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ORIGINAL ARTICLE

Optimizing basketball-specific physical performance through core strength training: Evidence from an experimental study

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ABSTRACT

Basketball is a highly competitive sport that demands superior physical coordination and stability of the upper and lower body. Core strength training, a multifaceted approach targeting the core region, has been increasingly recognized as an effective method for enhancing basketball-specific physical fitness. This study investigates the impact of core strength training on basketball players' physical performance, particularly focusing on trunk stability, movement coordination, and skill execution. By employing methods such as literature review, experimental comparison, and statistical analysis, the study evaluates key performance metrics, including layups, dribbling, shuttle runs, and shooting accuracy. The results reveal that core strength training significantly improves players' physical attributes, with marked advancements in movement efficiency, stability during dynamic motions, and overall skill performance. These findings aim to provide practical insights for optimizing basketball training methods and advancing the development of school-level basketball programs.

Keywords: Performance analysis, Core strength, Basketball training, Basketball-specific fitness, Physical performance, Skill development.

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INTRODUCTION

With the rapid development of modern competitive sports, the concepts and methods of sports training are constantly updated, and core strength training, as a functional training method, has gained widespread attention worldwide in recent years. Core strength training aims to enhance trunk stability, coordination and power transmission efficiency, and provides a scientific basis for improving sports performance and preventing sports injuries by improving athletes' body control ability (Hsu et al., 2018; Peate et al., 2007).Compared to traditional strength training, core strength training emphasizes the synergy of the entire body's muscle groups, and has been proven to be effective in a number of sports in competitive sports (Shinkle et al., 2012).

Basketball as a high confrontation, rapid change of team sports, the physical quality of the athletes put forward a very high demand. In the actual game, basketball players need to frequently complete the change of direction breakthrough, jump shooting, air confrontation and other complex technical actions, and the completion of these actions rely on the stability of the core parts and body coordination (Liu, 2022). In recent years, the level of basketball in China has fluctuated, especially in the international tournaments with poor results, which is closely related to the lack of physical quality of athletes and the relative lag of training methods. The promotion and application of scientific and systematic basketball training methods are particularly important.

The comprehensive requirements of modern basketball for physical fitness and skills are constantly improving, especially in the game situation with strong confrontation and complex movements, the core strength of athletes determines the level and stability of the play of their specialized techniques. Core strength training not only improves athletes' body control ability, but also effectively reduces the incidence of sports injuries, and provides a guarantee for the healthy development of athletes (Peate et al., 2007). Based on this, this paper starts from the demand of improving the scientific level of campus basketball training, integrates the core strength training into the basketball special training system, and explores the specific impact of core strength training on basketball special physical quality through experiments. The goal of this study is to analyze the role of core strength training in improving basketball-specific physical quality through empirical evidence, to provide a scientific basis for optimizing campus basketball training methods, and at the same time to provide theoretical support and practical reference for the further development of basketball.

Research questions and objectives

a) How does core strength training enhance basketball-specific physical fitness and performance compared to traditional training methods?

To investigate the effectiveness of core strength training in improving trunk stability, movement coordination, and skill execution in basketball-specific scenarios.

b) How does core strength training contribute to injury prevention and support the development of basketball-specific skills?

To evaluate the role of core strength training in reducing the risk of injuries and enhancing skills such as dribbling, layups, and shooting accuracy through improved stability and control.

Literature review

The concept and development of core strength

Core strength is the comprehensive training goal of coordinated force generation by muscle groups centered on the trunk to provide physical stability and motor control. The first person to introduce the concept of core

strength training was the American physical therapist Joseph Pilates, who developed a core stability and control based exercise program in the early 1900s, primarily for spinal rehabilitation. (Wood, 2019)。This method was gradually introduced into the field of sports training in the 1970s and 1980s, initially used for the prevention of sports injuries, and gradually applied to competitive sports with the promotion of functional training (Isacowitz & Clippinger, 2019).

The modern theoretical framework for core strength training is based on the research of Paul Hodges, who revealed through experimental studies that the core muscles activate prior to other muscle groups in dynamic movements, thus providing a key role in body stability and force transmission (Hodges & Richardson, 1996). In addition, Stuart McGill's research further elucidates the critical role of core strength in spinal stability and suggests that core strength training should include an integrated training model of endurance, power and control (McGill, 2015). These theories have laid a scientific foundation for the development of core strength training and have led to it becoming an important part of the modern competitive sports training system.

Functions and roles of core strength

Research has shown that core strength training has a significant effect in several sports, and its role is mainly reflected in the following aspects:

Improving Sports Performance. Core strength, as the hub of upper and lower extremity power transfer, plays a key role in enhancing athletes' performance in high-intensity movements such as jumping, throwing and sprinting (Hibbs et al., 2008). Through the coordinated activation of the core muscles, athletes are able to complete movements more efficiently, reducing energy waste and improving exercise efficiency.

Enhanced dynamic balance and stability. The core muscles provide dynamic balance support to the body through control of the spine and pelvis (Borghuis et al., 2008; Prieske et al., 2016). The core muscles provide dynamic balance support to the body through control of the spine and pelvis (Ozmen & Aydogmus, 2016).

Prevention of sports injuries. Core strength training effectively reduces the risk of sports injuries in high-load areas such as the low back and hips by improving neuromuscular control (Huxel Bliven & Anderson, 2013). Especially in sports that require high-frequency changes of direction and sharp stops, core strengthening can significantly reduce the incidence of joint injuries (Jeong et al., 2021).

Supports full-body functional training. Core strength training is not only limited to the enhancement of local muscle groups, but also focuses on the coordination of the whole body, which can significantly improve the overall athletic ability of athletes (Okada et al., 2011). This functional characteristic makes it widely used in competitive sports and daily fitness.

A study of core strength in basketball

Basketball is a team sport that is highly dependent on dynamic balance, coordination, and power transmission, and the role of core strength in supporting basketball-specific skills has been confirmed by several studies (Zemková & Zapletalová, 2022).

Specialized skills support. Core strength is the basic condition for all technical movements in basketball. For example, in the jump shot and backward jump shot, the core muscles ensure the precision and consistency of the shooting movement through the coordinated role of trunk stability and power transfer (Şahiner & Koca,

2021). A study by Hassan et al. noted that core strength training significantly improved shooting percentage and sprint speed in basketball players (Hassan et al., 2023).

Performance Enhancement in Dynamic Motion. Rapid dribbling, change-of-direction breakthroughs, and aerial confrontations are key maneuvers in basketball that require athletes to complete power transfer and postural adjustments in a short period of time. Research has shown that core strength training can effectively enhance athletes' performance in these dynamic maneuvers (Feng, 2009).

Injury Prevention. Frequent sharp stops, changes of direction and high-intensity confrontation in basketball games can easily lead to sports injuries, while core strength training significantly reduces the incidence of sports injuries by improving joint stability and neuromuscular control(Arora et al., 2021).

Throughout the relevant studies, it can be seen that although the theory and practice of core strength training has been validated in several sports, there is still room for further development of research on basketball-specific training. Most of the current studies focus on the role of core strength on general physical fitness, and the development of specialized needs and training programs for different basketball positions is still insufficient. In addition, existing studies have explored fewer long-term training effects and psychological factors, and the future should focus on the sustained effects of training and multidimensional assessment.

METHODOLOGIES

Subjects of study

In this paper, 8 students of sophomore basketball specialization in Guangxi Science and Technology Normal College were taken as research subjects. They are randomly divided into two groups: experimental group and control group, each group has four people respectively. The age of the experimental subjects is 21-23 years old, and their skill levels are all specialized students who have been trained for about four years. The basic conditions of the experimental subjects are as follows:

Table 1. Basic information of experimental subjects.

Group	n/Participants	Average Age	Average Height (cm)	Average Weight (kg)
Experimental Group	4	22	182.4	80.8
Control Group	4	22	181.2	79.1

Research methodology

This study used a variety of research methods to explore the effects of core strength training on basketball-specific fitness. Literature method. Using Web of Science, Google Scholar, CNKI and other databases, the relevant literature on core strength, basketball training, and classification and testing of basketball-specific skills was systematically collected and analysed to provide a solid theoretical foundation for the study. Comparative experimental method. An 8-week controlled experiment was conducted on 8 students in the second year of basketball majoring in Guangxi University of Science and Technology, who were randomly divided into the experimental group and the control group. The experimental group performed core strength training twice a week, aiming to enhance basketball-specific fitness, while the control group maintained regular training. Mathematical statistical method. We used Excel 2010 to statistically analyse the data collected before and after the experiment and used graphical representations to support the conclusions. Logical analysis method. This included a systematic assessment of concepts, theories and experimental data to ensure the scientific and reliable nature of the findings and ultimately to highlight the academic and practical value of core strength training.

Conceptual framework

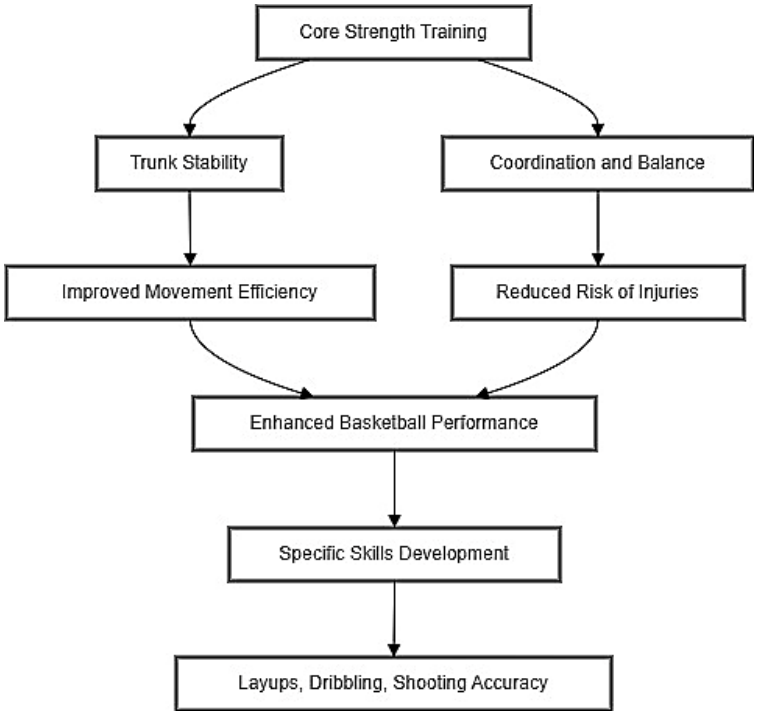

Figure 1. Conceptual framework.

Experimental program

Experimental steps

For the experimental group, an 8-week strength training in the core area was adopted, training twice a week, keeping the same frequency as the regular training, and the regular training was carried out accordingly, mainly focusing on the core strength training. Pre-experimental test was conducted before the beginning of the whole training, and post-experimental test was conducted at the end of the whole training.

The control group was trained according to the original routine training mode, mainly focusing on deep squat, half squat, bench press, simple sprint, and half-court slide. Pre-experimental tests were conducted before the start of the entire experimental training, and post-experimental tests were conducted at the end of the entire training.

Test content and indicators

This study synthesizes the relevant contents of "*Sports Human Science Experiment*" and "*Sports Measurement and Evaluation*" as well as "*Human Movement Ability Detection and Evaluation*", combines with the characteristics of basketball, and selects folding line layup, running around the pole with the ball, continuous folding run, one-minute fixed-point jump shot, and sharp stop and backward leap jump shot hitting rate, to make a comprehensive and representative test on the basketball-specific physical qualities after the core strength training. The best of the two test scores will be taken.

Test content

Zigzag Layup: This test evaluates the athlete's comprehensive ability to combine fast dribbling with a layup, primarily assessing lower limb strength, speed, and control.

Dribbling Around Cones: This test assesses the athlete‘s body control under dynamic conditions, focusing on trunk stability and directional change ability.

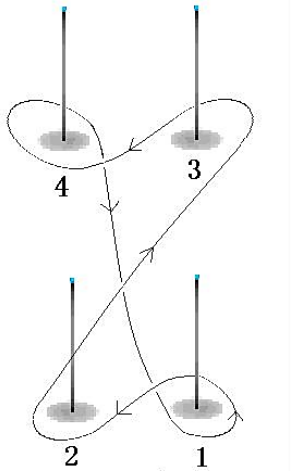

Figure 2. Schematic diagram of running with the ball around the pole.

Continuous Shuttle Run: This test evaluates the athlete's physical endurance and movement continuity.

One-Minute Spot Shooting Accuracy: This test reflects the athlete's upper limb force transmission, trunk stability, and shooting precision.

Stop-and-Back Jump Shot Accuracy: This test assesses the athlete's coordination, stability, and core strength transmission efficiency under dynamic imbalance conditions.

Design of core strength training program for basketball players

At this stage, the methods of core strength training have been abundant through the research of experts in different programs and fields at home and abroad. According to the characteristics of basketball specialties, the design of training programs for specific targets is the focus of this study. Through the design of the program and the implementation of strict systematic training to ensure the scientific reliability of the experimental data.

Core strength training principles for basketball players

The guiding principles of core strength training are derived from the objective laws of athletic training and emphasize the improvement of key muscle groups such as the abdominal and gluteal muscles. Unlike traditional strength training, which focuses on the muscles of the extremities and cardiorespiratory fitness, core strength training enhances whole-body coordination, trunk stability, and effective power transmission. This is especially important for specific movements in basketball, such as aerial contact and quick changes of direction during shooting.

Core strength training is based on the principle of training with small loads and many repetitions, and with the improvement of the trainer's ability, in order to adapt to the needs of the training or the game, it can be made more difficult or increase the intensity, the specific methods are to lengthen the time of static exercises, increase the number of repetitions of power exercises and the number of groups, and also increase the weight of the loads or increase the equipment. Breaking the routine training of basketball players who are set in stone and constantly stimulating the different muscles of the muscle group, so that the physical quality is

constantly improving, obtaining a better special sports ability, and providing power for the development of China's basketball and campus basketball.

Core strength training programs for basketball players

In basketball, agility and variability are the essence, technical confrontation is the approach, physical confrontation forms the foundation, speed and strength provide the assurance, and scoring through shooting is the ultimate goal. Considering the high demands of agility, technical confrontation, and shooting accuracy on body balance and stability, athletes' fundamental physical attributes, aligned with basketball-specific requirements, typically include strength, endurance, speed, flexibility, and agility. This study focuses on selecting fitness indicators that reflect the characteristics of basketball-specific performance and incorporates them into the training design. Based on these considerations, a core strength training program has been developed, as detailed in the following table.

Table 2. Core strength training program for the experimental group.

Training Content	Training Volume	Movement Requirements
Squat on a Balance Pad	(20–50) seconds × (3–5) sets, with 1–2 minutes of rest between sets	Place two balance pads hip-width apart and place your feet in the centre of the pads to perform the squat. Squat with your knees toward your toes, not buckled or turned out, and your knees not over your toes. Thighs are parallel or slightly above parallel to the ground. Straighten your back and tighten your core muscles.
Kneeling Balance on a Balance Pad	(20–50) seconds × (3–5) sets, 1–2 minutes rest between sets	Kneel on one knee on a balance mat and tighten your core muscles. Lift the other leg and opposite arm, keeping the pelvis neutral and not tilted. Control the balance of the body.
Kneeling Balance on a Swiss Ball	(20–50) seconds × (3–5) sets, 1–2 minutes rest between sets	Tighten your abdomen, hold the ball with your hands, control your body to rely on stability, and kneel on the ball while tightening your thighs and crossing your arms over your chest to keep your balance.
Kneeling Warrior Balance on a Swiss Ball	(20–50) seconds × (3–5) sets, 1–2 minutes rest between sets	Kneel on a Swiss ball with one knee, leaning the upper body slightly forward. Cross both arms and extend them straight in front of the head. Extend the opposite leg smoothly backward in the direction opposite to the arms. Hold the warrior balance position for several seconds, ensuring that the upper limbs, torso, and lower limbs are aligned on the same plane. During the hold, keep your eyes focused on the direction of your outstretched hands.
Push-Ups on a Balance Pad	(20–50) seconds × (3–5) sets, 1–2 minutes rest between sets	Place the balance pad on the ground at shoulder-width distance. Position both hands at the centre of the balance pad and perform push-ups. Maintain a straight line from head to toe throughout the movement. Lower your body until your elbows form a 90-degree angle. While pushing back up, ensure the elbows do not hyperextend. Keep your core engaged, avoid arching your lower back, and maintain a straight posture from head to toe. alternate.
Side-Lying Elbow Plank with Opposite-Side Thigh Flexion and Extension	(20–50) seconds × (3–5) sets, 1–2 minutes rest between sets	Position the torso in a side-lying position with one elbow supported on the surface of a Swiss ball. Use the supporting elbow and the same-side foot as the primary points of contact. Align the torso and lower limbs in a straight line. Perform straight-leg flexion and extension with the opposite leg at the hip joint. Ensure the supporting leg remains straight, avoiding knee bending during the motion. Prevent the hip joint from dropping excessively during the exercise.
Swiss Ball Leg Curl Sit-Ups	(20–50) seconds × (3–5) sets, 1–2 minutes rest between sets	Lie supine on a Swiss ball with all four limbs off the ground. Place your hands behind your head and bend your legs at the hip and knee joints. Perform sit-up movements by engaging the core, lifting the torso upward, and then returning to the starting position while maintaining balance on the ball.
Swiss Ball Single-Leg Resistance Flexion and Extension	(20–50) seconds × (3–5) sets, 1–2 minutes rest between sets	Stand on a Swiss ball with one leg while the other foot is wrapped with a resistance band held by a partner. Perform flexion and extension movements with the working leg under resistance, maintaining balance and stability throughout the exercise.

Suspended Push-Ups	(20–50) seconds × (3–5) sets, 1–2 minutes rest between sets	Perform push-ups using suspension straps (e.g., TRX). Place your hands on the straps at shoulder-width, keeping your body straight from head to toe. Lower your body until your elbows form a 90-degree angle, maintaining control of the straps and avoiding swaying. Push back up while engaging your core and keeping your back straight. This exercise improves upper body strength, core stability, and balance.
Knee Tucks	(20–50) seconds × (3–5) sets, 1–2 minutes rest between sets	Begin in a plank position with your feet on a stability tool (e.g., Swiss ball or suspension straps). Engage your core and pull your knees toward your chest, then extend your legs back to the starting position. This exercise strengthens the core, hip flexors, and improves balance.
Side Plank with Crunch	(20–50) seconds × (3–5) sets, 1–2 minutes rest between sets	Start in a side plank position, supporting your body with one forearm and feet stacked. Engage your core and bring your top elbow and knee together in a crunch motion. Return to the starting position and repeat. This exercise targets the obliques and improves core stability.

RESULTS

Both the control group and the experimental group underwent basketball-specific performance tests before and after the experiment. The test results were statistically analysed, with the average scores of the 4 students in each group calculated. Data were processed and analysed using Office 2010 software, focusing on comparisons between pre-test and post-test results within the control group, pre-test and post-test results within the experimental group, and the differences between the control and experimental groups following core strength training.

Comparative analysis of each test index before and after the experiment in the control group

Table 3. Basketball-specific physical fitness test results before and after the experiment in the control group.

Item	Control Group	
	Pre-Test	Post-Test
Zigzag Layup (s)	6.2	6.1
Dribbling Around Cones (s)	10.7	10.3
Continuous Shuttle Run (s)	20.8	20.4
One-Minute Spot Shooting Accuracy	56.3%	71.9%
Stop-and-Back Jump Shot Accuracy	50.0%	60.0%

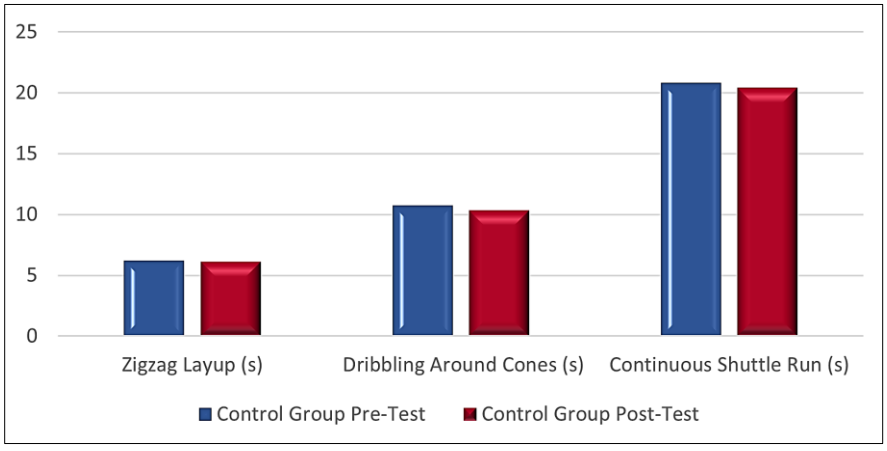

Figure 3. Results of Basketball-Specific Physical Fitness Tests for the Control Group: Pre-Test and Post-Test. Running quality.

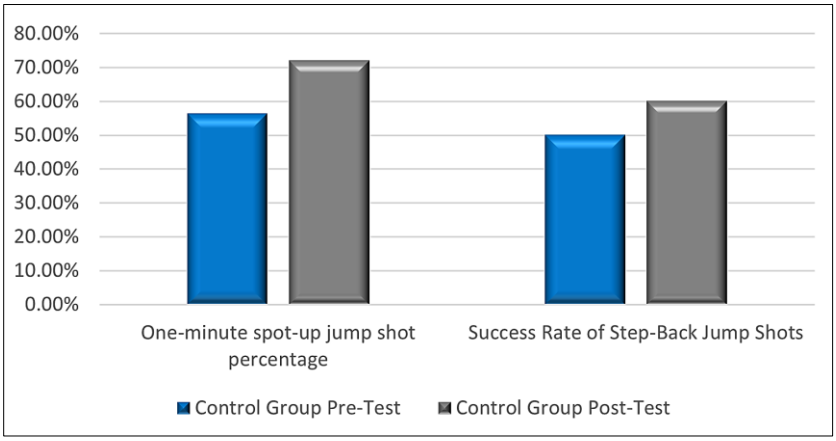

Figure. 4. Basketball-specific physical quality tests before and after the experiment in the control group. Shooting quality.

According to the core requirements of the comparative experimental method, the control group underwent conventional training, which primarily consisted of deep squats, half squats, bench presses, simple sprints, and half-court sliding steps. After the experiment, comparisons revealed that conventional training led to noticeable improvements in basketball-specific skills such as directional control while dribbling around cones, upper limb force control, and accuracy in spot shooting and stop-and-jump shooting. These results align with established training principles; however, the extent of improvement was not particularly significant. Specific data are presented in Table 3 and the comparative results can be visually observed in Figure 3 and Figure 4.

Comparative analysis of the results of each test before and after the experiment for the experimental group

Table 4. Basketball-specific physical fitness test results before and after the experiment for the experimental group.

Item	Experimental Group	
	Pre-Test	Post-Test
Zigzag Layup (s)	6.3	6.2
Dribbling Around Cones (s)	11	10.3
Continuous Shuttle Run (s)	21	19.3
One-Minute Spot Shooting Accuracy	59.4%	75.0%
Stop-and-Back Jump Shot Accuracy	50.0%	70.0%

In accordance with the requirements of the comparative experimental method, the experimental group carries out systematic core strength training, mainly to exercise core stability, the strength of the waist, back, hip and shoulder joints, supplemented by conventional training. After the comparison after the experiment, it was found that the core training has significantly improved the special ability of basketball, special selective students in change of direction control with the ball around the pole, upper limb power control and the hit rate of set jump shot and sharp stop jump shot. During the process of backward jump shot, the torso is in a state of dynamic instability, and the improvement of core strength effectively enhances the athletes' body control ability and improves the synergy between the strength of the torso and the upper limbs, which significantly improves the success rate of the shot. This result is visualized in the data analysis in Table 4 and the comparison graphs in Figures 5 and 6.

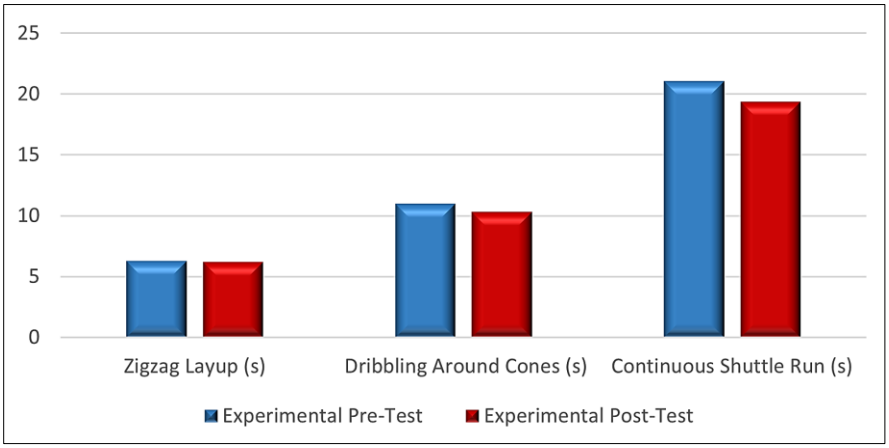

Figure 5. Basketball-specific physical fitness test before and after the experiment in the experimental group. Running quality.

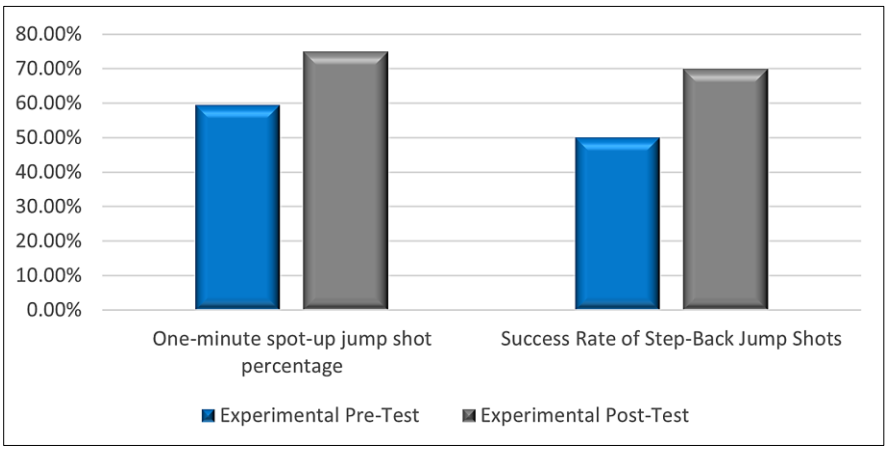

Figure 6. Basketball-specific physical fitness test before and after the experiment in the experimental group. Shooting quality.

Comparative analysis of the results of each test between the control group and the experimental group after the experiment

Table 5. Basketball-specific physical fitness test results of the experimental and control groups after the experiment.

Item	Experimental Group	Control Group
	Post-Test	Post-Test
Zigzag Layup (s)	6.2	6.1
Dribbling Around Cones (s)	10.3	10.3
Continuous Shuttle Run (s)	19.3	20.4
One-Minute Spot Shooting Accuracy	75.0%	71.9%
Stop-and-Back Jump Shot Accuracy	70.0%	60.0%

From Table 5, it is evident that there are varying degrees of differences in physical fitness test indicators between the experimental and control groups after the experiment.

Zigzag layup: The experimental group improved from 6.3 seconds to 6.2 seconds following core strength training, while the control group improved from 6.2 seconds to 6.1 seconds. Although both groups showed improvement, the experimental group's progress was relatively minor, likely due to the zigzag layup relying more heavily on lower limb explosive power.

Dribbling around cones: The experimental group's performance improved significantly, decreasing from 11 seconds to 10.3 seconds, compared to the control group's improvement from 10.7 seconds to 10.3 seconds. This indicates that core strength training has a more pronounced effect on dynamic balance and coordination.

Continuous shuttle run: The experimental group's results improved from 21 seconds to 19.3 seconds, while the control group improved from 20.8 seconds to 20.4 seconds. The greater improvement in the experimental group demonstrates that core strength training is particularly effective in enhancing overall body control and endurance.

One-minute spot shooting accuracy: The experimental group improved from 59.4% to 75.0%, compared to the control group's improvement from 56.3% to 71.9%. The experimental group demonstrated greater advantages in precision and control.

Stop-and-back jump shot accuracy: The experimental group's accuracy increased significantly from 50.0% to 70.0%, while the control group's improvement was from 50.0% to 60.0%. The experimental group's significant progress in complex dynamic movements further validates the importance of core strength in enhancing trunk stability.

In summary, analysis of Table 4 and Figure 4 shows that after 8 weeks of training, the basketball players' specific physical fitness improved in both groups, with the experimental group demonstrating particularly notable advancements in dynamic balance, endurance, and the execution of complex movements. This indicates that core strength training effectively enhances trunk stability and coordination, promoting the synergistic performance of upper and lower limb strength, thereby improving overall specific skills and control. The experimental results further confirm that core strength training significantly enhances basketball-specific physical fitness, highlighting its practical value and potential for widespread adoption in basketball training.

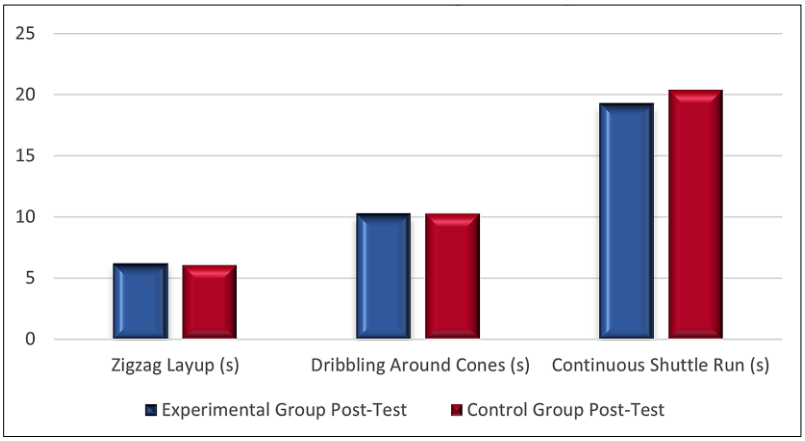

Figure 7. basketball-specific physical fitness test after the experiment. Running quality.

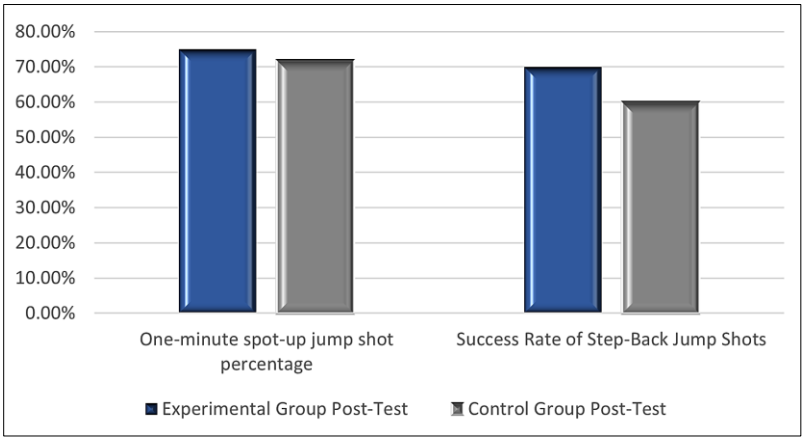

Figure 8. Basketball-specific physical fitness test after the experiment. Shooting quality.

DISCUSSION

The role of core strength training in enhancing specific abilities

Core strength training enhances trunk stability and force transmission. The experimental group demonstrated significant improvements in the continuous shuttle run and dribbling around cones, indicating that core strength training effectively enhances trunk stability and the efficiency of force transmission between the upper and lower limbs (Hodges & Richardson, 1996). This training approach strengthens the functional stability of the transverse abdominis and multifidus muscles, optimizing the overall coordination of the kinetic chain.

Core strength training also improves basketball-specific skill performance. The significant improvement in the stop-and-back jump shot accuracy highlights the benefits of core strength training in balance control and force output during complex movements. This finding aligns with McGill et al. (McGill et al., 2012) who emphasized that core stability is critical for executing high-difficulty athletic movements.

Differences between core strength training and traditional training

The notable progress of the experimental group underscores the advantages of core strength training compared to traditional training. While traditional training focuses on localized muscle strength development, core strength training emphasizes overall coordination and stability (Huxel Bliven & Anderson, 2013), making it more suited to the dynamic and multidimensional demands of basketball.

Prevention of sports injuries

The training program for the experimental group not only enhanced specific abilities but also reduced the risk of injuries among participants. This finding is consistent with Hibbs et al. (Hibbs et al., 2008) who noted that core strength training effectively reduces the incidence of sports injuries by improving neuromuscular control.

CONCLUSIONS

This study systematically analyses the effects of core strength training on basketball-specific physical fitness, and the results show that core strength training is significantly effective in enhancing basketball players' special abilities and comprehensive physical fitness. The experimental results showed that core strength training could significantly enhance the stability, dynamic balance, and power transfer efficiency of the trunk,

thus improving the performance of the athletes in rapid change of direction, folding run, and complex dynamic movements. In addition, the significant improvement of the experimental group in the hasty stop backward jump shot and spot jump shot hitting rate verified the supportive effect of core strength training on the accuracy and stability of specialized skills, especially in the dynamic imbalance state. The study also found that by improving neuromuscular control and joint stability, core strength training effectively reduced the risk of injury in high-intensity confrontation, providing an important guarantee for the long-term health of basketball players.

Although this study verified the positive effects of core strength training on basketball-specific physical fitness, certain limitations still exist. Firstly, the sample size of the study was small, with only eight basketball-specific students as the experimental subjects, making it difficult to comprehensively reflect the response characteristics of athletes of different genders, ages and skill levels to core strength training. Second, the experimental period was 8 weeks, which mainly focused on the short-term training effects, and it was not yet possible to assess the long-term effects of core strength training and its sustainability on seasonal performance. In addition, this study failed to design a specific training program to address the specific needs of core strength for different positions (e.g., guards, forwards, and centres) in basketball, and did not analyse the potential effects of core strength training on athletes' psychological states (e.g., concentration, self-confidence).

Future studies should expand the sample size to include diverse groups, especially athletes of different genders, age levels and competitive levels, to enhance the generalizability of the findings. At the same time, the training cycle should be extended to explore in depth the long-term effects of core strength training and its sustainable effect on athletic performance during the season. More refined core strength training programs can be designed for the specialized needs of different positions in basketball, and their differential effects can be comparatively analysed. In addition, the effects of core strength training on athletes' psychological and cognitive performance can be further explored by combining psychological and cognitive science approaches (Tang & Lim, 2025). In the future, biomechanical analysis and wearable device technology can also be used to monitor and optimize real-time athletic performance during core strength training to improve training efficiency and effectiveness.

This study verified the important role of core strength training in the improvement of basketball special physical quality, which provides a theoretical basis and practical guidance for the scientificization of basketball training methods, as well as a practical reference for the overall development of basketball. The results of the study show that core strength training can not only improve the performance of athletes' specialized skills, but also effectively reduce the incidence of sports injuries, laying a foundation for the health and sustainable development of basketball players. In the future, by optimizing the training program and combining scientific and technological means, it is expected to further develop the potential of core strength training in the field of basketball.

AUTHOR CONTRIBUTIONS

Tang Yangyang led the study design, conducted the core strength training intervention, collected and analysed the data, and was the primary contributor to drafting the manuscript. Tang was also responsible for the development and implementation of the experimental program and training protocol. Lim Seong Pek provided critical guidance on research methodology and statistical analysis, contributed to the literature review and theoretical framework, and offered key revisions to the manuscript for intellectual clarity and

academic rigor. Both authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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