



**EFFECT OF CORE STRENGTH TRAINING ON C-LEVEL DIFFICULTY
MOVEMENTS OF WUSHU ROUTINE ATHLETES**

By

LI LONG

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfilment of the Requirements for the Degree of Doctor of Philosophy**

January 2023

FPP 2023 9

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DEDICATION

Dedicated With Love
To
My Kind Father, Li Ding Quan
&
My Beloved Mother, Zhang Cai Xia
For Their Endless Love, Support and
Sacrifices



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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

EFFECT OF CORE STRENGTH TRAINING ON C-LEVEL DIFFICULTY MOVEMENTS OF WUSHU ROUTINE ATHLETES

By

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January 2023

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The C-level difficulty movement refers to the complicated jumping movement stipulated in the wushu rules of the competition set. This study examines the effect of 12 weeks of core strength training on C-level difficulty movements of routine wushu athletes. Forty-two elite wushu athletes, twenty-one (21) in the experimental and 21 in the control groups, respectively, were randomly selected for this study. The core strength training intervention imitated the movement modes of wushu athletes, like run-up, take-off, air spin, and landing stability. In this study, the control group followed the routine training designed by the wushu training center. The experimental group completed 12 weeks of core strength training, 30 minutes per week, and three tests. The pre-test was conducted before starting the intervention (week 0), the second test (week 7), and the third test (week 13). For the variables in terms of run-up, take-off, air spin, and landing stability of the Whirl Wind Kick at 720°, the GEE results of the participants revealed that the group had a substantial effect. These results indicate that there was a statistically significant difference in the run-up performance between the groups ($\chi^2=672,988$, $p<0.001$), take-off ($\chi^2=787.728$, $p<0.001$), air spin ($\chi^2=310.456$, $p<0.001$), and landing stability ($\chi^2=784,774$, $p<0.001$), respectively. Meanwhile, for run-up, take-off, air spin, and landing stability of the Movement Revolving Turn at 720°, the GEE results of the participants revealed that the group also had a substantial effect. These results indicate that there was a statistically significant difference in the run-up performance between the groups ($\chi^2=18187.46$, $p<0.001$), take-off ($\chi^2=28.041$, $p<0.001$), air spin ($\chi^2=142031.199$, $p<0.001$), and landing stability ($\chi^2=41451.042$, $p<0.001$), respectively. For the variables in terms of run-up, take-off, air spin, and landing stability of the Outward Leg Swing in Flight at 720°, the GEE results of the participants revealed that the group had a substantial effect. These results indicate that there was a statistically significant difference in the run-up performance between the groups ($\chi^2=2753.107$, $p<0.001$), take-off ($\chi^2=3851.754$, $p<0.001$), air spin ($\chi^2=16315.333$, $p<0.001$), and landing stability ($\chi^2=13337.705$, $p<0.001$), respectively. These results showed that the 12-week core strength training significantly improved the C-level difficulty movements

of routine wushu athletes. This study can be a source or reference for future researchers who intend to evaluate the effect of core training, especially among wushu players.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESAN LATIHAN KEKUATAN TERAS TERHADAP KESUKARAN TAHAP C DALAM PERGERAKAN RUTIN WUSHU

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Pergerakan kesukaran tahap C merujuk kepada pergerakan lompatan yang rumit yang ditetapkan dalam peraturan wushu dari set pertandingan. Kajian ini mengkaji kesan latihan kekuatan teras selama 12 minggu pada pergerakan kesukaran tahap C atlet wushu rutin. Empat puluh dua atlet wushu elit, masing-masing 21 dalam kumpulan eksperimen dan 21 dalam kumpulan kawalan, dipilih secara rawak untuk kajian ini. Intervensi latihan kekuatan teras meniru mod pergerakan atlet wushu seperti larian, lepas landas, putaran udara, dan kestabilan pendaratan. Dalam kajian ini, kumpulan kawalan mengikuti latihan rutin yang dirancang oleh pusat latihan wushu. Kumpulan eksperimen pula menjalani latihan kekuatan teras selama 12 minggu, 30 minit seminggu, dan tiga kali ujian. Pra-ujian dilakukan sebelum memulakan intervensi (minggu 0), ujian kedua (minggu 7), dan ujian ketiga (minggu 13). Untuk pemboleh ubah dari segi larian, lepas landas, putaran udara, dan kestabilan pendaratan Whirl Wind Kick pada 720°, hasil keputusan GEE para peserta menunjukkan bahawa kumpulan tersebut mempunyai kesan yang teguh. Keputusan ini menunjukkan bahawa masing-masing terdapat perbezaan yang signifikan secara statistik dalam prestasi larian ($\chi^2=672,988$, $p<0,001$), lepas landas ($\chi^2=787,728$, $p<0,001$), putaran udara ($\chi^2=310,456$, $p<0,001$), dan kestabilan pendaratan ($\chi^2=784,774$, $p<0,001$) antara kumpulan. Sementara itu, untuk larian, lepas landas, putaran udara, dan kestabilan pendaratan Movement Revolving Turn pada 720°, hasil keputusan GEE para peserta menunjukkan bahawa kumpulan itu juga mempunyai kesan yang teguh. Keputusan ini menunjukkan bahawa masing-masing terdapat perbezaan yang signifikan secara statistik dalam prestasi larian ($\chi^2=18187,46$, $p<0,001$), lepas landas ($\chi^2=8,041$, $p<0,001$), putaran udara ($c^2=142031,199$, $p<0,001$), dan kestabilan pendaratan ($\chi^2=41451,042$, $p<0,001$) antara kumpulan. Untuk pemboleh ubah dari segi larian, lepas landas, putaran udara, dan kestabilan pendaratan Outward Leg Swing in Flight pada 720°, hasil keputusan GEE para peserta menunjukkan bahawa kumpulan tersebut mempunyai kesan yang teguh. Keputusan ini menunjukkan bahawa masing-masing terdapat perbezaan yang signifikan secara statistik dalam prestasi larian ($\chi^2=2753,107$, $p<0,001$), lepas landas ($\chi^2=3851,754$, $p<0,001$), putaran udara ($\chi^2=16315,333$, $p<0,001$), dan kestabilan pendaratan ($\chi^2=13337,705$, $p<0,001$) antara kumpulan. Hasil kajian ini

menunjukkan bahawa latihan kekuatan teras 12 minggu secara signifikan meningkatkan pergerakan kesukaran tahap C atlet wushu rutin. Kajian ini boleh menjadi sumber atau rujukan bagi penyelidik masa depan yang berhasrat untuk menilai kesan latihan teras, terutama dalam kalangan pemain wushu.



ACKNOWLEDGEMENTS

“The grace of dripping water should be reciprocated by a gushing spring.” Grateful to meet you, Grateful to have your help along the way. Let me have an unforgettable experience, and this will be the most incredible wealth of my life.

With a profound sense of devotion, I would like to thank most sincerely Professor Dr. Soh Kim Geok, my major lecturer and chair of my supervisory committee, for her guidance and support not only in accomplishing this research work and doctoral level studies at University Putra Malaysia but also in other aspects throughout the entire stay in Malaysia. The impression of her motherly attitude, insightful instructions, valuable comments, and legitimate help will never go unremembered. I would also like to extend my sincere thanks and appreciation to Professor Dr. Othaman Talib, Dr. Muhammad Taufik Hidayat and the members of my supervisory committee for their helpful advice, guidance, constructive comments, and encouragement during my study.

I want to convey my sincere gratitude, appreciation, and thanks to the individuals who assisted and contributed to the successful completion of this study. Most of all, I am very much grateful to express my deep feelings of true love and respect for my beloved and lovely parents for having me, for their understanding in giving me the freedom to choose my life path, and for their endless love, support, and sacrifices. Deep in my heart, I would also like to acknowledge my love and understanding of my wife and daughter.

May blessing be upon all of you!

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

CNKI	China National Knowledge Internet
CRCT	Cluster Randomized Controlled Trial (CRCT)
1RM	One-Repetition Maximum
FITT	Frequency, Intensity, Time, Type



CHAPTER 1

INTRODUCTION

1.1 Background

Wushu is a popular and trendy sport in China. Its training methods and contents have changed over thousands of years of inheritance (Li, 2007). From the earliest cold weapon era to the present, the function of the wushu has changed from actual combat to performance, and its content has changed from practical to beautiful (Li, 2021). The competitive wushu routine is one of them (Ding, 2016).

The competitive wushu routine comprises difficulty, quality, and level points (Liu, 2021). Competitive wushu originated in the middle of the 19th century and can be described as the result of the fusion of Chinese and Western sports (Long, 2022). Modern competitive wushu is an important event in the development of Chinese wushu in the 20th century (Long, 2022). Wushu routine exercises are primarily demonstrated as follows: the new routine structure, fast movement speed, increased load, beautiful shape, higher altitude, more complicated (720° in the air), and smooth landing (Long, 2022). Athletes must have comprehensive physical quality and good physical fitness and meet higher standards for body control and balance (Gao, 2016).

The difficulty of competitive wushu jumping is constantly increasing as competitive wushu routines become high, complex, beautiful, and new (Li, 2022). The 2003 revision of the wushu rules has made some reforms to the complex (difficulty) movements of wushu routine jumping, the designated actions are canceled, and the difficulty coefficient is set (Yang, 2021). However, the development of competitive wushu in most parts of China is not optimistic (Wei, 2012). The development of wushu theory and movement techniques, particularly the training theory of C-level jumping difficult movements, lags (Wei, 2012). Thus, the exploration of training methods for C-level jumping difficult movements is a new cognition of the existing wushu theories and a supplement and improvement of the existing theories (Zhu, 2006).

C-level difficulty movements refers to the complicated (highly challenging) jumping movement stipulated in the wushu rules of the competition set, including wushu C-level difficulty movements, Whirl Wind Kick at 720° , Movement Revolving Turn at 720° , Outward Leg Swing in Flight at 720° , Side air rotations at 720° , Dragon on the Ground 540° , skyward (upward) sole kick 180° , Whirl Wind 540° one foot landing (Zhu, 2006). The difficult jumping movements are crucial to the competitions of wushu sets and represent their artistic and technical values (Wang, 2014). The C-level difficulty movements is the primary basis for evaluating the competitive wushu set's technical level and value. Complex jumping movements are also the primary focus of the competitive wushu routine's future development (Wang, 2014). The C-level wushu difficulty movement is a complex whole. Insufficient run-up speed leads to a lack of take-off height, which results in insufficient rotation degree in the air, and finally leads to an

unstable landing (Hu, 2020). Therefore, it is significant to promote the strength level of wushu routine athletes through core strength training (Li, 2010).

Core strength training is a form of strength training. The core power was early called "Spine Stability" and it later raised the "medium spine" (Panjabi, 1992). It has further deepened research on "Spine Stability". The "Core Stability" concept refers to the ability to maintain the body stable and control the central region between the spine within a physiological range, namely, core stability content in competitive sports training. Trunk support was proposed to elicit core strength (Gates et al., 2005).

Core strength training connects the upper and lower limbs to coordinate movement and improve neuromuscular coordination and control ability in time and space (Zhou, 2022). The ability training should emphasize coordination, balance and stability and instability, fast and accurate conversion between balance and imbalance, and conversion between no-load and light load (Wu, 2019). Based on the characteristics of the wushu competition routine, core strength training can improve the athlete's core stability, the aerial athlete's body posture control, limb control, thereby improving the athlete's technical level and performance (Ma, 2021).

1.2 Problem Statement

The Chinese wushu development is relatively mature, but the competitive wushu development in many regions of China is not optimistic (Wu, 2019). Wushu requires many kinds of physical qualities (Hu, 2020). Simultaneously, wushu C-level complex (difficult) movements also influence the wushu athlete's competitive performance. Wushu C-level difficulty movements are the basis of competitive wushu routines (Zhou, 2003). The C-level difficulty movements are the key to demonstrating artistic beauty and value and providing the most spectacle in wushu competition (Yang, 2016). In the past, the traditional training mode was sufficient but not obvious, leading to many wushu athlete's mistakes, injuries, and even retirement from the competition (Chen, 2013). Currently, wushu athletes are performing poorly. According to the previous research, this study discovered that wushu athletes have the following problems: (i) Wushu C-level difficulty movements problems (Dong, 2011); (ii) Physical fitness problems (Lack of core strength) (Zhuang, 1997); (iii) Training method problems (Zhang, 2021).

Some scholars believe completing the C-level difficulty movements of wushu displays the following problems. First, a lack of run-up speed leads to a lack of good sprinting ability in wushu athletes when doing C-level difficult wushu because the run-up speed is the primary condition for doing the C-level difficult wushu (Liu, 2010). Second, the take-off height is insufficient, preventing wushu athletes from completing the corresponding actions and requirements in the air (Liu, 2010). Third, the degree of rotation in the air is insufficient, leading directly to the failure of the wushu C-level difficulty movements and increasing the risk of injury among wushu athletes (Gao, 2008). Finally, the body appears shaky or jumpy after landing. These jerky or jumpy body movements increase the penalty points of wushu athletes in the competition

process. Wushu athletes cannot get better results in the competition process (Gao, 2008). These problems are closely related to core strength training.

However, some scholars believe that wushu athletes have physical deficiencies, such as insufficient strength, endurance, flexibility, and agility. These problems lead to unbalanced and uncoordinated movements. Wushu requires fast speed and steady momentum in its movements. It needs fast speed and enough strength to demonstrate wushu's distinctive rhythm and specific requirements to complete an action (Li, 2016).

Additionally, some scholars discovered that traditional training methods could not improve the performance of wushu athletes' C-level difficulty movements (Zhuang, 1997). Because the traditional strength training mode has the following problems:

- i. Different training methods and means: the essential feature of traditional strength training is that the body's center of gravity is in a relatively stable state during the training process, but in our actual exercise process, most of them are in an unstable state, which can easily lead to the loss of strength gained through regular training. Core strength training utilizes a Swiss ball, a balance board, and additional training equipment to compensate for this defect (Zhang, 2021).
- ii. Different training effects: traditional strength training lacks static exercises. Dynamic and high-intensity training is essential but can easily cause joint and muscle damage. Static training is primarily employed in the introductory stage of core strength training to enhance the tensile capacity and core stability of muscles and joints and make basic preparations for future strength training (Zhang, 2021).

The core strength training theory is new in sports training (Zhang, 2013). The core strength training theory is applied to sports training. It improves joint and muscle building in the body's core, transmit, and control strength under stable and unbalanced conditions (Hibbs et al., 2008). Core strength training is a kind of high-load and dynamic training mode that can cause muscle hypertrophy and enhance the nerve activation of sports units, increasing muscle strength and density, thus increasing in core strength to improve performance, significantly speed, sensitivity, and strength (Hibbs et al., 2008). According to previous studies, core strength training methods have improved the performance of athletes such as taekwondo, Muay Thai, boxing, karate and Sanda. Few studies focus on wushu, especially wushu C-level difficulty movements, so the study examines the effect of core strength training on C-level difficulty movements of wushu routine athletes.

1.3 Objectives

This study's research objectives are divided into general and specific objectives.

1.3.1 General Objective

The primary objective of this study is to examine the effect of 12 weeks of core strength training on C-level difficulty movements of wushu routine athletes.

1.3.2 Specific Objectives

Based on the general objective, the specific objectives are as follows:

- i. Examine the effect of core strength training across the baseline, post-test one, and post-test two on wushu routine athletes in Whirl Wind Kick at 720° of professional wushu athletes in Ningxia, China.
- ii. Examine the effect of core strength training across the baseline, post-test one, and post-test two on wushu routine athletes in Movement Revolving Turn at 720° of professional wushu athletes in Ningxia, China.
- iii. Examine the effect of core strength training across the baseline, post-test one, and post-test two on wushu routine athletes in Outward Leg Swing in Flight at 720° of professional wushu athletes in Ningxia, China.

1.4 Hypotheses

This study's research hypotheses is divided into a general and specific hypotheses.

1.4.1 General Hypothesis

This study's main hypothesis is to evaluate whether the 12-week core strength training significantly impacts the competitive wushu routine in Whirl Wind Kick at 720°, Movement Revolving Turn at 720°, and Outward Leg Swing in Flight at 720° of professional wushu athletes in Ningxia, China.

The specific null hypotheses associated with the first objective are:

- H01 : There is no significant difference between the control and experiment groups in the run-up of Whirl Wind Kick at 720° among professional wushu athletes in Ningxia, China.
- H02 : There is no significant difference between the control and experiment groups in the take-off of Whirl Wind Kick at 720° among professional

wushu athletes in Ningxia, China.

- H03 : There is no significant difference between the control and experiment groups in air spin of Whirl Wind Kick at 720° among professional wushu athletes in Ningxia, China.
- H04 : There is no significant difference between the control and experiment groups in landing stability of Whirl Wind Kick at 720° among professional wushu athletes in Ningxia, China.

The specific null hypotheses associated with the second objective are:

- H05 : There is no significant difference between control and experiment groups in the run-up of Movement Revolving Turn at 720° among professional wushu athletes in Ningxia, China.
- H06 : There is no significant difference between control and experiment groups in the take-off of Movement Revolving Turn at 720° among professional wushu athletes in Ningxia, China.
- H07 : There is no significant difference between control and experiment groups in the air spin of Movement Revolving Turn at 720° among professional wushu athletes in Ningxia, China.
- H08 : There is no significant difference between control and experiment groups in the landing stability of Movement Revolving Turn at 720° among professional wushu athletes in Ningxia, China.

The specific null hypotheses associated with the third objective are:

- H09 : There is no significant difference between control and experiment groups in the run-up of Outward Leg Swing in Flight at 720° among professional wushu athletes in Ningxia, China
- H010 : There is no significant difference between control and experiment groups in the take-off of Outward Leg Swing in Flight at 720° among professional wushu athletes in Ningxia, China.
- H011 : There is no significant difference between control and experiment groups in the air spin of Outward Leg Swing in Flight at 720° among professional wushu athletes in Ningxia, China.
- H012 : There is no significant difference between control and experiment groups in the landing stability of Outward Leg Swing in Flight at 720° among professional wushu athletes in Ningxia, China

∴

1.5 Significance of Study

1.5.1 Theoretical Significance

Core strength training is a kind of high load and dynamic training mode that can hypertrophies muscles. Muscle hypertrophy can increase muscle strength and density, improving core strength and sports performance, especially speed, agility, and strength (Hibbs et al., 2008). To summarise, this theoretical model is suitable for general sport and part physical components, but this theory does not focus on wushu therefore, this study is theoretically significant because it investigates the impact of core training on the C-level complex (difficult) movements run-up, take-off, air spin and landing of wushu routine athletes.

1.5.2 Practical Significance

This study aims to design a 12-week core strength intervention plan based on the effect of core strength training on C-level difficulty movements of wushu routine athletes. The primary stage of core strength training lasts 1–4 weeks, the consolidation stage lasts 5–8 weeks, and the improvement stage lasts 9–12 weeks. The purpose is to improve the run-up, take-off, air spin, and landing of wushu C-level difficulty movements through core strength training to promote the development of wushu C-level difficulty movements. Therefore, wushu coaches or researchers can use this 12-week core training plan to help wushu athletes achieve better results in wushu C-level difficulty movements training. This study also can be a source or reference for future researchers who intend to evaluate the effect of core training, especially among wushu players.

1.6 Delimitations

This study selected 20–22-year-old wushu athletes because they require approximately 10 years of training before joining a professional team. Training wushu with C-level difficulty movements is a long process and cannot be completed without some basic wushu skills. There are seven C-level difficulties movements in wushu, and only three of them (Whirl Wind Kick at 720°, Movement Revolving Turn at 720°, Outward Leg Swing in Flight at 720°) are selected in this study because they are the most widely used. They are mainly used in the competitive wushu routines of long boxing, knives, guns, batons, and swords, and the other four are only used in Taijiquan and Nanquan.

1.7 Limitations

In addition to practical training, a study affirmed that diet might influence sport performance to some degree (Zhang, 1998). In the context of this study, there were no significant differences in the diet between the two groups because the food was provided for all the members of the Ningxia wushu professional team. Meanwhile, both groups were not allowed to go out during the experiment and could only eat in the canteen. During the training with three times a week, the diet is mainly based on high-protein

food such as chicken, beef and seafood, and supplemented by some vegetables. In addition, these participants promised to eat regularly and they all signed the Informed Consent Form (ICF). Therefore, a diet had minimal effects on this study (Appendix A).

1.8 Definition of Terms

This section defines the key terms used in this study.

1.8.1 Core Strength Training

Terminology: Core strength training is based on the lumbar pelvic joints, which can effectively stabilize the conduction force, generate force, or reduce buffers, and maintain human movement balance (Willardson, 2007). The erector spinal muscles, pelvis, and bone joints are essential to the stability of the human spine and pelvis (Hong, 2019). These muscles are antagonistic to the abdominal muscles. They coordinate the human body's static and dynamic movements to complete a variety of technical movements that provide the necessary support (Willardson, 2007). The skeletal structure of the pelvic girders, the stable normal position that connects the pelvic muscles, is fundamental, especially for lower limb acceleration, deceleration, and skeletal joint adduction and abduction exercises (Hong, 2019).

Operational: This study's core strength training scheme includes static support under stable and unstable states and dynamic motion under stable and unstable states. Core strength training is divided into seven difficulty levels: static training under a stable state, no-load training, special strength training in the core area, static training under an unstable state, training to overcome resistance, free strength training, and explosive force training in the core area. Core strength training with a balanced plate, air cushion, fitness ball, suspender, and skateboard under an unstable state.

1.8.2 Wushu

Terminology: Wushu is a traditional Chinese sport event focusing on internal and external training. It consists primarily of practice routines and the techniques of attack and defense as its primary content. Wushu belongs to traditional Chinese defense and attack. It is to kick, hit, fall, take, hit, stab, and other techniques of attack and defense as the main content, through bare hands or with the help of a weapon to show the ability of attack and defense. The confrontational fighting and routine sports are based on the traditional Chinese defense and attack technique (Li, 2007).

Operational: Competitive wushu is a high-level wushu competition, a wushu training competition activity that aims to maximize personal sports potential and achieve excellent results. It is characterized by specialization, professionalism, high level, overload, and outstanding competitiveness. The movements of the competitive wushu routine include bending, stretching, looping, balancing, jumping, tumbling, and falling. Almost all body parts must participate in the movement.

1.8.3 Wushu Routines

Terminology : Wushu routines are a series of action combinations with the meaning of attack and defense. They are a complete set of exercise forms based on the material of attack actions and the changing laws of contradictory movements such as attack and defense, movement and static movement, hardness, softness, emptiness and reality. Wushu routines are divided into competitive wushu routines and traditional wushu routines, competitive wushu routines are include long punch and weapons, and traditional wushu routines are include traditional punch and weapons (Li, 2018).

Operational: The wushu routines in this study are competitive wushu routines, mainly including boxing and equipment. Boxing is divided into Changquan (optional), Taijiquan (optional) and Nanquan (optional), and equipment is divided into, Knives (optional), Guns (optional), Batons (optional), Sword (optional), Taiji sword (optional), Southern Broadsword, (optional), Southern Staff (optional). These routines must have the balance movements, sweeping and turning legs, difficult movements and throwing and catching movements of equipment specified in the wushu rules.

1.8.4 Wushu C-Level Difficulty

Terminology : Wushu C level difficult moves refer to the special skills and physical strength required to complete difficult moves (Zhang, 2006). Wushu C-level difficulty movement is a fulcrum of human space compound axis rotation (Liu, 2008). There are seven types of wushu C-level difficulty movement, Whirl Wind Kick at 720°, Movement Revolving Turn at 720°, Outward Leg Swing in Flight at 720°, Side air rotations 720°, Dragon on the Ground at 540°, skyward (upward) sole kick 180°, Whirl Wind at 540°one foot landing. C-level difficulty movement structure is complex. According to the action of phase, the entire action is divided into run up, take off, air spin, and landing (Gao, 2008).

Operational: Wushu C-level difficulty movement studied in this this study are as follows: Whirl Wind Kick at 720°, Movement Revolving Turn at 720°, Outward Leg Swing in Flight at 720°

1.8.5 Wushu Athletes

Terminology : People specially engaged in wushu events registered by the Wushu Sports Management Center of the General Administration of Sport of China (Gao, 2022). Wushu athletes are divided into wushu routine athletes (Athletes of competitive wushu routines and traditional wushu routines) and wushu Sanda athletes.

Operational: The wushu athletes in this study are from healthy male athletes of Ningxia wushu professional team, aged between 20 and 22. They have accepted 8-9 years of

basic wushu practice, and have a certain level of wushu practice. 100% of wushu athletes have sports qualifications above the national level II.



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Appendix B

PRISMA Flow Chart of the Study Selection Process

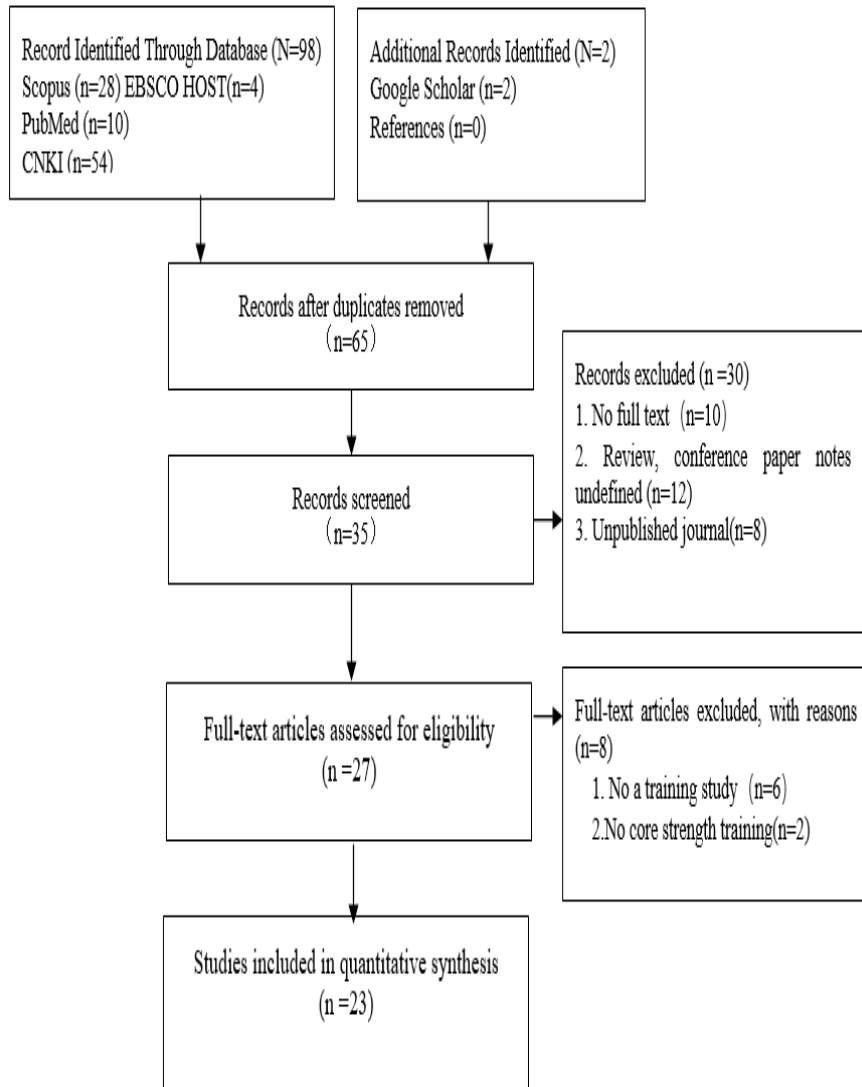
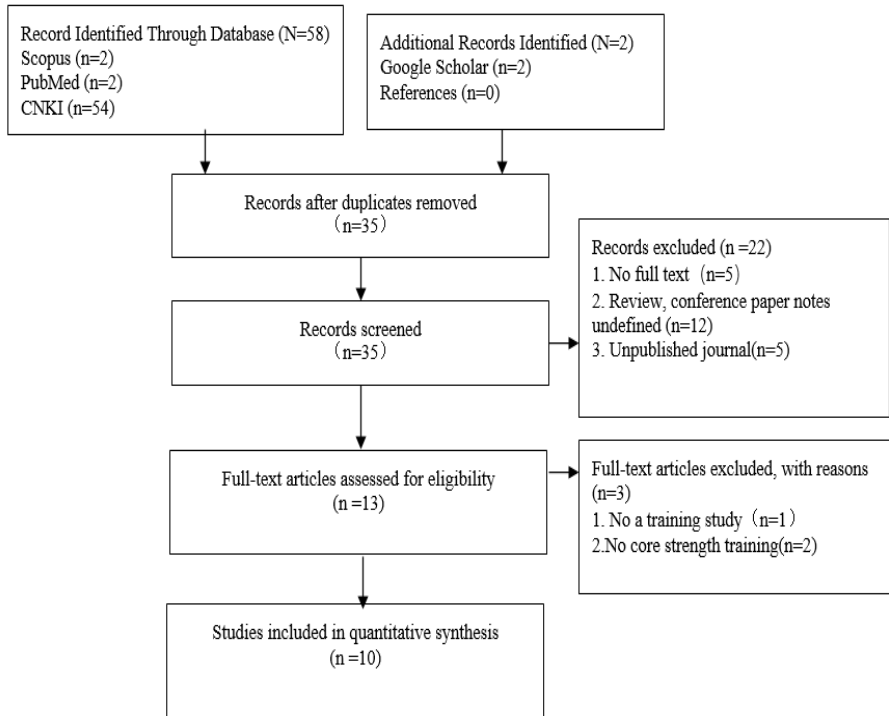


Figure 1 : PRISMA Flow Chart of The Study Selection Process

Appendix C

PRISMA Flow Chart of the Study Selection Process



Article Publishing Details

Journal of Positive School Psychology
2022, Vol. 6, No. 5, 1744 – 1756

<http://journalppw.com>

Effect of Core Strength Training on Wushu Performance: A Systematic Review

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Abstract

Core strength training has a conspicuous effect on the performance of Wushu. The primary purpose of this paper is to summarize the effect of core strength training on Wushu Sanda, traditional Wushu routines, and competitive Wushu routines. Heretofore, there is no systematic evaluation report on the performance of Wushu's core strength. Extant literature shows that core strength training can promote the performance of Sanda and set Wushu. However, the lack of influence of core strength training is the most noteworthy challenge associated with competitive Wushu routine. In the current literature, there are insufficient conclusions on the influence of core strength training on Wushu performance. In recent years, the development direction of competitive Wushu routines has been dominated by high-difficulty movements. If there is a lack of high-difficulty movements in competitive Wushu routines, athletes will not have good results in competitions. This has necessitated a rigorous literature review to evaluate the influence of core strength training on the performance of Wushu.

Keywords: Core strength training, Wushu, Sanda, Performance.

1. INTRODUCTION

Core strength training has become a vital form of athletic training recognized by coaches and athletes. It was proposed by American scholars in 2005 [1]. It can help improve the waist strength and spine stability of Wushu athletes, which in turn can improve the explosive power, movement speed, and movement balance ability of Wushu athletes [2].

Core strength training refers to the training of deep and shallow muscles in the core area of the human body. The trunk, especially the waist position of the human body, is a critical anatomical part of the human movement system. It is a link connecting the upper and lower limbs of the human body. It plays a

prime role in stabilizing and balancing the body's center of gravity, cooperating in participation, and transmitting power [32]. Core strength training enhances the core strength of athletes through muscle, nerve, and other aspects. The methods, contents, and means of core strength training are relatively affluent. Wushu is a more complex whole-body sport and is largely dependent on human trunk muscle groups, which is reflected in the strength level of muscle groups (strength, explosive power, and endurance) and the ability to participate in sports to maintain body static and dynamic balance. It selectively strengthens the strength of trunk muscle groups, and their collaborative training of Wushu athletes, will receive the anticipated effect [40].

Appendix D

Sample Size Calculation

Table 1 : Effect Size Calculation for Research Variables

Variables	Baseline Mean SD	Posttest 1 Mean SD	Effect size (f) Mean SD	Reference
Speed 20 m (s)	3.23 (0.16)	3.30 (0.17)	0.43	Paul Macadam, 2017
The high jump (Technical level)	36.13 (3.53)	46.17 (2.81)	1.69	Doaa Mohamed Mohy El Din 2016
The high jump (Digital level)	60.00 (8.21)	98.13 (5.28)	2.71	Doaa Mohamed Mohy El Din 2016
Squat movement (Slow)	122.31 (9.04)	131.94 (36.43)	1.08	MATTHEW R. RHEA 2009
Squat movement (Fast)	115.94 (36.07)	119.18 (35.56)	0.38	MATTHEW R. RHEA 2009
FACC	116.00 (31.43)	125.81 (30.69)	1.10	MATTHEW R. RHEA 2009
Relative 1RM squat (kg/kg BW)	1.92 (0.25)	2.17 (0.55)	0.24	Erik CH Tan 2017
CMJ height (cm)	44.0 (8.4)	48.4 (9.7)	0.41	Erik CH Tan 2017
CMJ peak power (W)	3122.5 (849.2)	3445.0 (936.2)	0.30	Erik CH Tan 2017
CMJ rel. peak power (W/kg BW))	55.6 (10.3)	59.5 (10.9)	0.32	Erik CH Tan 2017
CMJ peak force (N)	1373.5 (217.1)	1921.4 (392.9)	0.37	Erik CH Tan 2017
CMJ rel. peak force (N/kg BW)	24.7 (1.8)	33.6 (5.5)	0.72	Erik CH Tan 2017
CMJ peak velocity (m·s ⁻¹)	2.93 (0.26)	3.13 (0.30)	0.61	Erik CH Tan 2017
SJ height (cm)	38.5 (7.6)	41.5 (10.0)	0.26	Erik CH Tan 2017

Test family: F tests

Statistical test: ANOVA: Repeated measures, within-between interaction

Type of power analysis: A priori: Compute required sample size - given α , power, and effect size

Input Parameters

Determine =>

Effect size f	0.24
α err prob	0.05
Power (1- β err prob)	0.8
Number of groups	2
Number of measurements	2
Corr among rep measures	0.5
Nonsphericity correction ϵ	1

Output Parameters

Noncentrality parameter λ	8.7552000
Critical F	4.1131653
Numerator df	1.0000000
Denominator df	36.0000000
Total sample size	38
Actual power	0.8210017

Options X-Y plot for a range of values Calculate

Appendix E

Body Shape Instruments

This test mainly includes height, weight. (National institutional health standards 2010)

(i) Measurement requirements: Participants were measured on an empty stomach in the morning. Their height was measured in cm, accurate to 0.1 cm, and their weight was measured in kg, accurate to 0.1 kg.

(ii) Measuring method: Participants are required to take off their shoes and hats, stand on the floor of the height meter with their back to the column, with their bodies naturally straight, their heads upright, their eyes looking straight ahead, their arms naturally drooping, their legs straight, and their feet close together. Their height and weight were recorded.

Appendix F

Details of Method Validation

Content	Reference
Run-up	Chinese Wushu Association, 2012
Take-off	Chinese Wushu Association, 2012
Air spin	Chinese Wushu Association, 2012
Landing stability	Chinese Wushu Association, 2012



Appendix G

Basic Information About the Evaluation Expert

Number	Name	Title	Areas of Study	Occupation
1	Mao ya qi	associate professor	Wushu	Wushu coach
2	Li Wei	associate professor	Wushu	Wushu coach
3	Li Hu	professor	Wushu	Wushu Referee
4	Wang an zhi	professor	Wushu	Wushu Referee
5	Luo bing guang	professor	Wushu	Wushu Referee
6	Gao Tao	professor	Wushu	Wushu Referee

Part I: Core Strength Training Plan. (Weeks 1-4; weeks 5-8; and weeks 9-12)

(1) The first stage is core strength stability exercise

Training time: 30 minutes three times a week for 1-3 weeks

Training content: Plate support, Side brace, Alternate elbow support, Hanging left and right leg swings, Bird dog type. Number and times of training groups.

Table 1 : The first stage is core strength stability exercise

Training Phase	Training Content	Frequency	Sets/Reps	Intensity
Preparation part (5 minutes)	Jogging	3 day/weeks	3/50m	3 minutes
	Neck movement (front, rear, left and right)	3 day/weeks	4/8	30S
	Shoulder movement	3 day/weeks	4/8	30S
	Waist movement	3 day/weeks	4/8	30S
	Lunge leg press	3 day/weeks	4/8	30S
Core strength stability exercise (30 minutes)	Plate support	3 day/weeks	6/12	body weight/5 minutes
	Side brace	3 day/weeks	6/12	body weight/5 minutes
	Alternate elbow support	3 day/weeks	6/12	body weight/5 minutes
	Hanging left and right leg swings	3 day/weeks	6/12	body weight/5 minutes
	Bird dog type	3 day/weeks	6/12	body weight/5 minutes
	One minute break between groups			

Expert score: your evaluation of the six difficulty levels of students' experiment is (the total score is 10 points: 10 points for very applicable, 9 points for more applicable, 8 points for applicable, and 7 points for not applicable.):

- Very applicable (10 points)
- More applicable (9 points)
- Applicable (8 points)
- Not applicable (7 points)

Modification opinions of experts:

(2) The second stage is core strength promotion exercise
 Training time: 30 minutes three times a week for 5-8 weeks
 Training content: Supine leg lift, bow down and row, Barbell top hip, Weight bearing Russian swivel, Alternate high fives with push-ups.
 Number and times of training groups (Table 3)

Table 2 : Contents of Core Strength Training in Week 4-9 Basic Stage

Training Phase	Training Content	Frequency	Sets/Reps	Intensity
Preparation part (5 minutes)	Jogging	3 day/weeks	3/50m	3 minutes
	Neck movement (front, rear, left and right)	3 day/weeks	4/8	30S
	Shoulder movement	3 day/weeks	4/8	30S
	Waist movement	3 day/weeks	4/8	30S
	Lunge leg press	3 day/weeks	4/8	30S
Core strength promotion exercise (30 minutes)	Supine leg lift	3 day/weeks	3/8	80% of IRM
	bow down and row	3 day/weeks	3/8	80% of IRM
	Barbell top hip	3 day/weeks	3/8	80% of IRM
	Weight bearing Russian swivel	3 day/weeks	3/8	80% of IRM
	Alternate high fives with push-ups	3 day/weeks	3/8	80% of IRM
One minute break between groups				

Expert score: your evaluation of the six difficulty levels of students' experiment is (the total score is 10 points: 10 points for very applicable, 9 points for more applicable, 8 points for applicable, and 7 points for not applicable.):

- Very applicable (10 points)
 - More applicable (9 points)
 - Applicable (8 points)
 - Not applicable (7 points)
- Modification opinions of experts:

(3) The third stage is core strength explosive exercise
 Training time: 30 minutes three times a week for 9-12 weeks
 Training contents: Load side turn, Heavy Lunge, Load side lifting, Heavy lifting, seated row. Number and times of training groups

Table 3 : Contents of Core Strength Training in Week 4-9 Basic Stage

Training Phase	Training Content	Frequency	Sets/Reps	Intensity	
Preparation part (5 minutes)	Jogging	3 day/weeks	3/50m	3 minutes	
	Neck movement (front, rear, left and right)	3 day/weeks	4/8	30S	
	Shoulder movement	3 day/weeks	4/8	30S	
	Waist movement	3 day/weeks	4/8	30S	
	Lunge leg press	3 day/weeks	4/8	30S	
	Load side turn	3 day/weeks	3/8	85% of 1RM	
Core strength explosive exercise (30 minutes)	Heavy Lunge	3 day/weeks	3/8	85% of 1RM	
	Load side lifting	3 day/weeks	3/8	85% of 1RM	
	Heavy lifting,	3 day/weeks	3/8	85% of 1RM	
	seated row	3 day/weeks	3/8	80% of 1RM	

Expert score: your evaluation of the six difficulty levels of students' experiment is (the total score is 10 points: 10 points for very applicable, 9 points for more applicable, 8 points for applicable, and 7 points for not applicable.):

- o Very applicable (10 points)
 - o More applicable (9 points)
 - o Applicable (8 points)
 - o Not applicable (7 points)
- Modification opinions of experts:

Control group core strength training

The control group practiced traditional strength exercises for 30 minutes three times a week for 12 weeks

Table 4 : 1-12 Weeks of Traditional Strength Training

Training Phase	Training Content	Time And Frequency
Preparation part (5 minutes)	Jogging	2 minutes 2x50m
	Neck movement (front, rear, left and right)	60S 4x8 groups
	Shoulder movement	60S 4x8 groups
	Waist movement	60S 4x8 groups
	Lunge leg press	60S 4x8 groups
Traditional core strength exercises (30 minutes)	Sit-ups	6 minutesx6 groups
	Back up	6 minutesx6 groups
	Side up (left)	6 minutesx6 groups
	Side up (right)	6 minutesx6 groups
One minute break between groups		

Thank You for the feedback.
Sincerely
Li Long

Appendix I

Training Load Chart

		TRAINING LOAD CHART										
Max reps (RM) →	1	2	3	4	5	6	7	8	9	10	12	
% 1RM Load	100%	95%	93%	90%	87%	85%	83%	80%	77%	75%	70%	
10	9.5	9.3	9	8.7	8.5	8.3	8	7.7	7.5	7		
20	19	18.6	18	17.4	17	16.6	16	15.4	15	14		
30	28.5	27.9	27	26.1	25.5	24.9	24	23.1	22.5	21		
40	38	37.2	36	34.8	34	33.2	32	30.8	30	28		
50	47.5	46.5	45	43.5	42.5	41.5	40	38.5	37.5	35		
60	57	55.8	54	52.2	51	49.8	48	46.2	45	42		
70	66.5	65.1	63	60.9	59.5	58.1	56	53.9	52.5	49		
80	76	74.4	72	69.6	68	66.4	64	61.6	60	56		
90	85.5	83.7	81	78.3	76.5	74.7	72	69.3	67.5	63		
100	95	93	90	87	85	83	80	77	75	70		
110	104.5	102.3	99	95.7	93.5	91.3	88	84.7	82.5	77		
120	114	111.6	108	104.4	102	99.6	96	92.4	90	84		
130	123.5	120.9	117	113.1	110.5	107.9	104	100.1	97.5	91		
140	133	130.2	126	121.8	119	116.2	112	107.8	105	98		
150	142.5	139.5	135	130.5	127.5	124.5	120	115.5	112.5	105		
160	152	148.8	144	139.2	136	132.8	128	123.2	120	112		
170	161.5	158.1	153	147.9	144.5	141.1	136	130.9	127.5	119		
180	171	167.4	162	156.6	153	149.4	144	138.6	135	126		
190	180.5	176.7	171	165.3	161.5	157.7	152	146.3	142.5	133		
200	190	186	180	174	170	166	160	154	150	140		
210	199.5	195.3	189	182.7	178.5	174.3	168	161.7	157.5	147		
220	209	204.6	198	191.4	187	182.6	176	169.4	165	154		
230	218.5	213.9	207	200.1	195.5	190.9	184	177.1	172.5	161		
240	228	223.2	216	208.8	204	199.2	192	184.8	180	168		
250	237.5	232.5	225	217.5	212.5	207.5	200	192.5	187.5	175		

NSCA: Available at : https://www.nsca.com/contentassets/61d813865e264c6e852cadfe247eae52/nsca_training_load_chart.pdf

Appendix J

Validity of Intervention

Original Scale	Recode Scale
9-10	4
6-8.5	3
3-5.5	2
0-2.5	1

Figure 2 : Encoding the Effectiveness of Intervention

Recode Scale	
Recode Scale	New rating Scale
1 or 2	0
3 or 4	1

Figure 3 : Calculation of Intervention re Effectiveness

Item/Expert	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert in Agree	I-CVI
Q1	1	1	1	1	1	1	10	1
Q2	1	1	1	1	1	1	10	1
Q3	1	1	1	1	1	1	10	1
Q4	1	1	1	1	1	1	10	1
Q5	1	1	1	1	1	1	10	1
Q6	1	1	1	1	1	1	10	1
Q7	1	1	1	1	1	1	10	1
Q8	1	1	1	1	1	1	10	1
Q9	1	1	1	1	1	1	10	1
Q10	1	1	1	1	1	1	10	1
Q11	1	1	1	1	1	1	10	1
Q12	1	1	1	1	1	1	10	1
Q13	1	1	1	1	1	1	10	1
Q14	1	1	1	1	1	1	10	1
Q15	1	1	1	1	1	1	10	1
Proportion relevance	1	1	1	1	1	1		

Figure 4 : Content Validity Index Calculation

Appendix K

Detailed Process of Action Measurement of C - Level Difficulty

(Whirl Wind Kick at 720°, Movement Revolving Turn at 720°, Outward Leg Swing in Flight at 720° Run-up, Take-off, Air Spin, Landing stability)

Baseline

1. C-level Wushu Difficulty Run-up

Purpose: The lack of run-up speed will lead to the lack of good sprinting ability of wushu athletes when they are doing C-level difficult of wushu, because the run-up speed is the primary condition for doing the C-level difficult of wushu. The run-up is the preparation for completing the C-level difficulty and the guarantee for the success of the movement quality.

Measuring required: JVC9800 high-speed cameras

Methods

- (i) Wushu athletes are allowed to warm up by running and doing light stretches.
- (ii) Read test requirements to athletes.
- (iii) Using two JVC9800 high-speed cameras, the shooting frequency is 25 frames per second, and three-dimensional fixed-point shooting.
- (iv) Before the actual shooting action, place the frame according to the range of motion of the pre-action, and shoot the frame. One camera is 10 meters away from the intersection of the main optical axis, the other is 12.1 meters away from the main optical axis, the center of gravity of the lens is 1.25m from the ground, and the angle between the two cameras is close to 90°.
- (v) During the action shooting process, the wushu athletes take turns to do the run-up movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.
- (vi) Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.
- (vii) The confirmed movements were intercepted from the video, and six experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese Wushu Association for the confirmation standard of difficult movements and the deduction standard for movement quality. Through repeated observation of the video, a high-quality action of each athlete was determined.

2. C-Level Wushu Difficulty Take-off

Purpose: The take-off height will affect the completion of air movements. The main factors of taking off are the natural height of the body, the posture of the body when taking off from the ground, the swing of the arms and legs, and the initial speed obtained by the body's centre of gravity. Posture is the main factor that affects the height of the body in the air. To obtain a higher height in the air, athletes should obtain a better vertical speed and horizontal speed when taking off.

Measuring required: JVC9800 high-speed cameras

Methods

- (i). Read test requirements to athletes.
- (ii). During the action shooting process, the wushu athletes take turns to do the take-off movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.
- (iii). Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.
- (iv). The confirmed movements were intercepted from the video, and six experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese Wushu Association for the confirmation standard of difficult movements and the deduction standard for movement quality. Through repeated observation of the video, a high-quality action of each athlete was determined.

3.C-Level Wushu Difficulty Air Spin

Purpose: The degree of rotation in the air of C-level difficulty is insufficient, which will directly lead to the failure of the whole movement. As the degree of rotation in the air of C-level difficulty increases, the difficulty also increases.

Measuring required: JVC9800 high-speed cameras

Methods

- (i). Read test requirements to athletes.
- (ii). During the action shooting process, the wushu athletes take turns to do the air spin movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.
- (iii). Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.

(iv). The confirmed movements were intercepted from the video, and six experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese wushu Association for the confirmation standard of difficult movements and the deduction standard for movement quality. Through repeated observation of the video, a high-quality action of each athlete was determined.

4.C-level Wushu Difficulty Landing Stability

Purpose: Landing is the last move of C-level difficulty and landing is an important part of the stability of reaction action. Especially in the game, when players use mobile connection actions, such as falling down on the ground with both feet in turn, both feet moving or jumping are considered to be unqualified.

Measuring required: JVC9800 high-speed cameras

Methods

- (i). Read test requirements to athletes.
- (ii). During the action shooting process, the wushu athletes take turns to do the landing stability movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.
- (iii). Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.
- (iv). The confirmed movements were intercepted from the video, and six experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese wushu Association for the confirmation standard of difficult movements and the deduction standard for movement quality. Through repeated observation of the video, a high-quality action of each athlete was determined.

Posttest 1

1. C-level Wushu Difficulty Run-up

Purpose: After six weeks of core strength intervention, whether the run-up of wushu C-level difficulty movements has been improved.

Measuring required: JVC9800 high-speed cameras

Methods

- (i). Wushu athletes are allowed to warm up by running and doing light stretches.

(ii). Read test requirements to athletes.

(iii). Using two JVC9800 high-speed cameras, the shooting frequency is 25 frames per second, and three-dimensional fixed-point shooting.

(iv). Before the actual shooting action, place the frame according to the range of motion of the pre-action, and shoot the frame. One camera is 10 meters away from the intersection of the main optical axis, the other is 12.1 meters away from the main optical axis, the center of gravity of the lens is 1.25m from the ground, and the angle between the two cameras is close to 90°.

(v). During the action shooting process, the wushu athletes take turns to do the run-up movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.

(vi). Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.

(vii). The confirmed movements were intercepted from the video, and six experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese Wushu Association for the confirmation standard of difficult movements and the deduction standard for movement quality. Through repeated observation of the video, a high-quality action of each athlete was determined.

2. C-Level Wushu Difficulty Take-off

Purpose: After six weeks of core strength intervention, whether the take-off of wushu C-level difficulty movements has been improved.

Measuring required: JVC9800 high-speed cameras

Methods

(i). Read test requirements to athletes.

(ii). During the action shooting process, the wushu athletes take turns to do the take-off movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.

(iii). Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.

(iv). The confirmed movements were intercepted from the video, and 6 experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese Wushu Association for the confirmation standard of difficult movements and the deduction standard for movement quality. Through repeated observation of the video, a high-

quality action of each athlete was determined.

3.C-Level Wushu Difficulty Air Spin

Purpose: After six weeks of core strength intervention, whether the air spin of wushu C-level difficulty movements has been improved.

Measuring required: JVC9800 high-speed cameras

Methods

- (i). Read test requirements to athletes.
- (ii). During the action shooting process, the wushu athletes take turns to do the air spin movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.
- (iii). Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.
- (iv). The confirmed movements were intercepted from the video, and six experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese Wushu Association for the confirmation standard of difficult movements and the deduction standard for movement quality. Through repeated observation of the video, a high-quality action of each athlete was determined.

4.C-level Wushu Difficulty Landing Stability

Purpose: After six weeks of core strength intervention, whether the landing stability of wushu C-level difficulty movements has been improved.

Measuring required: JVC9800 high-speed cameras

Methods

- (i). Read test requirements to athletes.
- (ii). During the action shooting process, the wushu athletes take turns to do the landing stability movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.
- (iii). Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.

(iv). The confirmed movements were intercepted from the video, and six experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese Wushu Association for the confirmation standard of difficult movements and the deduction standard for movement quality. Through repeated observation of the video, a high-quality action of each athlete was determined.

Posttest 2

1. C-level Wushu Difficulty Run-up

Purpose: After 12 weeks of core strength intervention, whether the run-up of wushu C-level difficulty movements has been improved.

Measuring required: JVC9800 high-speed cameras

Methods

- (i). Wushu athletes are allowed to warm up by running and doing light stretches.
- (ii). Read test requirements to athletes.
- (iii). Using two JVC9800 high-speed cameras, the shooting frequency is 25 frames per second, and three-dimensional fixed-point shooting.
- (iv). Before the actual shooting action, place the frame according to the range of motion of the pre-action, and shoot the frame. One camera is 10 meters away from the intersection of the main optical axis, the other is 12.1 meters away from the main optical axis, the center of gravity of the lens is 1.25m from the ground, and the angle between the two cameras is close to 90°.
- (v). During the action shooting process, the wushu athletes take turns to do the run-up movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.
- (vi). Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.
- (vii). The confirmed movements were intercepted from the video, and six experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese Wushu Association for the confirmation standard of difficult movements and the deduction standard for movement quality. Through repeated observation of the video, a high-quality action of each athlete was determined.

2. C-Level Wushu Difficulty Take-off

Purpose: After 12 weeks of core strength intervention, whether the take-off of wushu C-level difficulty movements has been improved.

Measuring required: JVC9800 high-speed cameras

Methods

- (i). Read test requirements to athletes.
- (ii). During the action shooting process, the wushu athletes take turns to do the take-off movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.
- (iii). Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.
- (iv). The confirmed movements were intercepted from the video, and six experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese Wushu Association for the confirmation standard of difficult movements and the deduction standard for movement quality. Through repeated observation of the video, a high-quality action of each athlete was determined.

3.C-Level Wushu Difficulty Air Spin

Purpose: After 12 weeks of core strength intervention, whether the air spin of wushu C-level difficulty movements has been improved.

Measuring required: JVC9800 high-speed cameras

Methods

- (i). Read test requirements to athletes.
- (ii). During the action shooting process, the wushu athletes take turns to do the air spin movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.
- (iii). Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.
- (iv). The confirmed movements were intercepted from the video, and six experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese Wushu Association for the confirmation standard of difficult movements and the deduction

standard for movement quality. Through repeated observation of the video, a high-quality action of each athlete was determined.

4.C-level Wushu Difficulty Landing Stability

Purpose: After 12 weeks of core strength intervention, whether the landing stability of wushu C-level difficulty movements has been improved.

Measuring required: JVC9800 high-speed cameras

Methods

- (i). Read test requirements to athletes.
- (ii). During the action shooting process, the wushu athletes take turns to do the landing stability movements three times, without stopping in the middle, to completely shoot the whole process of all the movements.
- (iii). Six experts were invited to observe the movements and confirm the movements of the athletes. The unconfirmed movements will not be redone.
- (iv). The confirmed movements were intercepted from the video, and six experts were invited to confirm and evaluate the athlete's approach based on the quality of the athlete's movements, the evaluation criteria refer to the new rules of the Chinese Wushu Association for the confirmation standard of difficult movements and the deduction standard for movement quality. Through repeated observation of the video, a high-quality action of each athlete was determined.

Appendix M

Information Sheet and Informed Consent Form of the Respondents



JAWATANKUASA ETIKA UNIVERSITI
UNTUK PENYELIDIKAN MELIBATKAN
MANUSIA (JKEUPM)
UNIVERSITI PUTRA MALAYSIA,
43400 UPM SERDANG,
SELANGOR, MALAYSIA

FORM 2.4 : RESPONDENT'S INFORMATION SHEET AND INFORMED CONSENT FORM

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1. STUDY TITLE : Effect of core strength training on C-level difficulty movements of Wushu routine athletes

2. INTRODUCTION: *This research is mainly to do the core strength training of wushu routines of grade C difficulty (Whirl Wind Kick at 720°, Movement Revolving Turn at 720°, Movement Revolving Turn at 720°) run up, take off, spin, and landing experimental research. The subjects of this study are professional Wushu athletes from Ningxia Wushu Professional Team, aged between 20 and 22, who were registered and trained in the Wushu professional team in 2019 (a total of 40 volunteers). They were training in the use of traditional strength training, didn't practice in C-Level difficulty movements used core strength training, by phone or email, communicate to their coaches and players, they all volunteered, then let before 40 players to fill in a C-level difficulty in using the traditional training methods of feelings, as well as the problems. The problems are classified to facilitate the use of core strength training for targeted solutions.*

The participants were young and had some time of Wushu training, but had no core strength training in level C difficulty training, meaning they had little or no core strength training experience in the past two years. Participants were selected based on Nimmo's (2011) recommendations. They all live in Yinchuan, Ningxia Hui Autonomous Region, and all participants have health insurance. Due to the dangers of the experiment, two medical staff were prepared during the experiment.

3. WHAT WILL YOU HAVE TO DO?

This study carried out core strength training for a total of 12 weeks, during which the athletes' waist and spine strength were mainly trained, and then the training was combined with the running up, take-off, rotation and landing of wushu grade C difficulty. The first test was conducted before the training, the second test was conducted for 6 weeks, and the third test was conducted for 13 weeks.

Please initial here if you have read and understood the contents of this page

9. CONSENT

I Identity Card No.
address.....
.....hereby
voluntarily agree to take part in the research stated above *(clinical /drug trial/video
recording/ focus group/interview-based/ questionnaire-based).

I have been informed about the nature of the research in terms of methodology, possible
adverse
effects and complications (as written in the Respondent's Information Sheet). I
understand that I have the right to withdraw from this research at any time without giving
any reason whatsoever. I also understand that this study is confidential and all
information provided with regard to my identity will remain private and confidential.

I* wish / do not wish to know the results related to my participation in the research

I agree/do not agree that the images/photos/video recordings/voice recordings related to
me be used in any form of publication or presentation (if applicable)

* delete where necessary

Signature Signature
(Respondent) (Witness)

Date : Name :

I/C No. :

I confirm that I have explained to the respondent the nature and purpose of the above-
mentioned research.

Date Signature
(Researcher)

BIODATA OF STUDENT

Li Long, martial arts teacher and lecturer of Ningxia Normal University, applied for UPM Doctor of Philosophy degree. I am currently a Chinese second level martial arts athlete, a national level social sports instructor, and a first-class fitness qigong referee in China. Deputy Secretary General of Guyuan Martial Arts Association. Member of the Northeast Asia Youth Leaders Forum (South Korea). In 2008, he was admitted to the Ethnic Traditional Sports major at the School of Physical Education of Northwest Normal University. In 2012, he was recommended to pursue a master's degree at the School of Physical Education of Northwest Normal University.

In 2009, he won the first place in traditional boxing and second place in traditional equipment in the World Shadow Cup Martial Arts Competition,

In 2015, he won the title of "First place in Traditional Instruments and Third place in Traditional Fist" at the Ningxia Minority Games,

In 2016, it won the second place in the National invitational tournament of Taijiquan,

In 2017, he won the second place in the National College Fitness Qigong Competition for Wuqinxi and the fourth place in the Yijinjing National Competition,

In the 2017 World Traditional Martial Arts Championships, he ranked third in traditional boxing and second in traditional equipment,

In the 13th National Games of 2017, he was awarded the title of Sports Ethics and Fashion Athlete.

The 2019 World Traditional Martial Arts Competition (Kuala Lumpur Station) won first place in traditional boxing and traditional equipment.

LIST OF PUBLICATIONS

Journals

- Li, L., Geok, S. K., Li, H., Talib, O., Sun, H., & Lam, S. K. (2022). A comprehensive study on physical fitness of Wushu routine athletes based on video-driven core strength training mechanism in wireless network. *Wireless Networks*, 1-12.
- Li, L., Geok, S. K., Hu, L., Talib, O., He, S., & Lam, S. K. (2022). Effect of Core Strength Training on Wushu Performance: A Systematic Review. *Journal of Positive School Psychology*, 1744–1756-1744–1756.
- Li, L., Geok, S. K., Li, H., Talib, O., Sun, H., & Lam, S. K. (2023). Effect of 10 Weeks Agility Ladder Training on Agility Performance among Female Wushu Players. *s International Journal of Academic Research in Business and Social Sciences* 2222-6990