



Effects of Lower Limb Strength Training to Improve Single-Step Backflip Butterfly Stance in Wushu Taolu Nanquan Athletes

Wang Xinhao¹, Prakrit Hongseanyatham², and Yurasin Wattanapayungkul³

Faculty of Sports Science and Technology, Bangkokthonburi University, Thailand

¹E-mail: 531838321@qq.com, ORCID ID: <https://orcid.org/0009-0006-7522-2718>

²E-mail: prakitsport@gmail.com, ORCID ID: <https://orcid.org/0009-0009-2196-0258>

³E-mail: yurasin.wat@bkkthon.ac.th, ORCID ID: <https://orcid.org/0009-0001-0414-7099>

Received 12/09/2024

Revised 17/09/2024

Accepted 17/10/2024

Abstract

Background and Aim: Lower limb strength training is crucial for improving the single-step backflip butterfly stance. Lower limb strength training ensures that the body reaches a certain height in the air to have enough time for rotation. Weighted squats, single-leg jumps, frog jumps, tuck jumps, single-leg squats, and calf raises are all methods to enhance lower limb strength training, which helps increase the height of the backflip after a single step. Therefore, the researcher is interested in studying the effect of lower limb strength training to determine whether it can improve the single-step backflip technique in Wushu Taolu Nanquan athletes.

Materials and Methods: The population for this research consists of 48 male Wushu Taolu Nanquan athletes from Changzhou Sports School, aged 14 to 17. They possess basic Wushu skills, but they still require further training to enhance and develop additional techniques. All 48 male Wushu Taolu Nanquan athletes will participate in the single-step backflip butterfly stance test, and their scores will be recorded. Following the test, 36 athletes completed the technique. From this group, the researcher selected 20 athletes whose scores ranked between 9th and 28th for participation in this research as a sample group. The lower limb strength training was conducted for 8 weeks, and the single-step backflip butterfly stance test was conducted before training, after 4 weeks of training, and after 8 weeks of training to evaluate the effects of lower limb strength training in improving single-step backflip butterfly stance. This research employed mean, standard deviation, one-way repeated measures ANOVA, and dependent t-tests for data analysis, with a significance level set at 0.05.

Results: After training with the lower limb strength training program, there was a significant difference between the single-step backflip butterfly stance test results before training, after 4 weeks of training, and after 8 weeks of training at the level of 0.05.

Conclusion: The developed lower limb strength training program was effective in improving the single-step backflip butterfly stance of Wushu Taolu Nanquan athletes.

Keywords: Lower Limb; Strength Training; Single Step Backflip Butterfly Stance; Wushu Taolu; Nanquan Athletes

Introduction

Nanquan, as one of the important boxing techniques within traditional Chinese Wushu, boasts a rich cultural heritage and distinctive martial style. Its inheritance and advancement carry profound implications for preserving and perpetuating the traditional culture of the Chinese nation. Primarily, the inheritance and development of Nanquan can promote the protection and inheritance of the traditional culture of the Chinese nation. Nanquan's status as a vital component of traditional Chinese Wushu underscores its significance in upholding cherished cultural values. By nurturing its inheritance and development, Nanquan becomes a conduit for the dissemination and enrichment of China's cultural legacy. Moreover, Nanquan's role extends beyond cultural preservation, extending into the realm of sports development. Serving as a multifunctional sport encompassing fitness, strength-building, and self-defense aspects, Nanquan's evolution augments the growth of sports while enhancing the populace's physical well-being and prowess. Furthermore, the inheritance and progression of Nanquan play a pivotal role in fostering social cohesion and stability. Embedded within Nanquan are traditional cultural tenets and values that hold considerable social significance. By nurturing its legacy, Nanquan contributes to promoting societal harmony and bolstering individuals' cultural pride and national identity. Therefore, exploring Nanquan is of great significance in promoting the protection and inheritance of the traditional culture of the Chinese nation, promoting the development of sports, and promoting social harmony and stability (Lu, 2023).

To execute the single-step backflip butterfly stance technique, begin by bending your legs into a half-squat position while keeping your upper body upright. Next, vigorously thrust both arms upward.



Simultaneously, propel your legs diagonally backward toward the ground. As you do so, engage your core muscles to lift your legs and contract your abdomen, launching yourself into the air. Once airborne, grasp your knees with your hands and initiate a backward roll. Maintain control as you rotate backward until your feet are poised to make contact with the ground. Finally, land firmly on the ground with your legs, completing the backflip maneuver. The single-step backflip butterfly stance technique consists of three primary stages: the kick-off technique, the mid-air flip technique, and the landing technique. These technical phases are intricately connected, and the execution of each stage impacts the overall success of subsequent movements. Thus, careful attention to detail is crucial in each stage to ensure high-quality execution of the entire backflip maneuver (Huang, 2021).

The height of an athlete's take-off directly influences the execution of the movement. If the jump fails to meet the required height during aerial rotation, the quality of the landing is compromised, increasing the likelihood of errors and injuries. In recent years, deductions in difficulty have been observed in various national Wushu competitions due to this issue. To address this, targeted exercises tailored to the specific needs of competitive Wushu are necessary during strength training. Different training methods should be employed based on individual athletes' physical conditions to enhance the stability of jumping movements and overall technical quality. Athletes must not only achieve considerable take-off height but also maintain fast rotation speed and ensure a stable landing throughout routine drills. The important foundation of competitive Wushu is strength quality. If strength is not well controlled, athletes will suffer injuries. The important key to whether Wushu athletes can achieve good results is whether the strength of the lower limbs is used correctly. Specialized training can effectively enhance the specific strengths of Wushu athletes. To enhance the lower limb strength of Wushu taolu athletes, the most crucial step is to implement scientific training methods consistently during daily training. When creating a training plan, it's essential to promptly assess the intensity of the strength training load for each athlete. However, this alone is far from sufficient, as some techniques in Wushu taolu have unique characteristics, thus requiring special demands on lower limb strength as well (Liu, 2013).

Moreover, Lower limb strength training is crucial for improving the single-step backflip butterfly stance. Lower limb strength training ensures that the body reaches a certain height in the air to have enough time for rotation. Weighted squats, single-leg jumps, frog jumps, tuck jumps, single-leg squats, and calf raises are all methods to enhance lower limb strength training, which helps increase the height of the backflip after a single step. Therefore, the researcher is interested in studying the effect of lower limb strength training to determine whether it can improve the single-step backflip technique in Wushu Taolu Nanquan athletes.

Research Objectives

Main Objective

To study the effects of lower limb strength training to improve single-step backflip butterfly stance in Wushu Taolu Nanquan athletes.

Subsidiary Objectives

1. To study the current situation and the problems of single-step backflip butterfly stance technique training in Wushu Taolu Nanquan athletes.
2. To draft a lower limb strength training program to improve single-step backflip butterfly stances in Wushu Taolu Nanquan athletes.
3. To compare single step backflip butterfly stance technique of Wushu Taolu Nanquan athletes before the training, after 4 weeks of training, and after 8 weeks of training.

Literature Review

1. Nanquan

Due to their smaller stature and relatively limited strength, southerners place a particular emphasis on the stability of their footwork. They prioritize securing a stable footing, building robust stances, and



firmly grounding themselves. They aim to be as unyielding as an iron tower and as steadfast as a bell. Techniques such as “One move, multiple applications,” “Repeated hand exchanges within a single step,” “Swift and concise strikes,” and “Lightning-fast movements” underscore their approach. They execute close-range, powerful punches with courage and unpredictability, striving for speed, strength, and swift victory. There's a saying that encapsulates their strategy: “Strike where the ox lies.” In ancient times, the people of ancient Yue inhabited the region south of the Yangtze River. Engaging in extensive waterborne trade and maritime activities, they adopted the tradition of “hair tattoos” and favored adorning their arms and feet with tattoos. This custom persists in the men's Nanquan discipline today, evident in the characteristic practice of performing bare-armed (Li and Niu, 2008).

During the exertion of force, vocalization and controlled breathing are frequently employed to enhance movement and generate power, resulting in fluidity, dynamism, and heightened explosiveness. The Nanquan boxing system places significant emphasis on pictograms and incorporates combat techniques to express its distinctive technical prowess. According to Liu (2019), Nanquan's technical training styles can be categorized into three main types: precise execution of standardized movements, rhythmic clarity, and robust power generation. This involves maintaining a stable stance with a firm base, relaxed shoulders, and agile footwork while utilizing a diverse range of techniques. By maintaining proper posture, employing vocalization for added force, and delivering powerful strikes, practitioners achieve harmonious coordination of mind, energy, and physical strength, thereby showcasing the captivating allure of Nanquan.

Zhang (2012) underscores that hosting competitive martial arts tournaments spurs the evolution of Nanquan competition regulations. Success hinges on restoring the technical essence of Nanquan by ensuring movements are both high-quality and challenging. Emphasizing the fluidity and coherence of sequences, incorporating authentic Nanquan techniques, and integrating offensive and defensive maneuvers are pivotal. Moreover, increasing difficulty and fostering innovation are essential for crafting competitive Nanquan routines that align with modern competition standards while preserving the traditional Nanquan technical flair. Zhao et al., (2015) the proficiency of Nanquan's technical training is represented by its speed, agility, and strength, encompassing both offensive and defensive maneuvers. It emphasizes maintaining stable stances, executing movements with varying tempos, and keeping actions concise. Athletes must master Nanquan's distinctive technical style and understand its punching techniques. Leveraging these skills, they can devise innovative and individualized routines that reflect their interpretation of Nanquan, aiming to achieve outstanding competition outcomes.

2. Single Step Backflip Butterfly Stance

2.1 The definition of a single-step backflip butterfly stance

Single-step backflip butterfly stance is an intricate martial arts technique that seamlessly combines acrobatics with traditional stances, commonly found in martial arts, particularly in styles like Nanquan. It involves executing a backward flip while transitioning into a butterfly stance in a single fluid motion.

A single-step backflip is a backward flip executed from a standing position, typically initiated by pushing off with one foot while simultaneously propelling the body backward and upward. A butterfly stance is a stable and balanced stance in martial arts, characterized by a low squatting position with knees bent and feet shoulder-width apart or slightly wider. The torso is generally upright, and the arms can be positioned for defense or ready-to-execute techniques. Combining these elements, the “single step backflip butterfly stance” entails performing a backward flip with a single step while transitioning smoothly into a low, balanced butterfly stance upon landing. This maneuver requires agility, strength, and precise control of body movements. It's often used as a display of skill and athleticism in martial arts demonstrations and competitions. Practitioners of Wushu Nanquan often train extensively to master complex movements like the single-step backflip butterfly stance, refining their technique through repetition, conditioning, and guidance from experienced instructors. This technique exemplifies the blend of athleticism and martial arts proficiency characteristic of Wushu Nanquan performances. (Tang and Tang (2006).

2.2 The single-step backflip butterfly stance technique

The single-step backflip butterfly stance technique

The single-step backflip butterfly stance technique comprises three primary stages: the take-off technique, the mid-air flip technique, and the landing technique. These stages are intricately connected, and the successful execution of each directly influences the overall performance of subsequent movements. Thus, meticulous attention must be given to each technical aspect within these stages to ensure the overall backflip is completed with precision and quality (Huang, 2021).

The kick-off technique serves as the pivotal phase influencing the high-quality execution of the backflip movement. The efficacy of the kick-off directly impacts the height, trajectory, and overall execution of the backflip. The kick-off phase comprises two key stages: the squatting phase and the kicking phase. During the squatting phase, athletes assume a natural stance with feet slightly wider than shoulder-width apart, hands raised overhead, eyes forward, and body relaxed. Before kicking off, they squat down, bending their legs to a half-squat position. The depth of the squat is determined by the individual's optimal point for generating force during the kick-off. The upper body leans slightly forward, ideally maintaining a tilt between 10-35°, with eyes fixed forward. As athletes prepare to kick off, they swing their arms downward until they are approximately upright, synchronizing with a slight backward tilt of the body's center of gravity. In the kicking phase, athletes propel their legs upward from a loose to a tight position, simultaneously swinging their arms upward and lifting their shoulders to elevate the center of gravity. The swinging of arms and lifting of shoulders contribute to the generation of kicking power, aiding in elevating the body's overall center of gravity. This upward lift assists in achieving greater height in the somersault. The force generated by the legs pushing off the ground, combined with the kicking force from the legs and ankles, is crucial in driving the backflip motion. Additionally, the backward and upward swing of the arms also contributes to generating force, adding momentum to the kick-off phase (Yuan, 2013).

The mid-air flip technique is a crucial element influencing the successful execution of the backflip movement. The speed of leg retraction, the tightness of the knee tuck, and the body's positioning significantly impact the flip's speed and determine the adequacy of height and timing for landing. Following the initial kick-off and arm throw, the athlete's legs leave the ground. Simultaneously, as the arms reach overhead, the athlete pulls them upward, elevates the shoulders, and uses them as a pivot point to initiate the backward flip. The body's center of gravity shifts backward, while the legs bend, bringing the knees toward the chest, and the abdomen tightens. Continuous tension in the abdominal muscles and maintaining an arched back facilitate a smooth aerial flip. Additionally, grasping the knees with both hands and executing body movements such as lifting the head and hips simultaneously can expedite the flip's rotation speed. Throughout the flipping process, it's essential to maintain a tight jaw and execute movements smoothly, cohesively, and without interruption. Any hesitation, loosening of the hands, or other disruptions should be avoided. The speed of leg retraction and the tightness of the knee tuck determine the size of the rotation radius in the air. A smaller rotation radius corresponds to a faster flip speed, whereas a larger rotation radius results in a slower flip speed (Wu, 2014).

Landing technique is an important part of completing the backflip movement. In the single-step backflip butterfly stance, it is very necessary to connect other movements after landing with difficulty, such as kneeling, falling to the ground, etc. The backflip landing technique is immature, and the quality of the connection movement will also be affected. When athletes turn their faces downward and their eyes can see the ground, they should actively extend their legs and body to increase the rotational inertia and buffer the inertia caused by landing (Zhao, 2018).

2.3 The importance of lower limb strength in the single-step backflip butterfly stance technique

Lower limb strength plays a critical role in the execution of the single-step backflip butterfly stance technique. The explosive power generated by the lower limbs is essential for propelling the body upward and backward during the backflip. A strong push-off from the ground is required to initiate the backward flip with sufficient height and momentum. After completing the backflip, strong lower limb muscles help absorb the impact of the landing, ensuring a stable and controlled touchdown. Adequate lower limb strength reduces the risk of injury and enables a smoother transition into the butterfly stance. Moreover, Lower limb



strength contributes to overall balance and control throughout the entire movement sequence. Strong leg muscles provide stability during takeoff, mid-air rotation, and landing, allowing the athlete to maintain proper form and alignment. The butterfly stance requires considerably lower limb strength to maintain the low squatting position with knees bent and feet firmly planted on the ground. Strong leg muscles support the body's weight and facilitate smooth transitions between movements. Therefore, performing the single-step backflip butterfly stance technique requires a high level of endurance, particularly in the lower body muscles. Strengthening the lower limbs helps prevent fatigue and sustain performance quality throughout repeated practice sessions or competitive routines (Wang et al, 2020).

In summary, lower limb strength is essential for generating power, stabilizing landing, maintaining balance, executing the butterfly stance, and preventing fatigue during the Single Step Backflip Butterfly Stance technique. Training focused on strengthening the legs and lower body muscles is crucial for mastering this advanced martial arts maneuver.

3. Lower Limb Strength Training

3.1 Lower limb strength training

During Wushu taolu training, emphasis is placed on strengthening the leg muscle groups, which are essential for athletes' performance. These muscle groups include the quadriceps femoris located on the front of the thigh, the biceps femoris situated on the back of the thigh, as well as the gastrocnemius and tibialis anterior muscles of the calf. Strengthening these muscles is paramount as they play a pivotal role in supporting various Wushu movements and techniques (Yan, 2021).

Firstly, the quadriceps on the front of the thigh stand as a cornerstone muscle within the leg muscle group. It primarily governs knee flexion and is instrumental in explosive movements like jumping and sprinting. Training the quadriceps enhances leg explosiveness and strength, thereby improving athletes' starting speed and explosive power in competition. Secondly, the biceps femoris on the back of the thigh is equally vital. It controls knee joint extension and significantly impacts jumping and running performance. Strengthening the biceps femoris fosters leg stability and endurance, thereby enhancing athletes' stamina and resilience in competitions. Lastly, the gastrocnemius and tibialis anterior muscles of the calf are crucial components of the leg muscle groups requiring intensive training. The gastrocnemius, located at the back of the calf, plays a pivotal role in jumping and running movements. Meanwhile, the tibialis anterior, situated at the front of the calf, influences running and jumping performance. Training these muscles heightens calf strength and stability, improving athletes' explosive power and flexibility during competition (Cui and Geng, 2024).

Zhang (2022) suggests that compression squat training offers notable benefits for enhancing lower limb circumference and muscle strength among young male fitness enthusiasts. In an 8-week study comparing compression squat training with traditional squat training among basketball players, several key findings emerged. Firstly, the weak leg strength of both groups significantly improved, with the compression training group experiencing a more substantial increase ($P < 0.01$) compared to the traditional training group ($P < 0.05$). This indicates that compression training significantly enhances the muscle dimensions of the lower limbs. Comparing the results between the two groups, compression training showed a more pronounced effect. Secondly, participants in the compression training group demonstrated a significant increase in vertical jump height ($P < 0.01$), indicating improved explosive power and athletic performance. Lastly, low-intensity compression training was found to increase maximum muscle strength of the lower limbs and promote overall lower limb dimensions. In summary, research highlights the effectiveness of compression squat training in augmenting lower limb muscle strength, circumference, and athletic performance, particularly in the context of young male fitness enthusiasts and basketball players.

3.2 Lower limb strength training for improving the single-step backflip butterfly stance

Lower limb strength training is crucial for athletes aiming to enhance their performance in martial arts techniques such as the single-step backflip butterfly stance. An overview of effective lower limb strength exercises that improve the single step backflip butterfly stance technique such as (1) Squats: squats



are foundational exercises for building lower limb strength, targeting the quadriceps, hamstrings, and glutes. Variations such as barbell squats, goblet squats, and pistol squats offer progressive resistance and muscle activation. According to a study published in the *Journal of Strength and Conditioning Research* (Gullett et al., 2009), squats are effective for increasing lower limb strength and power; (2) Lunges: lunges are unilateral exercises that strengthen the quadriceps, hamstrings, glutes, and calf muscles. Forward lunges, reverse lunges, and walking lunges can be incorporated into lower limb strength training routines. Research published in the *Journal of Sports Science & Medicine* (Danneskiold-Samsøe et al., 2009) suggests that lunges improve lower limb muscle strength and balance; (3) Deadlifts: deadlifts target the posterior chain muscles, including the hamstrings, glutes, and lower back. Conventional deadlifts, sumo deadlifts, and Romanian deadlifts are effective variations for developing lower limb strength and power. A study in the *Medicine and Science in Sports and Exercise* (Escamilla et al., 2002) found deadlifts to be beneficial for enhancing lower limb muscle activation and functional performance; (4) Calf Raises: calf raises isolate the calf muscles, specifically the gastrocnemius and soleus, which are important for ankle stability and propulsion. Performing calf raises with bodyweight, dumbbells, or on a calf raise machine can improve lower limb strength and endurance. Research published in the *Frontiers in Physiology* (Kinoshita et al., 2023) supports the effectiveness of calf raises for strengthening the lower limbs; and (5) Plyometric Exercises: plyometric exercises, such as box jumps, jump squats, and single-leg hops, enhance lower limb power and explosiveness. These exercises involve rapid stretching and contraction of muscles, improving muscle fiber recruitment and coordination. According to a study in the *Journal of Strength and Conditioning Research* (Markovic et al., 2007), plyometric training improves lower limb power and performance. Incorporating these exercises into a comprehensive strength training program can effectively improve lower limb strength and contribute to mastering advanced martial arts techniques like the single-step backflip butterfly stance. As with any exercise regimen, it's important to prioritize proper form, progression, and recovery to minimize the risk of injury and optimize performance gains.

Summary

The literature and research review on the effects of lower limb strength training to improve the single-step backflip butterfly stance in Wushu Taolu Nanquan athletes highlight the critical role of lower limb strength in executing complex martial arts techniques. Numerous studies emphasize the importance of targeted strength training programs tailored to enhance the quadriceps, hamstrings, calves, and other leg muscles essential for stability, power, and balance during performance. Research indicates that such training programs lead to significant improvements in athletes' ability to perform the single-step backflip butterfly stance. These improvements encompass enhanced explosive power, increased muscle strength, improved balance, and heightened overall performance proficiency. Overall, the literature emphasizes the positive effects of lower limb strength training on improving the single-step backflip butterfly stance in Wushu Taolu Nanquan athletes. By implementing targeted training programs and exercises, athletes can enhance their performance capabilities, reduce injury risks, and achieve greater success in competitive settings. Therefore, this research aims to study whether lower limb strength training can improve single-step backflip butterfly stance in Wushu Taolu Nanquan athletes, through 8 weeks of training by using a developed lower limb strength training program.

Conceptual Framework

The conceptual framework for this research is as follows:

1. The independent variable is the lower limb strength training program.
2. The dependent variables are the improvement of single-step backflip butterfly stance in Wushu Taolu Nanquan athletes.

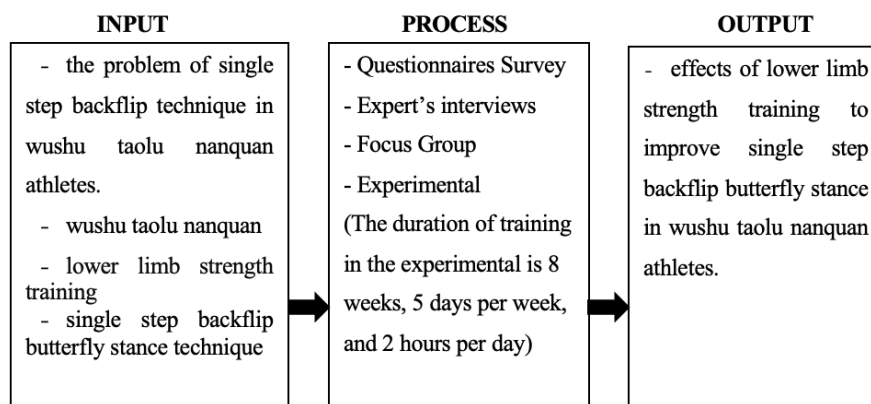


Figure 1 Conceptual framework

Methodology

1. Research Tools

In this research, the following tools were used to conduct the research:

- 1.1 Questionnaire for Wushu Taolu Nanquan athletes
- 1.2 Interviewing form
- 1.3 Lower limb strength training program
- 1.4 Single-step backflip butterfly stance test

2. Population and Sample

Population specification and size

The population of this research is 48 male Wushu Taolu Nanquan athletes of Changzhou Sports School, aged between 14 and 17 years, who have basic Wushu skills, but still need to undergo training to develop additional skills.

Sample

All 48 male Wushu Taolu Nanquan athletes will participate in single step backflip butterfly stance technique test and their scores will be documented. After the test, 36 Wushu Taolu Nanquan athletes were able to complete the single-step backflip butterfly stance technique. From the 36 Wushu Taolu Nanquan athletes, the researcher selected those whose test scores were in the range of 9th-28th, with a total of 20 Wushu Taolu Nanquan athletes and volunteers to participate in this research to be the sample group.

3. Data Collection

1. Questionnaires were drafted to assess the current training situation and identify challenges related to the single-step backflip butterfly stance technique among Wushu Taolu Nanquan athletes. Following this, the questionnaires were reviewed by 3 experts, who evaluated their alignment with the objectives using the Item-Objective Congruence (IOC) method.

2. Questionnaires will be distributed on-site to all 20 Wushu Taolu Nanquan athletes to investigate training difficulties and challenges encountered during the single-step backflip butterfly stance technique implementation.

3. Develop interview questions for experts' interviews and evaluate their alignment with objectives using Item-Objective Congruence (IOC) with 3 experts.

4. Invite 5 experts, including Wushu Taolu Nanquan coaches and physical education teachers (Wushu major), to conduct face-to-face interviews. They aim to establish a question framework for the focus group, emphasizing key elements for developing a lower limb strength training program to improve the single-step backflip butterfly stance technique among Wushu Taolu Nanquan athletes.



5. Conduct a focus group consisting of 10 experts, including Wushu Taolu Nanquan coaches, Wushu taolu referees, and physical education teachers (Wushu major), to formulate a lower limb strength training program aimed at improving the single-step backflip butterfly stance technique of Wushu Taolu Nanquan athletes.

6. Try out the developed lower limb strength training program with 5 Wushu Taolu Nanquan athletes to evaluate its suitability and intensity for use with Wushu Taolu Nanquan athletes (sample group).

7. Implement the training program over 8 weeks, scheduling sessions for 5 days each week (Monday-Friday), with a duration of 2 hours per day, from 15:00-17:00.

8. Conduct the single-step backflip butterfly stance test before the training, after 4 weeks of training, and upon completion of the 8-week training period. After that, analyze and compare the gathered test results to investigate the effect of lower limb strength training on improving the single-step backflip butterfly stance technique among Wushu Taolu Nanquan athletes.

4. Data Analysis

This research primarily utilized a software package for data analysis. The following methods were employed:

1. Descriptive statistical techniques, such as mean and standard deviation were utilized to analyze the data obtained from the questionnaire.

2. The content validity of questions in the questionnaire for Wushu Taolu Nanquan athletes and expert interview form was evaluated using the Indexes of Items of Objective Congruence (IOC), IOC value of questionnaires for students was 0.90, and the IOC value of the interview form was 0.86.

3. The expert interviews and focus group discussions were analyzed using content analysis.

4. Analysis of the pre-test, after 4 weeks of training, and post-test (after 8 weeks of training) was conducted using one-way repeated measures ANOVA.

5. Dependent t-tests were utilized to compare test results within one group, including comparisons between (1) pre-test and post 4 weeks of training; (2) post 4 weeks of training and post-test; and (3) pre-test and post-test, aiming to evaluate differences over time.

6. In this study, the level of significance was set at $p = 0.05$.

7. The researcher used a Likert scale to assess and determine the average questionnaire scores.

The meanings of 5 scale evaluation are 1 = Very Poor, 2 = Poor, 3 = Moderate, 4 = High, 5 = Highest. The details of the score criteria are as follows (Best John W, 1977):

Average score range	Meaning
1.00 - 1.79	Very Poor
1.80 - 2.59	Poor
2.60 - 3.39	Moderate
3.40 - 4.19	High
4.20 - 5.00	Highest

Results

1. Investigate the current situation and the problems of single-step backflip butterfly stance technique training in Wushu Taolu Nanquan athletes

The questionnaires were distributed on-site to 20 nanquan athletes to assess the existing issues and difficulties in training for the single-step backflip butterfly stance technique and lower limb strength.

The collected data will be analyzed to provide insights into the current state and challenges of training for the single-step backflip butterfly stance and lower limb strength. The analysis of the results can be summarized as follows:



Table 1 Questionnaire survey results of Wushu Taolu Nanquan athletes to survey the current situation and the problem of single-step backflip butterfly stance technique training

Questionnaire Items	Total Score		Result
	$\bar{x}$	S.D.	
1. How often do you practice the single step backflip butterfly stance technique during your training?	3.16	0.84	Moderate
2. How confident are you in your ability to perform the single step backflip butterfly stance?	2.12	1.43	Poor
3. Do you have challenges and problems when performing the single step backflip butterfly stance?	4.34	0.72	Highest
4. How difficult do you find the single step backflip butterfly stance technique?	4.05	0.74	High
5. Have you experienced any injuries related to single-step backflip butterfly stance training?	2.90	0.54	Moderate
6. Do you include lower limb strength exercises in your regular training?	3.10	0.54	Moderate
7. How important do you think lower limb strength is for improving your single step backflip butterfly stance technique?	4.50	0.60	Highest
8. Do you feel that your lower limb strength is sufficient to perform the single step backflip butterfly stance successfully?	2.12	1.43	Poor
9. Do you believe additional lower limb strength training would improve your single step backflip butterfly stance technique?	3.88	0.86	High
10. How would you rate the effectiveness of your current training program in improving the single step backflip butterfly stance?	2.40	0.49	Poor
11. Do you think school need to improve the training program for improving the single step backflip butterfly stance?	4.20	0.60	Highest

Form table 1 questionnaire survey results of Wushu Taolu Nanquan athletes to survey the current situation and the problem of single-step backflip butterfly stance technique training, showed that Wushu Taolu Nanquan athletes have many problems and are not confident in performing the single-step backflip butterfly stance, this can be seen from question 2 and question 3, question 2 “How confident are you in your ability to perform the single step backflip butterfly stance?”, the result of this question was in the “Poor” ($\bar{x} = 2.12$). Question 3 “Do you have challenges and problems when performing the single step backflip butterfly stance?”, the result of this question was in the “Highest” ($\bar{x} = 4.34$). Moreover, Wushu Taolu Nanquan athletes feel the single-step backflip butterfly stance technique is difficult, this can be seen from question 4 “How difficult do you find the single-step backflip butterfly stance technique?”, the result of this question was in the “High” ($\bar{x} = 4.05$). Additionally, Wushu Taolu Nanquan athletes feel that their lower limb strength is not sufficient to perform the single-step backflip butterfly stance successfully. This

can be seen from question 8 “Do you feel that your lower limb strength is sufficient to perform the single step backflip butterfly stance successfully?”, the result of this question was in the “Poor” ($\bar{x} = 2.12$). Most Wushu Taolu Nanquan athletes agree that improvement of lower limb strength can improve single-step backflip butterfly stance technique, this can be seen from question 7 “How important do you think lower limb strength is for improving your single-step backflip butterfly stance technique?”, the result of this question was in the “Highest” ($\bar{x} = 4.50$).

1. Develop a lower limb strength training program aiming to improve the single-step backflip butterfly stance in Wushu Taolu Nanquan athletes

10 experts including, 4 Wushu Taolu Nanquan coaches, 3 Wushu Taolu referees, and 3 physical education teachers (Wushu major) were invited to conduct a focus group to develop a lower limb strength training program aiming to improve the single-step backflip butterfly stance in Wushu Taolu Nanquan athletes. After focus group discussion, the lower limb strength training program was developed, the training program will be conducted for 8 weeks, with sessions scheduled for 5 days per week, 2 hours per day. After that, the training program was tested with 5 Wushu Taolu Nanquan athletes to assess its suitability. The results showed that the program included well-designed exercises and appropriate training intensity for Wushu Taolu Nanquan athletes, making it suitable for use with the sample group in this experiment.

2. Begin training using the developed lower limb strength training program, conducting the training for a total of 8 weeks

To evaluate whether the lower limb strength training program could improve the single-step backflip butterfly stance technique, the single-step backflip butterfly stance test was conducted at three intervals: before the start of the training, after 4 weeks, and upon completion of the 8-week training program. The results of the single-step backflip butterfly stance test are as follows:

The results of the single step backflip butterfly stance test of Wushu Taolu Nanquan athletes before training, after 4 weeks of training, and after 8 weeks of training

Table 2 Mean and standard deviation of the single step backflip butterfly stance test result of Wushu Taolu Nanquan athletes (n=20)

The single step backflip butterfly stance test	Mean ($\bar{x}$)	Std. Deviation (SD)
Before training	14.70	1.16
Week 4 after training	17.83	1.14
Week 8 after training	24.63	1.38

Table 2 presents the results of the single-step backflip butterfly stance test for 20 Wushu Taolu Nanquan athletes, conducted before training, after 4 weeks, and after 8 weeks of training using the developed lower limb strength training program. The mean and standard deviation of the test results were as follows: before the training program, the results were 14.700 ± 1.16 ; after 4 weeks of training, the results improved to 17.83 ± 1.14 ; and after completing 8 weeks of training, the results further increased to 24.63 ± 1.38 .



Table 3 The comparative results of the single step backflip butterfly stance test, conducted before training, after 4 weeks of training, and after 8 weeks of training with the developed lower limb strength training program

Source of Variance (Sov)	SS	Df	MS	F	P
Between Group	1030.08	2	912.24	1664.47*	0.00
Within Group	11.76	37	0.55		
Total	1041.84	39	912.79		

* $P < .05$

Table 3 presents the comparative results of the single-step backflip butterfly stance test conducted before training, after 4 weeks of training, and after 8 weeks of training with the developed lower limb strength training program. Analysis using one-way repeated measures ANOVA revealed a statistically significant improvement in single step backflip butterfly stance technique of Wushu Taolu Nanquan athletes, between before training, after 4 weeks of training, and after 8 weeks of training at the point [$F_{(2,37)} = 1664.47$, $p < .001$].

Table 4 The comparative results of the single step backflip butterfly stance test, between before training and after 4 weeks of training

Period	Mean ($\bar{x}$)	Standard Deviation (SD)	t	P
Before Training	14.70	1.16	56.53*	0.00
After 4 Weeks of Training	17.83	1.14		

* $P < .05$

Table 4 shows that the comparison of single-step backflip butterfly stance test results for Wushu Taolu Nanquan athletes, between before training and after 4 weeks of training with the developed lower limb strength training program, revealed a statistically significant difference at the 0.05 level.

Table 5 The comparative results of the single step backflip butterfly stance test, between before training and after 8 weeks of training

Period	Mean ($\bar{x}$)	Standard Deviation (SD)	t	P
Before Training	14.70	1.16	80.07*	0.00
After 8 Weeks of Training	24.63	1.38		

* $P < .05$

Table 5 shows that the comparison of single-step backflip butterfly stance test results for Wushu Taolu Nanquan athletes, between before training and after 8 weeks of training with the developed lower limb strength training program, revealed a statistically significant difference at the 0.05 level.

Table 6 The comparative results of the single step backflip butterfly stance test, between after 4 weeks of training and after 8 weeks of training

Period	Mean ($\bar{x}$)	Standard Deviation (SD)	t	P
After 4 Weeks of Training	17.83	1.14	70.00*	0.00
After 8 Weeks of Training	24.63	1.38		

* $P < .05$

Table 6 shows that the comparison of single-step backflip butterfly stance test results for Wushu Taolu Nanquan athletes, between after 4 weeks of training and after 8 weeks of training with the developed lower limb strength training program, revealed a statistically significant difference at the 0.05 level.

Summary

The developed lower limb strength training program effectively improved the single-step backflip butterfly stance in Wushu Taolu Nanquan athletes. This aligns with the hypothesis that, after 8 weeks of lower limb strength training, the single-step backflip butterfly stance of Wushu Taolu Nanquan athletes showed improvement with a statistical significance level of 0.05.

Conclusion

The results showed that after 8 weeks of training with a lower limb strength training program, there was a significant improvement in the single-step backflip butterfly stance of Wushu Taolu Nanquan athletes. This improvement was evident from the enhanced scores in the single-step backflip butterfly stance test. Statistically significant differences were observed at the 0.05 level in the test results between the pre-training phase, after 4 weeks of training, and after completing the 8-week training program.

Discussion

After 8 weeks of training with the lower limb strength training program, there was a significant improvement in the single-step backflip butterfly stance of Wushu Taolu Nanquan athletes. This was demonstrated by the improved scores in the single-step backflip butterfly stance test. Statistically significant differences at the 0.05 level were observed in the test results between the before-training phase, after 4 weeks of training, and upon completion of the 8-week training program. The research results indicate that lower limb strength training and strengthening of the lower body muscles can help improve the single-step backflip butterfly stance of Wushu Taolu Nanquan athletes. These research findings are consistent with the research results of Wang et al (2020) the butterfly stance demands significant lower limb strength to maintain a deep squat position with bent knees and feet firmly grounded. Strong leg muscles are essential for supporting body weight and enabling smooth transitions between movements. As a result, executing the single-step backflip butterfly stance technique requires substantial endurance, particularly in the lower body muscles. Strengthening these muscles helps prevent fatigue and ensures consistent performance quality during repeated practice sessions or competitive routines.

The developed lower limb strength training program aims to focus on building the strength of the lower limbs, with an emphasis on exercises such as squats and deadlifts. These training methods are often highly effective in building lower limb strength. These research findings are consistent with the research results of



Zhang (2022) the findings suggest that compression squat training provides significant benefits for increasing lower limb muscle strength and circumference in young male fitness enthusiasts. In an 8-week study comparing compression squat training with traditional squat training among basketball players, several key observations were made. Both groups saw a significant improvement in leg strength, but the compression training group experienced a more substantial increase ($P < 0.01$) compared to the traditional training group ($P < 0.05$). This indicates that compression training has a more pronounced effect on enhancing lower limb muscle dimensions.

Additionally, the single-step backflip butterfly stance requires good balance, combined with a low squatting position. Therefore, incorporating squats into training is crucial for developing the skills needed for this technique. These research findings are consistent with the research results of Tang and Tang (2006) the single-step backflip is a backward flip performed from a standing position, typically initiated by pushing off with one foot while propelling the body both backward and upward. The butterfly stance is a stable, low-squatting position in martial arts, characterized by bent knees and feet set shoulder-width apart or slightly wider.

Recommendation

Recommendation for this research

1. Consider a follow-up study to explore the long-term effects of lower limb strength training on maintaining or further improving the single-step backflip butterfly stance after the initial 8-week period.
2. Use detailed performance metrics to assess changes in technique, such as jump height, rotation speed, and landing stability, before and after the training program.
3. Assess which specific lower limb exercises (e.g., squats, plyometrics) are most effective in improving the single-step backflip butterfly stance. This could include a comparison of different training intensities and volumes.
4. Compare the effectiveness of the developed lower limb strength training program with other training methodologies or programs to determine relative benefits.

Recommendation for further research

1. Investigate how individual differences (e.g., age, baseline strength, experience level) affect the outcomes of the training program and tailor recommendations for different athlete profiles.
2. Include a component on how the strength training program impacts injury rates or prevention, given the high-impact nature of the single-step backflip butterfly stance.
3. Examine how flexibility and mobility of the lower limbs impact the execution of the single-step backflip butterfly stance, and how incorporating stretching and mobility exercises can complement strength training.

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