

Enhancing basketball jump shot performance and dynamic balance in male basketball players through balance shooting training

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Abstract:

This research aimed to achieve the following objectives: 1) develop the balance shooting training program (BSTP) and basketball jump shot performance test (BJSPT); 2) compare the basketball jump shot performance and dynamic balance in male basketball players before training, after 4 weeks, and after 8 weeks of undergoing balance shooting training; 3) compare the basketball jump shot performance and dynamic balance in male basketball players between the balance shooting training group (BSTG) and the regular training group (RTG). Sixteen participants were divided into two groups. The BSTG underwent an 8-week BSTP, with sessions held three days per week. The BJSPT and Y-balance test (YBT) were conducted before training, after 4 weeks, and after 8 weeks. Data analysis utilized a one-way analysis of variance with repeated measures, and pairwise comparisons were performed using the least significant difference (LSD) method. The BJSPT and YBT were administered, and data analysis was conducted using a one-way analysis of variance with repeated measures. Pairwise comparisons were made using the LSD method. The findings revealed the following. 1) The quality of the BSTP was assessed using the index of objective congruence (IOC) method, revealing that each item scored between 0.40 and 1.00. Similarly, the BJSPT underwent content validity assessment using IOC, scoring between 0.60 and 1.00 for each item. The reliability, measured by intratester reliability with intraclass correlation coefficient statistics (ICC), was found to be 0.86. 2) Significant differences were observed in comparing basketball jump shot performance and dynamic balance among male basketball players who underwent BSTP before training, after the 4th week, and after the 8th week of training. The differences reached statistical significance at the 0.05 level. 3) Comparing basketball jump shot performance between the BSTG and RTG after the 8th week of training, it was found that the BSTG exhibited significantly higher performance than the RTG at the 0.05 level. Conversely, the dynamic balance between these two groups showed no significant differences at the 0.05 level. Considering the effect size criteria, it was observed that the basketball jump shot performance (after 4th week: $d = 0.74$, after 8th week: $d = 1.23$) and dynamic balance (after 4th week: $d = 0.18$, after 8th week: $d = 0.51$) of the BSTG was more likely to change compared to that of the RTG. In summary, this study confirms that the BSTP can improve the basketball jump shot performance and dynamic balance in male basketball university players. The BJSPT is appropriate for testing male basketball university players.

Key Words: Balance Shooting Training, Basketball Jump Shot Performance, Dynamic Balance, Male Basketball Players

Introduction

Basketball, a widely enjoyed sport with global participation, encompasses diverse physical and technical demands (Abdelkrim et al., 2010; Scanlan et al., 2012). Characterized by intermittent intensity, basketball involves a combination of sprinting, lateral movements, jumps, and direction changes. Assessments have shown that basketball players excel in dynamic balance and vertical jumping, with superior performance in triple horizontal jumps (Domínguez et al., 2021). The dynamic nature of basketball gameplay requires the repeated execution of fundamental skills such as passing, rebounding, dribbling, and shooting, all occurring within periods of both high and low intensity (Read et al., 2014). Shooting is crucial in a team's offensive strategy because higher accuracy in two- and three-point shots significantly enhances a team's chances of victory (Ibáñez et al., 2008; Lorenzo et al., 2010; Özmen, 2016). Proficiency in basketball jump shot performance is a crucial indicator of an athlete's capability to compete effectively in basketball leagues, as asserted by Gulthawatwichai (2012) and further emphasized by Wissel (2004), who declares the jump shot as the paramount skill in basketball. While other fundamental skills may create advantageous shooting opportunities, converting these opportunities into points remains paramount. Despite the critical role of basketball jump shot performance in team success, there is a shortage of valid and reliable assessments designed specifically to evaluate this skill among basketball athletes.

Basketball jump shot performance is one of the game's most frequent and crucial technical aspects (Marko et al., 2023). Basketball shooting involves three distinct characteristics: the set shot, jump shot, and lay-up shot. The set shot, commonly used for free throws, is executed from a stationary position with both feet

firmly grounded. In contrast, the jump shot takes place mid-air, releasing the ball near the zenith of the leap, providing added power and range to surpass defenders. A vital element of the jump shot is the necessity for players to leap and release the ball, transmitting force through their body, arms, wrists, and hands. Maintaining balance is imperative, as emphasized by Pucharoen (1987), who underscores its pivotal role. Players must limit movement or decelerate before shooting to optimize balance. The efficacy of the jump shot is particularly evident at close distances (less than 3.65 m from the hoop) and medium ranges (3.65–6.70 m from the hoop). A distance of 4.60 m is strategically chosen for the balance shooting training program (BSTP). Another standard shot in basketball is the layup, executed while moving toward the basket, often utilizing the backboard for accuracy. The accuracy of a basketball jump shot relies on four fundamental shooting mechanics: balance, sight, follow-through, and elbow alignment (Wissel, 2004; Krause & Nelson, 2019). Balance, a cornerstone in various daily activities, can be categorized into static and dynamic balance. Proprioception training can enhance static and dynamic balance in male basketball players because proprioception involves a complex neuromuscular process related to internal kinesthetic awareness of body position and movement, facilitating joint stability (Domeika et al., 2020). Static balance involves maintaining an upright posture and containing the line of gravity within the base of support, as acknowledged by Clark et al. (2010) and Greve et al. (2007). The shooting mechanics is encapsulated by the balance, eyes, elbow, and follow through (BEEF) principle. B (balance): The movement always starts from the floor; when catching the ball, bend the knees and ankles to bring the body in a balanced position. E (eyes): For the shot to be accurate, the player must focus on the target (i.e., the player must identify the location of the ring). E (elbow): Maintain the position of the elbow so that the movement of the arm remains vertical. F (follow through): Lock the elbow and then release the arm, the fingers, and the wrist while following through towards the ring. The BEEF principle has been highlighted by Krause and Nelson (2019), who stressed the paramount importance of balance, denoted by the "B" in BEEF.

Moreover, the findings of a study conducted by Boccolini et al. (2013) highlight the positive impacts of balance training on both balance and vertical jumps. According to the guidelines set by the International Basketball Federation (FIBA) (2020), basketball jump shot performance is the ultimate offensive maneuver preceding the attempt to score. This performance entails various point values, contingent on the shot's origin: 1 point for a free throw, 2 points for a shot within the 2-point goal area, and 3 points for a shot from the 3-point goal area. Basketball shot distances are classified into close (less than 3.65 m from the hoop), middle (3.65-6.70 m from the hoop), and greater distances (beyond 6.70 m from the 3-point arc), with the middle distance being the most commonly encountered range (Rodphothong, 1983; Sattam, 2014).

This study is designed to assess the basketball jump shot performance and dynamic balance before and after the implementation of the BSTP. Furthermore, it examines the differences in basketball jump shot performance and dynamic balance between the BSTG and RTG.

Material & methods

Participants

This study comprised male basketball players from Silpakorn University, enrolled in the academic year 2020, with a sample size of 16 individuals selected through purposive sampling. The participants were then divided into two groups: the balance shooting training group (BSTG), consisting of 8 individuals, and the regular training group (RTG), also comprising 8 individuals, determined by simple random sampling. The sample size calculation was performed using the G*Power program Version 3.1.9.2 (Universität Düsseldorf, Düsseldorf, Germany), considering the mean and standard deviation of fast shooting scores from the study by Zacharkis et al. (2020). The power value was set at 0.95, and the alpha level was established at 0.05. While the control group engaged in the RTG, the experimental group underwent the BSTG. The research received approval from the Human Research Ethics Review Committee at Silpakorn University, with a COE certificate number of 63.0226-016, dated 26 February 2020.

Procedure

During the study, the sample was divided into two groups: the BSTG, comprising 8 individuals, and the RTG, comprising 8 individuals. The BSTG underwent training in the BSTP to enhance basketball jump shot performance and dynamic balance. The program was conducted for 60 min daily, three times a week, over eight weeks, encompassing three steps in the following sequence. Step 1: A 10-min warm-up, including 1) continuous running for 3 min, and 2) dynamic stretching exercises targeting all muscle groups. Step 2: Approximately 30 min dedicated to balance and shooting practice. This involved starting with dynamic balance exercises followed by jump shot training. Each exercise was repeated 5 times, with a 30-s rest between exercises or sets, and three sets were performed for each exercise. For instance, in set 1, goals were shot from a position of 0 degrees, set 2 involved shooting from a position of 45 degrees, and set 3 required shooting from a position of 90 degrees. The shooting distance was specified as the middle distance, where the trainer stood 4.60 m from the basket.

During weeks 1st to 4th, the athlete is recommended to perform the following sequence. 1) One-foot touch (right) and jump shot. 2) One-foot touch (left) and jump shot. 3) Front lunge and jump shot. 4) Jump front and Jump shot. 5) Jump back and jump shot. 6) Lunge lateral and jump shot. 7) Single-leg hop (right) and jump shot. 8) Single-leg hop (left) and jump shot.

For weeks 5th to 8th, the athlete is instructed to follow this sequence. 1) One foot to two feet (forward) and jump shot. 2) One foot to two feet (lateral) and jump shot. 3) 360-degree jump turn and jump shot. 4) One foot to two feet (angled) and jump shot. 5) Front lunge reverse to turn (right) and jump shot. 6) Front lunge reverse to turn (left) and jump shot. 7) Handoff one dribble to turn (right) and jump shot. 8) Handoff one dribble to turn (left) and jump shot, as depicted in Figure 1. After completing these 8 poses, proceed to step 3: cool down the body for 10 min by: 1) jogging continuously for 3 min, 2) performing static stretches for all body parts.

The quality of this program is assessed using the index of objective congruence (IOC), with input from five professors. The content consistency index of the BSTP was determined to be within the range of 0.40–1.00 for each item. Notably, for the item with an IOC value of 0.40, specifically addressing "Rest between positions or sets for 20 s," the researchers opted to revise the program. The rest period between positions or sets was modified from 20 s to 30 s. Following this revision, the experimental group underwent training based on the updated BSTP, which was conducted for 60 min each day, three times a week, over eight weeks.

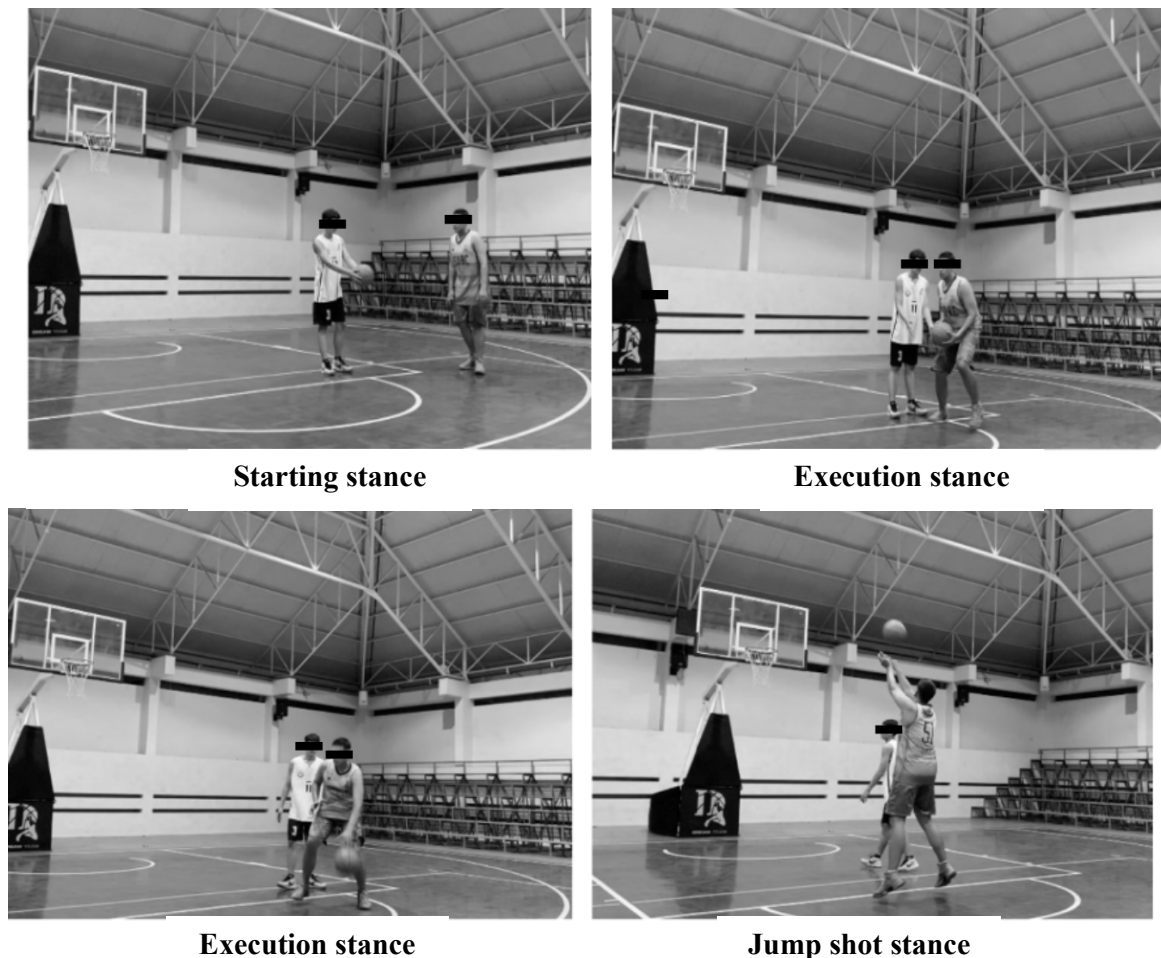


Figure 1. Depiction of the handoff one dribble to turn (left) and jump shot stance
Measure

This research employed two measurements for assessment. The basketball jump shot performance was gauged using the BJSPT, while the dynamic balance was measured through the Y-balance test (YBT).

The basketball jump shot performance test (BJSPT)

The BJSPT aims to apply force to propel the basketball accurately toward and into the basket at a medium distance (approximately 4.60 m from the basket) based on measurements devised by the researchers. The BJSPT was conducted for 60 min daily, three times a week, over eight weeks. This test comprised 15 shot attempts from middle distances on three different court locations (4.60 m away from the basket), as illustrated in Figure 2. Each shot attempt underwent specified operations and scoring. The operations encompass three procedures. Procedure 1: Inform the test supervisor about the preferred use of the left or right side of the basketball basket for testing. Procedure 2: Before commencing the test, ensure a 15-min warm-up. Practice the test by completing one round per person (only once per area). Follow these three steps for jumping and shooting. Starting stance: Stand with your left side toward the basketball hoop, approximately 2 regular steps away from the training assistant. Ensure your feet are shoulder-width apart. Execution stance: Move forward with the usual

2-step, receive the ball from the training assistant's hands by jumping, stop, and jump with both feet facing the left side toward the basket. Dribble the ball once, catch it, and jump backward until facing the basket, landing on the ground with both feet. The final action is the jump shot. Procedure 3: Perform a jump shot test 15 times with the participants. Begin shooting from Zone 1 (4.60 m from the goal) to assess the basketball jump shot performance, as depicted in Figure 2, and shoot 5 times consecutively. Then, switch to Zone 2 (4.60 m from the goal) for 5 shots and Zone 3 (4.60 m from the goal) for another 5 shots. Ensure each change of shooting position and shot is completed within 5 s.

According to the study results of Brenton et al. (2019), the original criteria assigned 1 point when the basketball entered the basket and 0 points when it did not. The scoring criteria are as follows: 3 points if the basketball passes through the basket without hitting the loop or backboard, 2 points if the basketball hits the loop or backboard before going through the basket, 1 point if the basketball hits the loop or backboard but does not go through the basket, and 0 points if the basketball neither hits the loop nor backboard and does not go through the basket.

To assess the quality of the BJSPT, content validity was examined using the IOC with input from 5 professors, revealing values in the range of 0.60–1.00 for each item. Reliability assessment was conducted through the test–retest method, indicating high within-subject repeatability with an ICC value of 0.86. A sample group not involved in the primary experiment underwent the BJSPT twice, with the first and second attempts spaced 1 week apart. The basketball jump shot performance was measured in each session. The assessment then evaluated the suitability of methods, time allocation, and testing procedures, implementing the test with male basketball players.

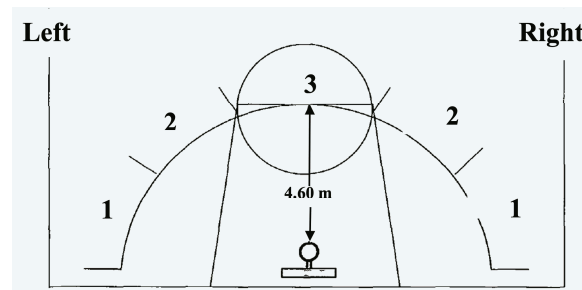


Figure 2. Diagram of the zones for assessing the basketball jump shot performance

Y-balance test (YBT)

The results from various studies highlight the effectiveness of BSTP in enhancing agility. Saraswat et al. (2015) demonstrated significant improvements in agility after a 4-week progressive balance training program, which emphasized dynamic stabilization following hops in various directions and conditions. Similarly, Domeika et al. (2020) observed enhanced dynamic balance following an 8-week intervention assessed through the YBT.

Dynamic balance can be quantified using the YBT (Shaffer et al., 2013), as illustrated in Figure 4. This test evaluates how well the experimental group can maintain balance while in motion. It involves shifting the center of mass or pressure on the foot and ensuring it returns within a specified area. The test assesses balance by having individuals stand on one leg while the other leg moves to touch in three directions: front, side–back, and side–front. The test results are presented as percentages (%).



Figure 3. Participants utilizing the YBT kit

Implement dynamic balance assessment using the YBT with the sample group by following these steps. 1) Measure the length of the leg with the subject lying down on a cushion, feet shoulder-width apart, and toes perpendicular to the wall. Measure the length of the legs from the anterior pelvis to the center of the medial malleolus for both sides (anterior superior iliac spine to the medial malleolus bilaterally) to analyze the

percentage of step distance to leg length. 2) Participants should watch a video introducing the test, allowing time for testers to familiarize themselves with and understand the test after watching an introductory video. Perform one practice trial on each side, totaling 6 practice trials. 3) Begin the test with the anterior left foot. Have the subject place their right foot on the YBT kit, as shown in Figure 3, with the toes at the set line and hands on the waist or hips. Extend the left foot, pushing the distance measuring pad anterior as far as possible, and then pull the left foot back to the starting position without losing balance. Repeat this process a maximum of 6 times to complete 3 practices. Change the testing side to the anterior right foot, posterolateral left foot, posterolateral right foot, posteromedial left foot, and posteromedial right foot, maintaining the same testing method as for the anterior left foot. 4) Record the complete effective stride length in centimeters. Then, take the complete stride length on each side of each foot for all 3 times and find the average, as illustrated in Figure 4.

$$\text{Average step length} = \frac{\text{1st step distance} + \text{2nd step distance} + \text{3rd step distance}}{3}$$

Figure 4. Average step length

Calculate the average of all 6-step distance values as outlined below. 1) Average anterior left footstep length. 2) Average left foot step length posterolateral. 3) Average left foot step length posteromedial. 4) Average anterior right foot step length. 5) Average right foot step length posterolateral. 6) Average right foot step length posteromedial. Next, compute the average of each value and determine the leg length percentage, as illustrated in Figure 5.

$$\text{Percentage of stride length to leg length} = \frac{\text{Average stride length} \times 100}{\text{Leg length}}$$

Figure 5. Leg length percentage

A total of 6 values were acquired for the percentage of step distance to leg length, as follows. 1) Percentage of step length to left leg length anterior. 2) Percentage of step length to leg length of left foot posterolateral. 3) Percentage of step length to leg length of left foot posteromedial. 4) Percentage of step distance to leg length of right foot anterior. 5) Percentage of step length to leg length of right foot posterolateral. 6) Percentage of step length to leg length of right foot posteromedial. Next, take all 6 values of the percentage of step distance to leg length and compute the average composite score, as shown in Figure 6.

$$\text{Composite Score} = \frac{\text{Sum of 6 percentages of stride length to leg length}}{6}$$

Figure 6. Average composite score

The quality of these tests is evaluated using the IOC with input from 5 professors, revealing a perfect content consistency index of 1.00 for each item. The trial involved ten university-level male basketball players (aged 18–25), repeating the test twice, with the first and second attempts spaced 1 week apart. The accuracy values in basketball jump shot performance, tested for intratester reliability with an ICC value of 0.97, indicate high consistency, confirming its suitability for data collection.

Data collection and analysis

This study adopts an experimental research design, specifically developed to investigate the impact of balance shooting training on basketball jump shot performance and dynamic balance in male basketball players. The research involved pretraining assessments and evaluations after 4 and 8 weeks, following an experimental design based on an equivalent time-sample design (Campbell & Stanley, 1963). Data collection included testing basketball jump shot performance using BJST and YBT. The sample group underwent training based on the program, with the experimental group following the BSTP and the control group adhering to the RTG. The training sessions spanned 8 weeks, occurring three times a week, with each session lasting 60 min. Assessments of basketball jump shot performance and dynamic balance were conducted at two intervals: after the 4th and 8th weeks of training

Statistical analysis

To evaluate the impact of balance shooting training on basketball jump shot performance and dynamic balance in male basketball players, assessments were conducted before training, after 4 weeks, and after 8 weeks. Mean, standard deviation, and one-way analysis of variance with repeated measures (ANOVA) were employed for statistical analysis. Statistically significant differences were further investigated through post-hoc LSD comparisons, supplemented by independent t-tests for intergroup comparisons and effect size (ES) calculations.

Interpreting the ES according to Cohen (1988), values <0.20 are considered negligible, between 0.20 and ≤0.50 are categorized as small, between 0.50 and ≤0.80 are considered moderate, values between 0.80 and ≤1.30 fall into the large category, and values >1.30 are classified as very large. Data analysis was performed

using IBM SPSS Statistics Version 20, and primary descriptive parameters were calculated. The Shapiro–Wilk test was employed to assess variables for normality.

Results

The study reveals that the BSTP improved basketball jump shot performance and dynamic balance, as assessed by the IOC. Each item in the assessment scored between 0.40 and 1.00, indicating good quality. The evaluation of content validity of the BJSPT using IOC also showed scores between 0.60 and 1.00, ensuring its reliability, as validated by the intratester reliability, with a score of 0.86 according to ICC statistics.

The comparison of the average basketball jump shot performance and dynamic balance in male basketball players between the BSTG and RTG before training, after 4 weeks, and after 8 weeks (illustrated in Figure 7) demonstrates noteworthy findings. Before training, the values ($\bar{x} \pm S.D.$) were 24.00 ± 4.12 , after the 4th week— 27.25 ± 4.30 , and after the 8th week— 29.63 ± 4.87 . Significantly increased basketball jump shot performance was observed after the 8th week compared to before training at the 0.05 level. Regarding dynamic balance (shown in Figure 8), before training, the values ($\bar{x} \pm S.D.$) were 97.02 ± 6.94 , after the 4th week— 104.09 ± 8.26 , and after the 8th week— 110.51 ± 7.19 . Dynamic balance significantly increased after the 4th week compared to before training at the 0.05 level. Moreover, after the 8th week, the dynamic balance was significantly higher than before training and after the 4th week at the 0.05 level.

Furthermore, the comparison between the basketball jump shot performance of the BSTG and RTG after the 8th week revealed statistically significant superiority of the BSTG at the 0.05 level. However, no significant differences were found in dynamic balance between these two groups at the 0.05 level. Considering the effect size criteria, it was determined that the effect size for basketball jump shot performance after the 4th week was $d = 0.74$ (moderate), and after the 8th week, it was $d = 1.23$ (large). For dynamic balance, after the 4th week, the effect size was $d = 0.18$ (ignored); after the 8th week, it was $d = 0.51$ (moderate).

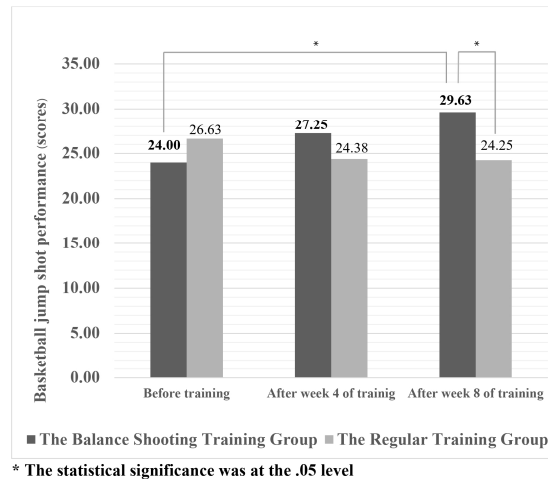


Figure 7. Comparison of the average basketball jump shot performance between the BSTG and RTG before, after the 4th week, and after the 8th week of training

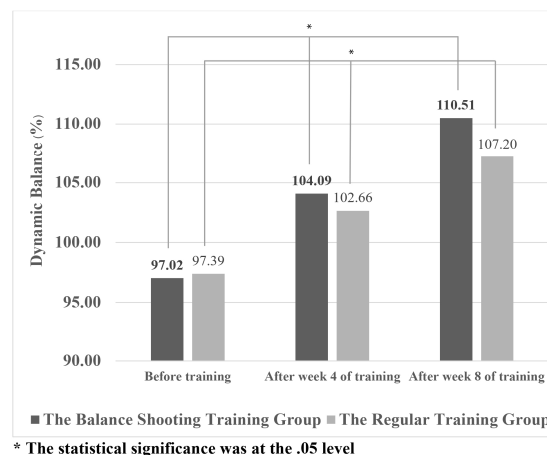


Figure 8. Comparison of the average dynamic balance between the BSTG and RTG before, after the 4th week, and after the 8th week of training

Discussion

The primary focus of this study is on basketball jump shot performance, which is the most frequently utilized shooting technique in competitions (Sattam, 2014; Marko et al., 2023). The middle distance, approximately 4.60 m from the basket, is identified as the most encountered range for this type of shot (Rodphothong, 1983; Sattam, 2014). Notably, a significant and large difference in accuracy for middle-distance shots was observed, with a high correlation between two trials of basketball jump shots ($ICC = 0.86$). This suggests that the BJSPT exhibits high validity in predicting and scoring jump-shot performance. Compared to Brenton et al. (2019), whose basketball jump shooting accuracy test reported a significant and large difference in accuracy between two- and three-point shots, the BJSPT demonstrates higher validity ($ICC = 0.71$).

The study further evaluates the impact of dynamic balance on basketball jump shot performance. The findings after the 8th week indicate a noteworthy improvement compared to pretraining levels. This aligns with Alhawary (2019), who emphasized the influence of dynamic balance exercises on kinematic variables and jump shot accuracy, particularly in female basketball players. The results also resonate with Zacharkis et al. (2020), illustrating how an 8-week balance and proprioceptive training program can enhance passing accuracy and improve static balance and fast shooting—crucial components of basketball skill execution. These findings underscore the paramount importance of dynamic balance in sports, a concept reinforced by Clark et al. (2010) and supported by the principles of balance outlined by Krause & Nelson (2019) and Wissel (2004). Maintaining balance is essential for athletes, particularly in basketball, where swift responses to changing situations and graceful execution are fundamental.

Shifting the focus to the third aspect, centered on dynamic balance, the study unveiled notable improvements after the 4th week of balance shooting training (BSTP), with even more pronounced progress evident after the 8th week. These outcomes resonate with Boccolini et al.'s (2013) research, emphasizing the efficacy of a 12-week BSTP in augmenting the balance abilities of male basketball university players. Additionally, Domeika et al.'s (2020) findings indicate that an 8-week basketball-specific proprioception training program significantly enhances dynamic balance in male basketball players. The study's results align with Balakrishnan et al.'s (2016) work, showcasing the superiority of plyometric push-up exercises in improving dynamic balance compared to static balance exercises. Pritesh and Shalaka's (2019) research reinforces these findings, emphasizing the advantages of a sports-specific BSTP over a generic one in enhancing balance and agility among basketball players. These results underscore the pivotal role of dynamic balance in sports training and its potential to enhance overall athletic performance.

The fourth aspect delved into the impact of balance shooting training on basketball jump shot performance, unveiling a significant improvement after the 8th week compared to the RTG. This finding aligns with Alhawary's (2019) research, highlighting the positive influence of dynamic balance exercises on jump shot accuracy, particularly among female basketball players. Further support is found in Zacharkis et al.'s (2020) work, demonstrating that 8-week proprioception and BSTP can enhance fast shooting and static balance in adolescent male basketball players. These results underscore the value of balance shooting training in enhancing basketball performance, aligning with the principles of dynamic balance outlined by Greve et al. (2007).

In the final aspect, the study compared the dynamic balance between the BSTG and RTG. Although no statistically significant difference emerged at the 0.05 level, a more detailed analysis using the effect size criterion unveiled greater improvements in dynamic balance within the BSTG. Of note, extending the training period beyond 8 weeks may yield a significant difference at the 0.05 level, as indicated by the results reported by Boccolini et al. (2013). This outcome aligns with Winkler's (2014) findings, who investigated the effects of balance and motor neuron training on static and dynamic balance in Division 2 NCAA basketball players and similarly found no significant difference at the 0.05 level. This aspect resonates with Zacharkis et al.'s (2020) research, indicating no significant difference in dynamic balance between experimental and control groups, particularly among male participants. These findings underscore the value of dynamic balance training and its potential to improve athletic performance, as emphasized by previous researchers such as Clark et al. (2010) and Greve et al. (2007).

In summary, this study emphasizes the pivotal role of balance shooting training in enhancing both basketball jump shot performance and dynamic balance in male basketball university players. These findings align with existing research, underscoring the importance of balance as a fundamental aspect of sports training and emphasizing the necessity to address static and dynamic balance for comprehensive skill development in sports like basketball.

Conclusions

In this study, the content validity of the BJST was examined using IOC, affirming its consistency and suitability for data collection. The BJST's reliability as a data collection tool was assessed using the ICC. The comparative analysis of basketball jump shot performance and dynamic balance in male basketball players undergoing the BSTP before training, after the 4th week, and after the 8th week unveiled significant differences. Specifically, following 8 weeks of training, basketball jump shot performance exhibited a statistically significant improvement compared to pretraining levels. Similarly, after 4 weeks of training, dynamic balance demonstrated a statistically significant enhancement compared to the baseline. Furthermore, after the 8th week of training,

dynamic balance showcased continued improvement compared to the pretraining and 4th-week levels, reaching statistical significance at the 0.05 level.

Notable differences were observed in the comparison between the BSTG and RTG. After the 8th week of training, the basketball jump shot performance of the BSTG surpassed that of the RTG, achieving statistical significance at the 0.05 level. Additionally, while the dynamic balance of the BSTG displayed a tendency for change compared to the RTG, the difference did not reach statistical significance at the 0.05 level. Considering the effect size, basketball jump shot performance exhibited a medium effect after the 4th week, escalating to a large effect by the 8th week. Meanwhile, though negligible after the 4th week, dynamic balance reached a moderate effect by the 8th week. This trend suggests a positive impact of implementing the BSTP on basketball jump shot performance and dynamic balance. Moreover, the BSTP's focus on proprioception development underscores its potential contribution to enhancing dynamic balance.

This study confirms that the BSTP can improve the basketball jump shot performance and dynamic balance in male university basketball players. Additionally, the BJSPT demonstrates high quality as a reliable measure for assessing basketball jump shot performance in male university basketball players.

Conflicts of interest - The authors report no potential conflicts of interest.

References:

- Abdelkrim, N.B., Castagna, C., El Fazaa, S., & El Ati, J. (2010). The effect of players' standard and tactical strategy on game demands in men's basketball. *Journal of Strength and Conditioning Research*, 24(10), 2652-2662.
- Alhawary, R. (2019). The Effect of Dynamics Balance Exercises on Certain Kinematic Variables and Jump Shoot Accuracy among Female Basketball Players. *Journal of Physical Education & Health*, 8(14), 41-48.
- Barrera-Domínguez, F.J., Carmona-Gómez, A., Tornero-Quiñones, I., Sáez-Padilla, J., Sierra-Robles, Á. & Molina-López, J. (2021). Influence of Dynamic Balance on Jumping-Based Asymmetries in Team Sport: A between-Sports Comparison in Basketball and Handball Athletes. *International Journal of Environmental Research and Public Health*, 18(4), 1866.
- Balakrishnan, R., Ellanchezian, Emelita, & Chinnavan, E. (2016). Comparison of static and dynamic balance among male Amateur basketball players. *International Journal of Physical Education, Sports and Health*, 3(1), 364-369.
- Boccolini, G., Brazziti, A., Bonfanti, L., & Alberti, G. (2013). Using balance training to improve the performance of youth basketball players. *Sport sciences for health*, 9(2), 37-42.
- Brachman, A., Kamieniarz, A., Michalska, J., Pawłowski, M., Słomka, K.J., & Juras, G. (2017). Balance Training Programs in Athletes – A Systematic Review. *Journal of Human Kinetics*, 58, 45-64.
- Brenton, J.B., Ashley, J.C., Aaron, T.S., & Spiteri, T. (2019). The Validity and Reliability of the Basketball Jump Shooting Accuracy Test. *Journal of Sports Sciences*, 37(14), 1-7.
- Bulow, A., Anderson, J.E., Leiter, J.R., MacDonald, P.B., & Peeler, J. (2019). The Modified Star Excursion Balance Test and Y-Balance Test Results Differ When Assessing Physically Active Healthy Adolescent Females. *The International Journal of Sports Physical Therapy*, 14(2), 192-203.
- Campbell, D.T. & Stanley, J.C. (1963). *Experimental and quasi-experimental designs for research*.
- Rand McNally College. Clark, R. A., Bryant, A. L., Pau, Y., McCrory, P., Bennell, K., & Hunt, M. (2010). Validity and reliability of the nintendo wii balance board for assessment of standing balance. *Gait & Posture*, 31(3), 307-310.
- Cohen J. (1988). *Statistical power analysis for the behavioral sciences*. 2nd ed. NJ: Lawrence Erlbaum Associate.
- Domeika, A., Slapšinskaitė, A., Razon, S., Šiupšinskas, L., & Kliziene, I. (2020). Effects of an 8-week basketball-specific proprioceptive training with a single-plane instability balance platform. *Technology and Health Care*, 5(28), 561-571.
- Greve, J., Alonso, A., Bordini, A.C., & Camanho, G.L. (2007). Correlation between body mass index and postural balance. *Clinics*, 62(6), 717-720.
- Gulthawatwichai, T. (2012). *Techniques and Skills in Basketball*. 3rd ed. Chulalongkorn University.
- Ibáñez, S.J., Sampaio, J., Feu, S., Lorenzo, A., Gómez, M.A., & Ortega, E. (2008). Basketball game-related statistics that discriminate between teams' season-long success. *European Journal of Sport Science*, 8(6), 369-372.
- International Basketball Federation (FIBA). (2020). *Official Basketball Rules 2020*. Mies:FIBA Central Board.
- Krause, J. & Nelson, C. (2019). *Basketball Skills and Drills*. 4th ed. Human Kinetics. National Strength and Conditioning Association.
- Lorenzo, A., Gomez, M.A., Ortega, E., Ibanez, S.J., & Sampaio, J. (2010). Game related statistics which discriminate between winning and losing under-16 male basketball games. *Journal of Sports Science and Medicine*, 9(4), 664-668.
- Marko, R., Anja L., Dušan, S., Milan, C., Višnja, D., Miloš, P., Milena, T., Evangelia, K., Adem, P., Jovan, M., Dragana, B., Marko, S., Miodrag, K., Nikola, A., Emilija, P., Milan, C., Špela, B. & Saša, B. (2023). Effects

- of Combined Plyometric and Shooting Training on the Biomechanical Characteristics during the Made Jump Shot in Young Male Basketball Players. *International Journal of Environmental Research and Public Health*, 20(1), 343.
- Özmen, M.U. (2016). Marginal contribution of game statistics to probability of winning at different levels of competition in basketball: Evidence from the Euroleague. *International Journal of Sports Science and Coaching*, 11(1), 98-107.
- Pritesh, Y. & Shalaka, P. (2019). Comparison of Sports Specific Balance Training Programs in Improving Balance and Agility in Basketball Players. *Journal of Sports and Physical Education*, 6(2), 7-13.
- Pucharoen, T. (1987). Accuracy of basketball jump shots by affecting and not affecting backboard, in the specified direction and distance. Master of Education Thesis Department of Physical Education graduate school Srinakharinwirot University.
- Read, P.J., Hughes, J., Stewart, P., Chavda, S., Bishop, C., Edwards, M., & Turner, A.N. (2014). A needs analysis and field-based testing battery for basketball. *Strength and Conditioning Journal*, 36(3), 13-20.
- Rodphothong, P. (1983). *Basketball guidebook*. Odeon Store.
- Sattam, J. (2014). The accuracy of shooting in male basketball players in the 40th national games. *Sripatum Chonburi Journal*, 10(4), 1-8.
- Scanlan, A.T., Dascombe, B., & Reaburn, P. (2011). A comparison of the activity demands of elite and sub-elite Australian men's basketball competition. *Journal of Sports Sciences*, 29(11), 1153-1160.
- Shaffer, S.W., Teyhen, D.S., Lorensen, C.L., Warren, R.L., Koreerat, C.M., Straseske, C.A., & Childs, J.D. (2013). Y-Balance Test: A Reliability Study Involving Multiple Raters. *Military Medicine*, 178(11), 1264-1270.
- Saraswat, A., Malhotra, D., & Sivaram, C. (2015). Effect of Dynamic Balance Training on Agility in Male Basketball Players. *International Journal Physiother*, 2(5), 798-803.
- Williams, C.Q., Webster, L., Spaniol, F. & Bonnette, R. (2016). The Effect of Foot Placement on the Jump Shot Accuracy of NCAA Division I Basketball Players. *The Sport Journal*, 22(2), 1-17.
- Winkler, P.L. (2014). The Effects of Gender & Neromotor & Balance Training on Peak Torque, Muscle Power, and Static and Dynamic Balance in NCAA Division II Men and Women Basketball Players. Master's Thesis. Southern Connecticut State University.
- Wissel, H. (2004). *Basketball : STEPS TO SUCCESS*. 2nd ed. Human Kinetics.
- Zacharkis, E.D., Bourdas, D.I., Kotsifa, M.I., Bekris, E.M., Velentaz, E.T., & Kostopoulos, N.I. (2020). Effect of Balance and Proprioceptive Training on Balancing and Technical Skills in 13-14-year-old Youth Basketball Players. *Journal of Physical Education and Sport*, 20(5), 2487-2500.