 —horse stance 10 times and Duration of Single-leg Front Lever requires better stability, balance and body control. These indexes highlight body's stability and control, thus all indexes above are able to make a comprehensive and objective evaluation on core strength.

3.2. Contrastive analysis of the control group before and after tests

Table 3 shows that the control group's performance of Wushu forms athletes, after 16 weeks of two-phased traditional strength training, have experienced, to varying degrees, improvements in 30-second Supine up from Both Ends, 10-second Forward Front Kick in Place, 10-second Crescent Kick in Place, 10-second Front Kick In Motion, 10-second Crescent Kick In Motion and the duration of Single-leg Front Lever as well as the success rates of those two difficult movements. However, there's no obvious difference according to the statistical test, which shows that the control group didn't significantly improve the core strength. By analyzing the reasons, we found that the sport Wushu requires lower limb strength and explosive power, besides the completion of some movements are in urgent need of better physical control. Only under the premise of maintaining the body's stability can rotation, jumping and other movements do favor to stably standing on floor in the end. Although traditional Wushu strength training emphasizes the strength training of lower body, in ways of weight-squatting and frog jumping which are used to improve the strength of large muscle groups and partial muscles. Even if the maximum strength of partial muscles has increased, the deep muscle groups are rarely involved in training, and the absence of the whole body's stability exercises and the lack of control capacity exercise, altogether leading to the poor performance of muscular coordination. To have a better performance of Supine up from Both Ends in 30s, Forward Front Kick in Place in 10s, Crescent Kick in Place in 10s and other movements, one must be able to maintain body's balance. Therefore, the indexes of Supine up from Both Ends in 30s, Forward Front Kick in Place in 10s and other movements did not increase significantly. All in all, there's no statistical difference between each index in this experiment.

Tests	Before	After	t	P
Supine up from Both Ends 30s(X±s)	21.10±1.60	21. 80±1.23	2.69	P＞0.05
Forward Front Kick in Place 10s(total)(X±s)	23.80±2.25	25.60±2.99	2.02	P＞0.05
Crescent Kick in Place 10s (total) (X±s)	21.70±1.25	22.60±1.84	1.79	P＞0.05
Front Kick In Motion 10s(X±s)	10.90±1.20	11.80±0.92	2.21	P＞0.05
Crescent Kick In Motion 10s(X±s)	10.10±0.99	10.40±0.97	1.15	P＞0.05
Single-leg Front Lever (X±s)	9.80±0.92	9.9±1.52	0.25	P＞0.05
Success Rate of Whirlwind Kick 540°--Horse Stance 10 times (X±s)	3.90±0.74	4.00±0.94	0.43	P＞0.05
Success Rate of Outward Lotus Kick 540°– Horse Stance 10 times (X±s)	3.90±0.57	4.20±0.63	1.41	P＞0.05

Table 3 Core Strength of Control Group before and after Tests

Notice: P<0.05 refers to significant difference, P<0.01 refers to insignificant difference. The same is as the following tables.

3.3. Contrastive analysis of the experimental group before and after tests

As is shown from Table 4, after two phases of a 16-week core strength training, the Wushu forms athletes have experienced, at different degrees, improvements in 30-second Supine up from Both Ends, 10-second Forward Front Kick in Place and 10-second Crescent Kick in Place and the duration of Single-leg Front Lever as well as the success rates of the two difficult movements. "P<0.05" indicates that there still exists the statistical difference. With all, it suggests that the stability and balance ability of the experimental group have been significantly improved after the core strength training.

The core strength is generated when the muscles and ligaments attached to the core of the human body contract under the control of the innervations. It is the main strength that stabilizes the core parts of the human body, controls the movement of body weight and transmits the strength between upper and lower extremities[10].The core strength training especially focuses on the training of those small muscle groups that are located in the deep, and one important principle of it is to make muscles work in coordination, not to perform in solitary joints, so that the muscle groups surrounding the upper and lower back and abdomen will work at the same time and coordinate the whole organism. This ensures that the core muscle groups will transmit the energy and stabilize the body of an athlete during his performance[11].

Du Zhencheng's Study on Fencer's Core Strength Training has found that the greater the contractility of the core muscle group is, the stronger the stability of the core body part will be. The two are positively correlated with each other[12]. Therefore, core strength training highlights enhancing the capability of power transmission, body coordination and control of muscle strength. It reflects a new idea that the whole body and multiple muscle groups can simultaneously participate in sports in many dimensions. Thus, for Wushu athletes, core strength training can not only enhance the control of nerve to muscle, but also improve the transmission efficiency of strength from upper body to lower body and accelerate the transformation of specific movements. Movements like Front Kick In Motion, Crescent Kick In Motion and Inside Crescent Kick In Motion can be better completed. Besides, the success rate of completing difficult movements is increased. This is the most important and fundamental reason for such significant differences among each

index.

Tests	Before	After	t	P
Supine up from Both Ends 30s (X±s)	21.20±1.40	26.30±3.09	4.68	P<0.05
Forward Front Kick in Place 10s(total)(X±s)	23.90±1.37	29.10±3.35	5.27	P<0.05
Crescent Kick in Place 10s(total)(X±s)	21.90±1.97	24.70±1.64	2.98	P<0.05
Front Kick In Motion 10s (X±s)	11.10±1.10	12.90±0.57	5.01	P<0.05
Crescent Kick In Motion 10s (X±s)	10.20±0.92	12.30±0.82	5.16	P<0.05
Single-leg Front Lever (X±s)	10.10±1.60	13.80±2.70	5.84	P<0.05
Success Rate of Whirlwind Kick 540°--Horse Stance 10 times (X±s)	4.00±0.67	5.30±0.95	4.30	P<0.05
Success Rate of Outward Lotus Kick 540°– Horse Stance 10 times (X±s)	4.30±0.95	6.00±1.33	4.02	P<0.05

Table 4 Core Strength of Experimental Group before and after Tests

Notice: P<0.05 refers to significant difference, P<0.01 refers to insignificant difference.

3.4. Contrastive analysis of control group and experimental group after tests

After 16 weeks of training, dramatic differences have been found among each index of control and experimental groups. Reasons are listed as follows:

(1) Coordination between muscles like musculus rectus abdominis and erector spinae are required in order to do Supine up from Both Ends well and fast. To do Forward Front Kick in Place and Crescent Kick in Place, one must have strong quadriceps, gluteus maximums and biceps femoris muscle of lower limbs to sustain his body. Pelvis, rectus abdominals, external and internal oblique, erector spinae are necessary to keep balance. At the same time, doing kicks of different directions requires contractions of different muscles, like tensor fascia lata, sartorius and rectus femoris. When doing core strength training, one is supposed to complete most of the movements under unsteady conditions with the help of Swiss ball and balanced pad. Therefore, coordination of muscles and the ability of body to keep balance and steady are improved, resulting in a better performance of Forward Front Kick in Place, Crescent Kick in Place and other items.

(2)When doing Single-leg Front Lever, musculus erector spinae, abdominal rectus abdominis, musculus obliquus externus abdominis and musculi obliquus internus abdominis contract simultaneously, keeping the back straight and vertical. Meanwhile, gluteus maximus, musculi quadriceps femoris and musculi biceps femoris in the lower limbers contract simultaneously, keeping balance of legs. The contraction in gluteus maximus of the other side makes the hips tilt upwards and the contractions in erector spinae keep the heads upwards and the back arched. There is little traditional strength training which involves exercise of balance. Here, core strength training, making use of training tools like Swiss ball and balanced pad, is practiced in an unstable condition, which can promote the coordination of the upper and lower limbs and the transmission of muscular strength between multi-joints, and enable the whole kinematic chain keep a state of high efficiency. Core strength training can better stabilize spine and pelvis to strengthen controllability and balance, increase power output and further improve the coordination of limbs, so as to prevent athletes from being injured[13]. Therefore, the duration of Single-leg Front Lever is enhanced greatly under a stable condition.

(3) Whirlwind Kick 540 --Horse Stance and Outward Lotus Kick 540 – Horse Stance are difficult movements in Wushu, which incurs higher standards of physical coordination and controllability. The take-off, rotation, and touchdown are all closely related to core muscle groups. Core muscle groups undergo moderate stretch before the take-off; high-level physical stability and controllability are called for in the rotation through the air; strong core muscle groups can be coordinated by the touchdown to buffer the impact and centrifugal force as well as to keep center of gravity stable during the falling. Core muscle groups play an important role in coordinating upper and lower limbs and keeping body balance, which lays a foundation for the successful performance of a series of movements in the take-off and rotation. And at the same time, under the influence of constantly changing reactive force of supporting, core muscles force the body to make continuous adjustments to unstable physical conditions so as to improve the proprioceptive sensibility of nerve-muscle, which can further activate and assemble more muscle fibers that will participate in muscle contraction. The improvement in the stability of core muscle groups is of key support to the completion of movements of Wushu forms athletes, in that coordination and control of center of gravity in quick movements is the key factor in completing the difficult movements.

4 Conclusion

(1)The control group of the teenage Wushu forms athletes, after 16 weeks of two- phased traditional strength training including ribs for lifting legs, sit-ups and weight-bearing squat, have experienced, to varying degrees, improvements in 30-second Supine up from Both Ends, 10-second Forward Front Kick in Place, 10-second Crescent Kick in Place, 10-second Front Kick In Motion, 10-second Crescent Kick In Motion and the duration of Single-leg Front Lever as well as the success rates of the two difficult movements. However, there is no difference according to the statistical test, which shows that the core strength of the control group has not improved significantly.

(2)The teenage Wushu forms athletes in the experimental group took 16 weeks of two-stage core strength training including Hip Thrust, Lying Leg Raise and Abdominal Curl, Single Elbow Push-up and Abdominal Curl, and Push-ups on Swiss Ball and Ball Rotation, and have obtained improvements in 30-second Supine up from Both Ends, 10-second Forward Front Kick in Place, 10-second Crescent Kick in Place, which indicates that their core stability and balance are enhanced to some extent.

(3) An indirect evaluation of the core strength is made based on the comparison of athletes' stability and sense of balance before and after the experiment so as to study the change of the core strength. After the 16-week training, there arises a striking disparity of all indexes entailed between the experimental group and the control group, indicating that the movements that we have designed are more beneficial than those of the traditional strength training in enhancing the core stability as well as the core strength of the teenage Wushu forms athletes.

5 Suggestions

(1) Core strength training can prevent the negative effects of overload on teenagers, effectively coordinate the movements of their upper and lower limbs, and stabilize and control the balance of the body. Core strength training should be based on the characteristics of youth athletes and sports programs, progressively and pointedly selecting the most effective training method, which is worthy of further research and application.

(2) Traditional strength is the basis of the core strength. Compared with the traditional strength, although the core strength training can better improve the balance and controllability on the body, it cannot totally replace the traditional strength training. To obtain the most ideal effect of training, it is supposed to combine them together to make a comprehensive application.

Acknowledgements:

This work was supported by the Research Funds of Higher Vocational Education in Changzhou University(No. CDGZ2020001).

References:

[1] Xie ZW. The Research Status and Rational Analysis of Core Stength Training. *J Journal of Chengdu Sport University*, 2017; 43: 62-69 .

[2] Deng Dl. Study on Training Method of Core Strength of Wushu Routine. J *Journal of National Traditional Sports* 2017; 7: 199-201.

[3] Lv SX. On the Problems and Its Causes of Traditional Wushu. *J Journal of Wu Dang* 2014; 2:38-40.

[4] LS. Comparison of the Vertee and Just Jump system for measuring height of vertical jump for young children. *J Perceptual and Motor Skills*, 1998; 86:659-662.

[5] Teford et al. A simple method for the assessment of general fitness: the tri-level profile. *J Australian of Science and medicine in sport* 1989; 27:20-24.

[6] Zhang YB. Modern Physical Training Methods. *M Beijing Sport University Press*; 2006.

[7] GREGORY DM, KEVIN RF, JOSEPH PP, et al. Neuromuscular Training Improves Single-limb Stability in Young Female Athletes. *J Orthop Sports Phys Ther* 2004; 34:305-316.

[8] PAUL W. HODGES A E, MARTIN E, et al. Intra-abdominal Pressure Increases Stiffness of the Lumbar Spine J. *J Biomechanics* 2005; 38: 1873-1880.

[9] Li YM, Yu HJ Zi W, etc. On the Core Strength and Its Application in the Competitive Sports---the Function and Methods of Its Origin, Problem and Development. *J China Sport Science*, 2008, 28:19-25.

[10] Zhou XQ, Zhang DQ. An Experimental Study on the Role of Core Strength Training in Improving the Speed of the Sanda Atheletes. *J Journal of Shandong Sport University* 2010; 5:66-68.

[11] Yan XH. On the Aplication of Core Stength Training in College Gymnastics Teaching. *J Journal of Heilongjiang Administrative Cadre Institute of Politics and Law* 2016; 6:159-160.

[12] Du ZC. On the Core Strength Training of the Fencer. *J Journal of Sports Science Research* 2007;28:72-74.

[13] He JW, Zhao GG.. A Study of Feasibility of the Treatment of Strength Training to the Atheletes' Lumbar Musle Strain. *J Journal Of Yangtze University* 2010;33: 403-404.

*** Corresponding author:** Huidi Zhao*