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Molecular & Cellular Biomechanics 2024, 21(2), 452.
https://doi.org/10.62617/mcb452

Article

The effect of core strength training on basketball players' shooting percentage

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CITATION

Xue P. The effect of core strength training on basketball players' shooting percentage. Molecular & Cellular Biomechanics.2024; 21(2): 452.
https://doi.org/10.62617/mcb452

ARTICLE INFO

Received: 30 September 2024
Accepted: 15 October 2024
Available online: 7 November 2024

Abstract: This study focused on how basketball players' shooting percentages are affected by core strength training (CST), which is essential since it offers important information for improving athletic performance. Assessing the effects of an 8-week CST program on the shooting skill and stability of male basketball players was the primary objective of this study. The study involved 30 male healthy athletes, with 15 in the experimental group having heights of 190.2 cm and body weight of 88.2 kg, and 15 in the control group having heights of 8.17 cm. Both groups were evaluated using the Star Excursion Balance Test (SEBT) and shooting tests for two-point and three-point areas within 60s. Both the SEBT and the shooting test underwent statistical analysis using a two-way repeated measures analysis of variance (ANOVA). The findings revealed significant group-time interactions for various lower extremity regions, including the left and right sides during the initial and final SEBT assessments ($p < 0.05$). Additionally, substantial differences were observed between the two-point and three-point areas during pre- and post-shot testing within the group-time interaction. The outcomes underscored the positive impact of the 8-week CST program on the balance and shooting performance of male basketball players.

Keywords: basketball; core strength training (CST); shooting percentage; training; star excursion balance test (SEBT); time interaction

1. Introduction

Core strength is critical for athletic efficiency across a variety of sports, greatly improving metrics such as speed, agility, and power. According to research, athletes who participate in structured core strength training improve their sprinting times and have fewer injuries in sports like track and field and soccer. The kinetic chain theory emphasizes the importance of a stable core in maximizing movement efficiency. For example, in gymnastics, targeted core exercises result in higher performance scores, whereas football players advantage from particular drills such as planks and medicine ball throws to improve explosive power. These results highlight the significance of incorporating core strength training into athletic programs, implying that it can decrease injuries while improving total efficiency. Therefore, the purpose of this research is to investigate the application of core strength training in basketball, thereby contributing to our understanding of optimum training practices.

Basketball is a game that includes sporadic bursts of greater-intensity movement (such as jumping, sprinting, shifting directions, and shuffling), repetitive over a long time. Both anaerobic and aerobic energy processes are involved. Thus, basketball players must be physically fit in all areas, particularly in the areas of aerobic capacity, anaerobic power, upper- and lower-body strength, agility, and core muscular endurance, to play successfully [1]. The shoot is the most fundamental component of the score, along with fundamental motor capacities. The most important and regularly used technical maneuver among the athletic abilities used in the play is shooting. Players' shooting abilities should be improved if they want to win the game. The primary motoric traits appear to be frontal when the distinctive characteristics of the basketball sport are taken into account. Therefore, it is challenging to pinpoint one factor that defines success. Shoot and fundamental motor abilities are the two most fundamental components of the score. Among the physical talents utilized in the play, shooting is the most significant and often utilized technical action [2]. Basketball is a very popular sport. Basketball players' all-around athletic ability will continue to be improved with the help of Virtual Reality (VR) technology, according to research. As a result, it is creative to use VR technology to enhance basketball players' overall skills. Several research has shown technical backing for this technology, although it is not yet fully developed [3].

Figure 1 depicts the basics of a basketball training program. Early preseason: Following the offseason, players are getting ready for the new season and beginning to bulk up. Building aerobic fitness, practical strength, and hypertrophy are prioritized. Late preseason: The start of the season is approaching, and preseason trials are quickly approaching. High strength and power as well as anaerobic conditioning are prioritized. In season: Players must be fully operational for the competition, which is currently in progress. It is important to maintain your strength, power, and aerobic and anaerobic fitness. Off-season: Even when the season is gone and it's time to take it easy for a while, you still need to be active. With a focus on maintaining a low level of exercise (cross-training, mild gym work), rest and recovery are prioritized. It is beneficial to take several weeks off from consistent fitness and strength training. More consistent practice can continue as preseason draws near, with a renewed focus on developing aerobic fitness for preseason workouts.

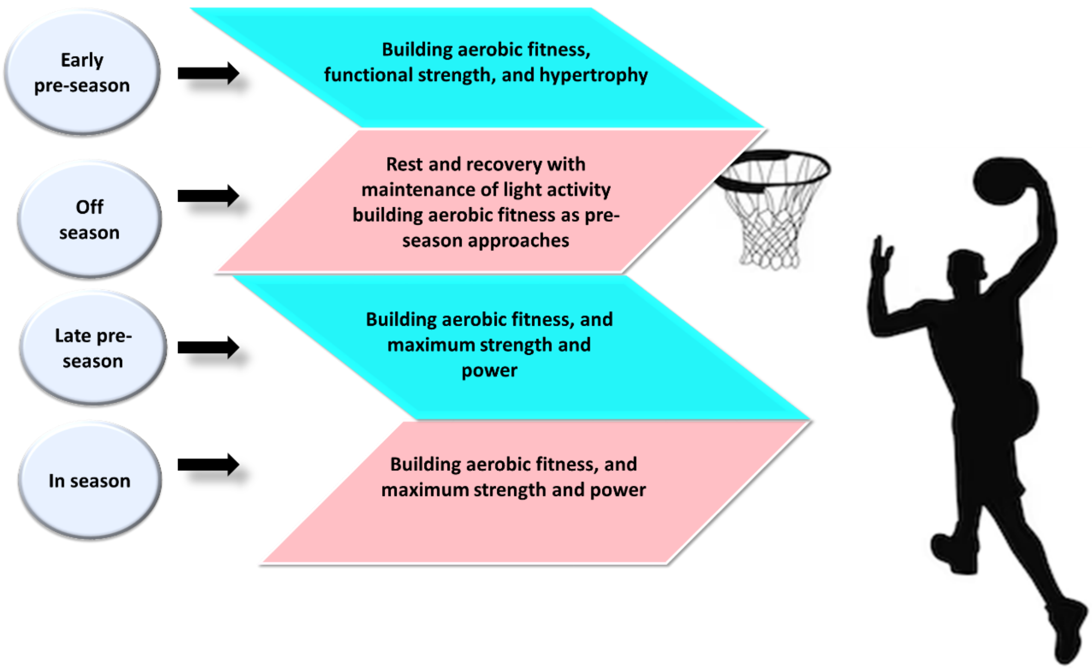

Figure 1. Basics of a basketball training program.

To succeed in today's game of women's basketball, athletes must play a game that is dynamic, diversified, and just better than their opponent's. In addition, as basket shots have a significant impact on basketball's representation and are typically made under more difficult circumstances during competitions, players should shoot with high levels of precision. A player needs good motor skills which differ between men and women to shoot baskets correctly [4]. Basketball players frequently practice shooting only during their shooting drills to meet their training goals. For coaches and basketball fans, increasing shooting target percentage under static and changeable offensive and defensive settings has become a major issue [5]. Women's anaerobic capacity peaks between the ages of 20 and 25, then declines due to both inherited and environmental variables. Basketball is based on anaerobic ability than aerobic ability due to the predominance and repetition of anaerobic needs during a game, and anaerobic glycolysis as a source of energy is crucial to the efficiency of much high-intensity activity [6]. One of the fundamentals of wheelchair basketball instruction is how to execute free throws. The movements used to make a free throw are identical to those used when shooting a basketball in general. Sarojini and Kavithashri [7] determined how certain physical fitness characteristics among kabaddi players were affected by skill-specific training combined with combat rope training. The muscles in the core are there to stabilize and manage. By serving as a connecting element between the lumbosacral region and the upper and lower body parts, the core assists in the distribution of forces produced by the upper and lower limbs [8]. The core assumes a special significance in sports as it provides proximal stability for distal motion. As it results in high force generation and lowers loads on peripheral joints, it turns out that a key component of biomechanical performance is core stability. Due to the importance of balance for basketball players, which might help them avoid injuries and perform better during games, the study participants all have dynamic balance disorders. To improve balance, athletes can become more flexible and activate their core muscles through stretching and core stability [9].

Basketball shooting performance, a complicated skill that is produced, is becoming more significant as biomechanical proficiency levels rise [10]. Athletes are screened before the start of the season to determine their risk for injury. Also, one of the newest areas of study in sports medicine is the enhancement of the muscles that stabilize the core and the enhancement of core stability. Improved sports performance, injury prevention, and the mitigation and treatment of musculoskeletal problems are just a few benefits of improving core stability. Moreover, core stability training lowers injury risk and enhances sports performance [11]. Basketball's primary objective is to attain the best level of athletic performance. Athletes need a greater level of physical and physiological competency in addition to their unique gifts and technical abilities to perform at a high level.

Basketball players need strong cores because they provide a solid base for their movements and improve their balance, coordination, and agility. It helps with strong motions like dribbling, passing, and shooting. It also improves alignment and posture, which lowers the chance of injury [12]. Furthermore, when total endurance rises due to core strength, quick direction changes, strong jumps, and effective defensive stances are made possible. A basketball program that incorporates CST enhances both athletic performance and long-term health and resilience on the court. Moreover, a robust core improves overall endurance, allowing players to compete at a high level throughout the entirety of the game. Since it enables quick direction changes, strong defensive postures, and forceful jumps, it is crucial for both attacking and defensive plays [13]. Consequently, including CST in a basketball practice enhances athletic performance while also promoting resilience and long-term health. After an 8-week CST program, the stability and shooting skills of male basketball players were examined in this study.

1.1. Contribution

- An 8-week CST program dramatically improves male basketball players' balance, according to the study.
- The training program also enhances shooting performance, with noticeable improvements in both two-point and three-point shots.
- The use of detailed statistical analysis strengthens the reliability of the findings.
- The results provide practical advice for coaches and trainers on incorporating core strength exercises to boost players' performance.
- The study highlights the specific benefits of core training on stability and shooting, suggesting that targeted training can optimize performance in basketball.

1.2. Motivation and significance of the study

The study investigates the relationship between core balance training and basketball players' shooting efficiency. It found a strong correlation between improved balances and increased shooting abilities, emphasizing the importance of core training on dynamic balance performance and shooting percentages. The findings have significant implications for athletic training regimens, emphasizing the need for balancing exercises to enhance sports performance, particularly in games like basketball that require dexterity and balance.

2. Literature review

Liu and Xi [14] developed practical supplemental teaching techniques for basketball shooting so that participants can increase their shooting efficiency throughout everyday basketball practice and protect against injury. Hessam et al. [15] determined how a twelve-week McGill core stability program affected motion patterns, shot precision, and throwing efficiency. Wang et al. [16] examined the impact of several strength-training approaches on soccer kicking techniques to identify the set that best promotes the accuracy of hits through its stability. Worobel [17] reviewed the existing literature on elements influencing basketball throw and trunk stabilization. To improve a throw's efficiency during training, one should look for the key components that condition proper trunk stabilization. The athletic performance of basketball players needs to be improved, and this requires efficient and ideal training methods. Haghighi et al. [18] evaluated how juvenile female basketball players' athletic performance was affected by six weeks of high-intensity interval training (HIIT) vs. plyometric training (PT). Xianbiao[19] examined basketball shooting's technical movements before outlining the best ways to teach these movements to students. According to the study's findings, a coach should first do a good job of theoretically explaining shooting method fundamentals so that athletes can master them. The coach should then use a variety of techniques to teach to raise athletes' enthusiasm and initiative to learn. Finally, the coach should merge physical fitness training with shooting technology action training. Dubey[20] analysed the relationship between upper-body and trunk coordination and how it affects the efficiency of wheelchair basketball players. The study involved eleven wheelchair basketball players found a strong correlation between the dominant side's upper extremity muscles and trunk during free throw attempts. The study found medium differences in triceps muscle activation and significant differences in anterior deltoid and external oblique muscle activation before and after training evaluations. Successful free throw attempts also varied significantly. Patel et al. [21] assessed the impact of adductor injuries on player efficiency, game inability, and career longevity after return to play (RTP) in National Basketball Association (NBA)athletes. The research, which looked at adductor injuries in NBA players, showed that guards suffered injuries more often than centers or forwards. Following an average of 7.7 ± 9.8 games and 16.9 ± 20.4 days following their initial adductor injury, all players were able to resume their play. Arslan et al. [22] examined the impact of 6 weeks of small-sided games (SSG) training vs training for core SSGcoreon the physical efficiency of young soccer players. The SSG group solely engaged in SSG periodization; the SSGcore group engaged in 2-, 3-, and 4-a-sided soccer matches as well as upper and lower body core strength activities coupled with SSG.In the sprint time, countermovement leap, squat jump, triple-hop distance, and three-corner run test (TCRT), the SSG core group demonstrated statistically significant gains. Şahiner and Koca[23] assessed how an 8-week neuromuscular training program (NTP) affected pre-pubescent male basketball players' motoric and chosen basketball skills. The experimental group, which had core training twice a week for eight weeks, and the control group, which carried on with their usual training. Performance testing for the free throw and vertical leap were carried out both before and after the instruction. Results revealed that the experimental and control groups' free throw and vertical leap test scores differed significantly, with the experimental group demonstrating more progress.The CST group showed significantly improved dynamic balance compared to the CT group, particularly in the anterior, posterolateral, and posteromedial directions. Feng et al. [24] showed greater agility at T2. However, the CST group's gains in dribbling abilities from T1 to T2 were significant but not compared to the CT group. These findings suggest that CST training can improve agility and dribbling abilities. Gong et al. [25] discovered that there were notable performance variations between the two groups both before and after the single-leg standing test with closed eyes. The experimental group showed substantial changes in SEBT Test results when their left or right foot was supported in different orientations. However, no discernible change was observed when the left foot was supported. Additionally, there were notable variations in the experimental group's Core Four-Direction Endurance Test results. Firouzjah showed that, in comparison to the control group, the experimental group's CX WORX exercises had a significant influence on knee strength, abductors, trunk extensors, and hip external rotator [26]. On the other hand, there was no discernible variation between the two groups' knee flexor muscle strengths. The research involved 26 articles with an average 4.5-point quality evaluation score. The average training time for reaction ability was 5 weeks, involving 150 participants, resulting in a 7.2%–19.4% improvement in agility quality. Speed quality was 6 weeks, resulting in a 1.2%–14.4.4% improvement. Strength quality was 6 weeks, resulting in a 1.4%–10.33% improvement. Plyometrics was 12 weeks long, resulting in a 2.34–6.69% increase in agility [27]. There were 13 students in the research, with their average age being 22 and their dropout rate being with a *p*-value of 0.000, statistically significant differences were discovered between the pre-SEBT (R) and post-SEBT (L) groups. A *p*-value of 0.000 was found in the pre-ASBC (Asthma and Blood Pressure Control) group mean. These results imply that improving these characteristics might lead to better overall health results [28].

3. Research method

Basketball was the field of research in which thirty willing participants, all male basketball players over 18 years of age, were included in the research, and 15 individuals were assigned to both the test and control groups, respectively. The test group's standard height was 190.3 ± 8.17 cm, and their average weight was 88.3 ± 8.13 kg. In contrast, the control group's average height was 190.86±8.97 cm and their average weight was 88.8 ± 11.99 kg.

3.1. Selection criteria

The study's selection criteria comprised both inclusion and exclusion factors to guarantee a uniform and appropriate sample for examining basketball players' dynamic balance performance.

Inclusion Criteria: The study involved male basketball players over 18, with a background in the sport. Participants were actively engaged in basketball, and they were required to provide informed consent, indicating their willingness to participate and understanding of study procedures and potential risks.

Exclusion Criteria: The study excluded participants with pre-existing health conditions or injuries that could affect balance or performance, recent injuries, particularly those affecting the lower extremities, and those on medication that could influence balance, cognitive function, or physical performance to maintain internal validity and reliability.

3.2. Study design

The test was disclosed to participants the day before the observations. The tests conducted had no negative health effects, and the subjects were informed. YıldızUzanEriş Balance Test (YUEDT) was utilized to determine the dynamic balance performance of basketball players. During YUETT practice, the person needs to keep their body stable with the supporting foot while using the other foot to push themselves as far as possible in various directions before coming back to the starting position.

Figure 2 depicts the two-point shot hit test. Throughout the test, the other foot was allowed to return to the center starting position without altering its position by lightly tapping the participant's reach. Each competitor in YUETT had the option to make three attempts with both feet on a total of eight lines. At the beginning of the test, each individual placed their right foot in the middle. There is a 5-minute break after the third trial, and the remaining Two-Point Shooting Accuracy Test was used to gauge athletes' 2-point shooting abilities. The player passed from the P1 point and then took a shot from the level of the No.2 funnel after sprinting from the No. 1 funnel to the No.2 funnel. As soon as he received the ball after the pass, he shot from the level of the No.3 funnel. This procedure was also carried out in the 4th, 5th, and 6th funnels. He was asked to complete the designated course within 60s.

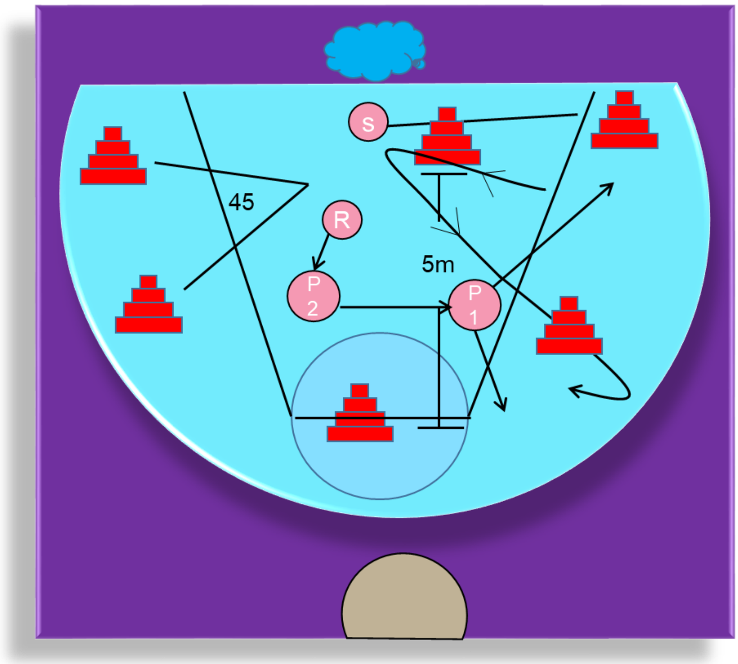

Figure 2. Two-point shot hit test.

The Three-Point Shooting Accuracy Test measured players' 3-point performances. The player ran from the No.1 funnel to the No.2 funnel took a pass from the P1 point and shot from the level of the No.2 funnel. He was given 60s to finish the predetermined course. The number of shots fired in the preceding 60s was noted. Three tests were performed. Between testing, complete rest was mandated.

Figure 3 denoted the accuracy test for three-point shots. The core training in the experimental group lasts for 8 weeks as long as they are conducted three days a week after the initial values of the shooting score and star-reaching reach balancing tests of the volunteer contestants in the control and experimental groups are taken. The training program applied is the training method called core training (CA) as defined in **Table 1**. The CA continued for 8 weeks and was implemented 3 days a week.

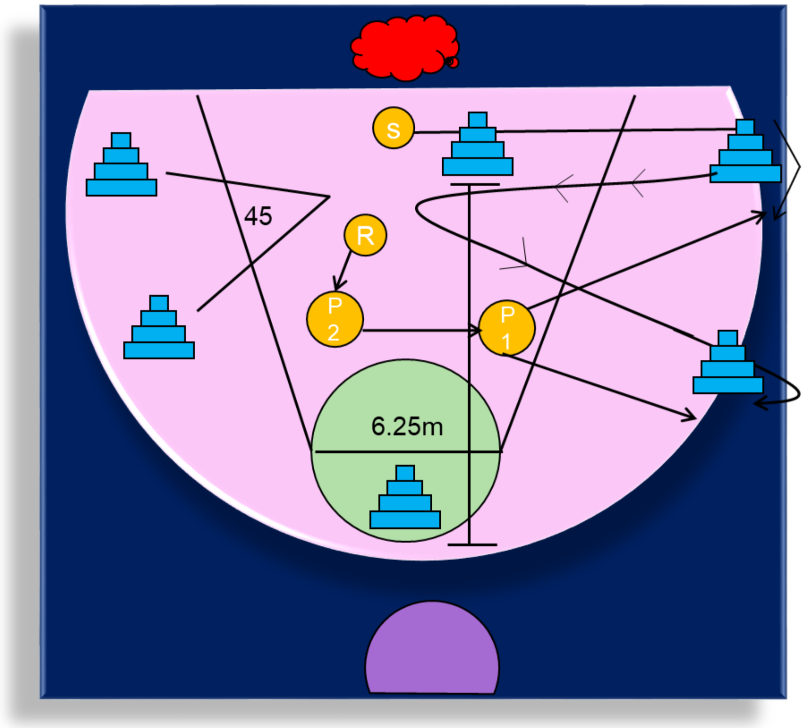

Figure 3. Accuracy test for three-point shots.

Table 1. Training details.

Movements	Contents
Bridge	Static hold in the bridge position for 5s and then descend. in 10 repetitions.
Body extension	Sit on the floor with knees bent and arms raised forward. Will make a 45-degree angle. Lie backward and wait for 15s to come to the starting position.
Shuttle	Lift the head and shoulders upwards and return to the first position after 5s of static. 10 continues again and again.
Romanon his beach shuttle	On the Romanian bench, knees are bent, hands are placed crosswise on the chest, and sit up. After 5s of static standing in the position, it is returned to the starting position. 10 is applied repeatedly.
Abdominal contraction	Knees bent, hands crossed in the thorax, during breathing, the abdominal muscles seconds of contraction and relaxation. It is applied with 10 repetitions.
Lowerextremityon the ground rotation	In the supine position, the arms are spread to both sides, providing trunk stabilization. Rotation to the right and left with the knees bent at 90 degrees. 5s right and 5s left and 10 repetitive applications.
On the legsscissorsmovement	In the supine position, with the legs stretched, the heels are raised 10 cm from the ground, and the application of both legs by lowered again. 10 repetitive applications.

SEBT (YUEDT) and two-way repeated analysis of variance for percentages of two- and three-point hit scores over 60s.

Training Protocol: The study used an 8-week Core Training (CA) program, conducted three days a week, to improve basketball players' dynamic balance and shooting abilities. Particular core strength exercises that targeted critical muscle areas for balance and shooting accuracy were the main emphasis of the training sessions.

Core Strength Exercises: To improve stability and control during dynamic movements, the training program includes core strength exercises such as leg lifts, Russian twists, planks, and side planks. The balance and shooting mechanics were reinforced with lower body strength and flexibility exercises such as lunges, squats, and hip rotations.

Training Frequency, Duration, and Intensity: An eight-week training program that comprised shooting skills, core strength exercises, and balancing drills was attended by the participants. The level of difficulty was progressively raised to test their limits, with an emphasis on good form and technique to reduce the chance of damage.

Assessment Methods: The SEBT and shooting tests for two- and three-point accuracy were used as assessment techniques in the study. By evaluating the participants' reach lengths in different directions, the SEBT evaluated the participants' dynamic balance. Timed sessions were used for shooting tests, where participants tried two- and three-point shots within predetermined courses, and the number of successful shots was recorded.

Statistical Analysis Techniques: A two-way repeated ANOVA was used as one of the statistical analysis approaches to evaluate the percentages of two- and three-point hit scores across 60s between the experimental and control groups. To assess how well the core training program affected dynamic balance and shooting performance, pre-training and post-training data were compared. To reduce the effects of tiredness and guarantee reliable assessment findings, full rest intervals were required in between testing sessions.

Core Strength Training Program: Duration, Frequency, and Intensity: The core strength training program used in this research lasted eight weeks, with participants training three times a week. Each session was designed to gradually raise in difficulties, enabling athletes to enhance their power, balance, and shooting mechanics while avoiding injury. The exercises targeted important muscle groups required for dynamic stability, with movements such as leg lifts, planks, side planks, Russian twists, lunges, and squats. The training was intended to difficulty the participants by slowly raising the duration and intensity of exercises, allowing them to push their limitations while keeping proper form. Each session focused on precision and control, especially lower body and core stability, which are essential for improving shooting accuracy and balance in dynamic basketball movements.

The Participant Recruitment Process and Selection Criteria: The participant recruitment procedure was designed to guarantee a representative sample of male basketball players by setting clear inclusion and exclusion criterion. Athletes were hired using their competitive basketball experience, guaranteeing that all participants were familiar with the sport's requirements. Participants had to be male, 18 years old or older, and active basketball players. To reduce variability in efficiency, individuals with existing injuries, particularly those impacting balance or shooting capacity, as well as any health conditions that could impair efficiency, were eliminated. In order to sustain the research's internal validity and reliability, participants who were taking medications that affected their physical or cognitive function were excluded. Before participating, all chosen athletes presented informed consent, which acknowledged the research processes and possible hazards. This rigorous selection procedure ensured that the last sample was representative of healthy, competitive male basketball players, laying the groundwork for evaluating the effect of core power training on balance and shooting efficiency.

4. Research results

30 male healthy athletes participated in the study. While the height values of 15 participants in the experimental group were 190.2 ± 7.18 cm and body weight was 88.2 ± 7.14 kg, 15 participants in the control group had a height of 8.17 cm.The mean and standard deviation values of the star balance test left-footed trials of the experimental and control group athletes involved in the research. **Table2** demonstrates the analyzed results of the Star Balance Test in repeated measurements of left-footed trials for experimental and control group athletes in a two-way ANOVA Test.As a result of 2-way repetitive evaluations of ANOVA, the Lateral star balance test of the star balance test of experimental and control group athletes ($F = 4.927$, $p < 0.05$).

Table 2. Star Balance Test of experimental and control group athletes involving in the research Two-Way ANOVA Test results in repeated measurements of left-footed trials.

Variable		Number of participants	Pretest (Mean±Sd)	Posttest	Group X Time (F)	Effect Size (Cohen's d)
Anterior Left (cm)	Experimental group	15	77.92±7,85	80.85±8.81	0.388	0.37
	Control Group	15	75.24±8.05	78.03±7.62		0.36
Anterolateral Left (cm)	Experimental group	15	89.24±7.41	91.10±8.55	0.108	0.23
	Control Group	15	83.88±8.33	85.24±6.84		0.17
Lateral Left (cm)	Experimental group	15	101.25±10.11	105.61±10.84	4.925	0.45
	Control Group	15	95.81±7.65	96.81±7.35		0.10
Poster lateral Left (cm)	Experimental group	15	104.00±10.58	104.44±10.51	10.678	0.04
	Control Group	15	102.91±9.62	104.43±10.55		0.15
Posterior Left (cm)	Experimental group	15	102.84±9.95	110.48±9.55	4.387*	0.80
	Control Group	15	104.52±10.61	107.00±10.95		0.23
Posteromedial Left (cm)	Experimental group	15	99.22±8.99	106.92±10.53	12.325*	0.81
	Control Group	15	100.45±10.85	102.89±13.91		0.19
Medial Left (cm)	Experimental group	15	84.91±6.35	92.43±9.35	6.678*	0.98
	Control Group	15	81.04±11.50	82.82±12.91		0.14
Anteromedial Left (cm)	Experimental group	15	71.50±5.43	74.15±7.61	4.669*	0.42
	Control Group	15	65.11±10.25	1.96±9.40		0.36

Figure 4 depicts the pretest mean scores for the experimental and control groups in the Star Balance Test for different directions calculated with the right foot. Prior to training, the experimental group had slightly higher mean scores in most variables than the control group, demonstrating slightly superior initial balance efficiency. For example, in the anterior direction, the experimental group had a mean score of 77.92 cm, whereas the control group scored 75.24 cm. Similar differences were observed in the lateral direction, with the experimental group measuring 101.25 cm versus 95.81 cm in the control group. These baseline findings serve as a basis for assessing the training program's influence on balance enhancement.

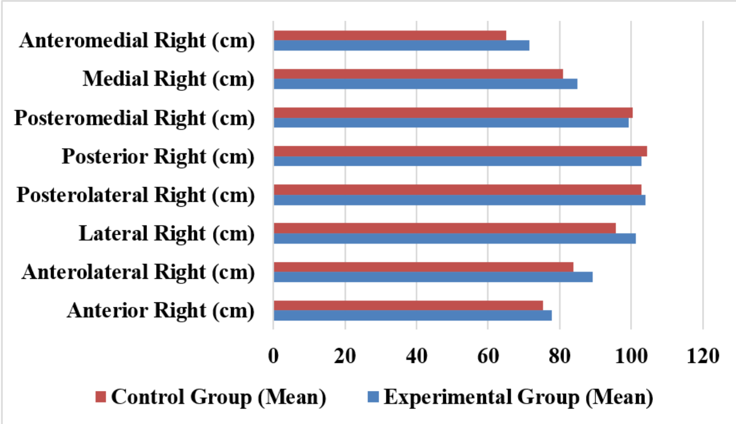

Figure 4. Pretest data for experimental and control groups (Mean only).

Figure 5 depicts the posttest mean scores for the experimental and control groups after the training intervention. The findings show a significant enhancement in balance efficiency for the experimental group in all measured directions. For example, the experimental group increased their anterior height from 77.92 cm to 80.85 cm and their lateral height from 101.25 cm to 105.61 cm. In contrast, the control group only showed minor enhancements, like in the anterior direction, where the mean raised from 75.24 cm to 78.03 cm. The substantial variations between the posttest findings indicate that the training program improved the experimental group's balance efficiency.

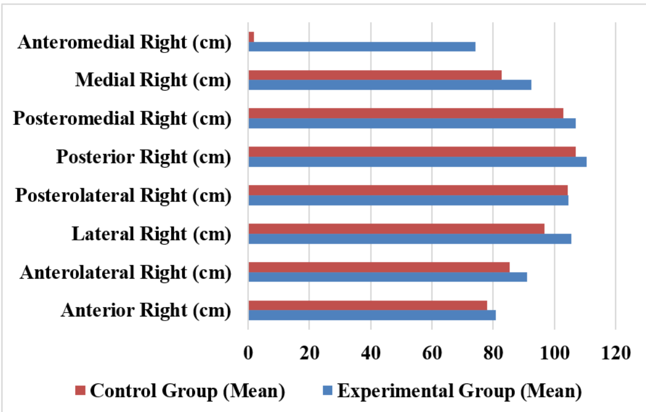

Figure 5. Posttest data for experimental and control groups (Mean only).

The mean and standard deviation values of the star balance test right foot trials of the experimental and control group athletes taking part in the research. **Table 3** shows a star Balance Test and Two-Way ANOVA Test on athletes from both experimental and control groups, focusing on repeated measurements of right foot trials. Analysis of 2-way repetitive evaluations of ANOVA.

Table 3. Star Balance Test of experimental and control group athletes involving in the research Two-Way ANOVA Test results in repeated measurements of right foot trials.

Variables	Experimental or Control group	Number of participants	Pretest (Mean±Sd)	Posttest (Mean±Sd)	Group X Time(F)	Effect Size (Cohen's d)
Anterior Right (cm)	Experimental group	15	77.92±7,85	80.85±8.81	0.388	0.37
	Control Group	15	75.24±8.05	78.03±7.62		0.36
Anterolateral Right (cm)	Experimental group	15	89.24±7.41	91.10±8.55	0.108	0.23
	Control Group	15	83.88±8.33	85.24±6.84		0.17
Lateral Right (cm)	Experimental group	15	101.25±10.11	105.61±10.84	4.925*	0.45
	Control Group	15	95.81±7.65	96.81±7.35		0.10
Poster lateral Right (cm)	Experimental group	15	104.00±10.58	104.44±10.51	10.678*	0.04
	Control Group	15	102.91±9.62	104.43±10.55		0.15
Posterior Right (cm)	Experimental group	15	102.84±9.95	110.48±9.55	4.387*	0.80
	Control Group	15	104.52±10.61	107.00±10.95		0.23
Posteromedial Right (cm)	Experimental group	15	99.22±8.99	106.92±10.53	12.325*	0.81
	Control Group	15	100.45±10.85	102.89±13.91		0.19
Medial Right (cm)	Experimental group	15	84.91±6.35	92.43±9.35	6.678*	0.98
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	Control Group	15	65.11±10.25	1.96±9.40		0.36

The average and standard deviation values of the Shooting Percentages Recorded in 1min by the experimental and control group athletes taking part in the research are shown in **Table 4**.

Table 4. Two-Way ANOVA Test results in repeated measurements of shooting percentages recorded by experiment and control group athletes participating in the study in 1 min.

Variables		Number of participants	Pretest (Mean±Sd)	Post-test (Mean±Sd)	Group X Time(F)
in 1min Two-Point Shot Percentage (%)	Experimental group	15	25.81±7.65	45.11±13.55	43.130*
	Control Group	15	31.39±6.66	33.61±5.95	
in 1min Three Point Shot Percentage (%)	Experimental group	15	15.82±10.11	34.72±12.33	28.634*
	Control Group	15	15.35±6.55	15.22±9.42	

Figures 6 and **7** denote the comparison of two-point shots and three-point shots in 1min. As a result of the 2-way repetitive evaluation of ANOVA. Two-point recorded by the experimental and control group athletes in 1min (F = 43.130; p < 0.05) and three-issue (F = 28.639; p < 0.05) GrupXZaman interaction between the pre-test and post-test values of the following percentages was found to be significant.

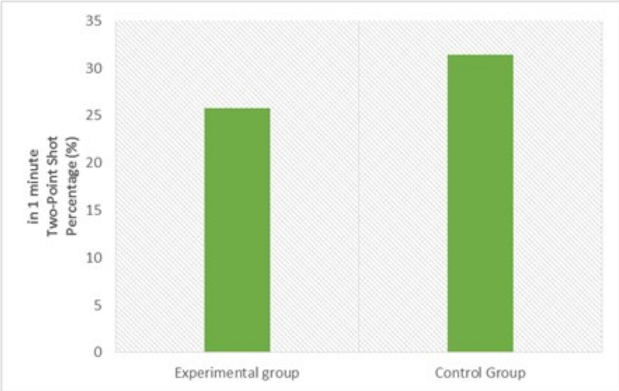

Figure 6. Comparison of two-point shot in 1 min.

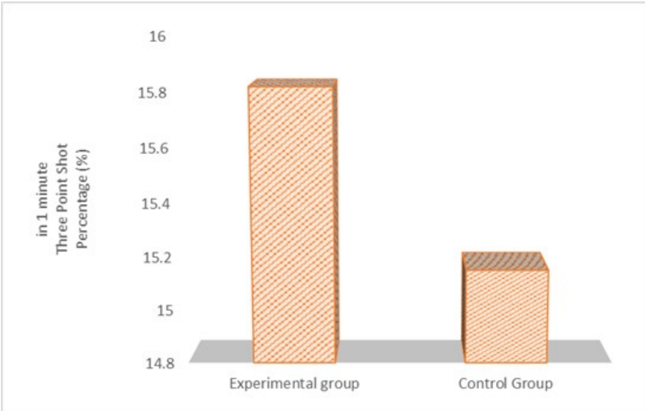

Figure 7. Comparison of the three-point shot in 1 min.

5. Discussion

Shooting is a pivotal element in basketball, requiring a multitude of physical skills, among which balance is paramount. A proficient shooter must not only have precision but also possess the ability to control their body effectively during both shooting and general movement on the court. This control is inherently linked to balance, making it a critical component in shooting efficiency. Consequently, improving an athlete's balance can directly influence their shooting performance. The primary objective of our study was to enhance balance performance and shooting accuracy through a dedicated core training program. Participants performed a strenuous core training program for eight weeks as part of the study, to improve balance and, in turn, shooting accuracy. In particular, we concentrated on 2-point and 3-point shooting accuracy to measure the gains in balance and shooting performance. While the control group carried on with their usual training, the experimental group took part in the eight-week core training program. Our results showed that the experimental group's balance had significantly improved, as seen by their increased stability on both their right and left foot. Compared to the control group, there was a discernible improvement. The study's effect sizes demonstrate the significant gains in shooting performance and attest to the efficacy of the remedial activities that were carried out. The exercises were designed to improve your shooting mechanics and coordination in several ways. The enhancements in Group A are consistent with the motor learning theories presented in the study [29] Their study highlights how important it is to use certain shooting workouts to improve shooting coordination and mechanics. Particularly successful shooting strategies included shooting off the dribble, shooting with a partner, and form shooting exercises. These exercises provide a comprehensive method for raising shooting efficiency and accuracy by addressing many aspects of the firing action. The results align with the study recognized that footwork, balance, and shooting technique are critical physical characteristics that contribute to improved shooting accuracy [30]. Athletes who possess strong physical and mental attributes typically shoot more accurately. This bolsters the idea that to maximize shooting performance, extensive training regimens that address both mental and physical components are required. They support adding form shooting, partner shooting, and dribble-based shooting to remedial exercises. The goal of form shooting is to consistently maintain good shooting form. Partner shooting adds a competitive and collaborative aspect that can improve attention and flexibility. Shooting from the dribble adds a dynamic element that helps players improve their accuracy in more challenging, game-like scenarios. The importance of stability exercises in these corrective exercises is emphasized in this study [31] Athletes need to maintain balance throughout the shooting action, and these workouts improve their stability and control over their body posture. Stability is especially crucial for dynamic motions, as firing accuracy may be greatly affected by a stable shooting platform. Players who possess a strong lower body can exert the required force through their legs, and dynamic stability guarantees that they can stay balanced during the shooting motion. To make precise and forceful strokes, especially while moving quickly or under duress, you need to have both strength and steadiness.

Core strength training increases shooting accuracy by improving the athlete's body's stability and control during dynamic motions, which is an important aspect of basketball shooting techniques. From a biomechanical standpoint, the core muscles, which include the abdominals, obliques, lower back, and hip muscles, are responsible for sustaining balance and transmitting power during the shooting motion. When shooting, especially in jump shots or off-balance circumstances, athletes depend on their core to stabilize the torso and effectively transmit power from the lower to upper body. This transmission enables for a smooth, controlled release of the ball, which has a direct impact on shooting accuracy. A strong core allows athletes to retain correct posture and alignment during the shooting motion, decreasing unwanted sway or movement that can impair accuracy. Furthermore, increased core strength improves dynamic stability, enabling athletes to modify their body position more efficiently when shooting under pressure or moving. This is especially essential in basketball, where players often shoot while in motion or as defenders shift their positions. Thus, core strength training not only improves balance but also enables for more consistent shooting mechanics, which leads to increased accuracy.

The effects of core strength training can vary greatly depending on a player's position, like centers and guards, as each has distinct requirements on the court. Centers, who frequently participate in physical play near the basket, need strong core muscles to sustain balance and stability while absorbing defensive contact. This core strength helps them pivot and position themselves efficiently for controlled, strong post shots, as well as improves their rebounding skills. Guards, on the other hand, depend on agility and dynamic movement, frequently shooting off the dribble or during quick transitions. Enhanced core power in guards leads to superior shooting stability and the capacity to modify directions rapidly while retaining balance during drives to the basket. Overall, while all players gain from core training, centers focus stability and power under pressure, whereas guards focus dynamic core stability for precise shooting while moving.

Limitations

One significant limitation of this study is its small sample size, which may impact the results' generalizability. With only 30 participants separated evenly between the experimental and control groups, there is a chance that the findings will not accurately depict the larger population of basketball players. A small sample size can raise variability and decrease statistical power in evaluations, possibly masking significant impacts or producing findings that cannot be replicated in larger cohorts. Individual differences in physical capacities, experience levels, and responsiveness to training interventions may also impact results. Future research should consider increasing the sample size to improve the reliability of the results and better comprehend the influence of core strength training on shooting accuracy across a wide range of player demographics and ability levels.

6. Conclusion

The impact of CST on basketball players' shooting percentages is an intricate problem with important performance implications. Comprehensive study shows that integrating core strength exercises into routine basketball training programs can significantly improve shooting effectiveness and total court effectiveness. To successfully incorporate CST, coaches and trainers should create practice sessions that incorporate exercises that target core stability and strength, like planks, medicine ball rotations, and stability ball workouts. These exercises should be introduced gradually to guarantee that players build the muscular endurance required to regulate their body mechanics during shooting sequences. Enhanced core strength not only helps to generate force and sustain balance, but it also lowers the possibility of injuries and strains, which contributes to player lifespan. Furthermore, players with higher shooting percentages can considerably improve team dynamics and offensive tactics. While this study presents useful information, it is constrained by a small sample size and inadequate assessment of long-term impacts. Future research should concentrate on increasing follow-up periods to evaluate the long-term effect of core strength training on shooting efficiency, as well as comparative assessments of various training techniques and age-related variables.

Ethical approval: Not applicable.

Conflict of interest: The author declares no conflict of interest.

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