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Original Article

The Correlation Between Dynamic Balance and Jump Performance, Sprints, and Agility in Female Basketball Players: A Preliminary Study

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Abstract

Background: Dynamic balance is essential when performing activities that require rapid acceleration, rapid deceleration, and rapid changes in direction, such as basketball. This allows athletes to adjust their posture and footing quickly during high-intensity activities, reducing the risk of injury. The objective of our study is to determine the correlation between dynamic balance and female basketball players' jump performance, sprints, and agility abilities. **Methods:** The dynamic balance of 14 female basketball players in Saudi Arabia, ages 18 to 23, was measured using the modified star excursion balance test (mSEBT). Jump performance, sprints, and agility skills were assessed using five tests: a vertical jump test (VJT), a standing board jump test (SBJT), a ten-meter sprint test (10mST), and a T-Agility test. **Result:** Dynamic balance was positively correlated with vertical jump, broad jump, and negatively correlated with the 10-m sprint and T-agility tests. **Conclusion:** Dynamic balance is a significant factor affecting performance in specific tests. This emphasizes the importance of incorporating dynamic balance exercises into training programs for basketball players.Arabia.

Keywords: Dynamic balance, jumping ability, sprint, agility, basketball.

Introduction

Dynamic balance refers to the ability to maintain stability and control of one's body during movement, especially when performing activities that involve changes in direction, acceleration, deceleration, and coordination of muscles and joints (Caseiro-Filho et al., 2023). In basketball, dynamic balance is crucial as players constantly engage in rapid and varied movements such as running, jumping, pivoting, and cutting. Maintaining effective dynamic balance allows basketball players to execute these movements with precision, agility, and efficiency, enabling them to outmaneuver opponents, control the ball, and execute plays effectively (Kapan et al., 2023).

Deficiency in dynamic balance poses significant challenges for basketball players, impacting their performance and increasing their susceptibility to injuries (Emery & Pasanen, 2019). Without adequate dynamic balance, players may struggle to maintain stability and control during rapid movements, leading to decreased agility and maneuverability on the court (Stojanović et al., 2018). This deficiency can hinder their ability to effectively defend against opponents, execute offensive plays, and maintain ball control, ultimately compromising their overall performance (Stojanović et al., 2018). Moreover, impaired dynamic balance raises the risk of injuries, particularly ankle sprains, anterior cruciate ligament tears, and other lower extremity (LE) injuries, as players may struggle to maintain proper alignment and stability during high-intensity movements (Emery & Pasanen, 2019). Additionally, poor dynamic balance can result in inefficient energy transfer and movement patterns, leading to fatigue and decreased endurance throughout the game (Kozinc et al., 2021).

LE performance includes various skills such as jump performance, change of direction, and sprint; therefore, investigating these components plays an integral role in assessing the physical capabilities of basketball players. Jump performance tests evaluate the player's ability to generate explosive power and vertical leap, which is crucial for rebounding, shooting, and blocking shots (Stojanović et al., 2018). Change of direction tests assess agility, quickness, and the ability to maneuver around opponents swiftly, which is vital for evading defenders and executing offensive and defensive strategies effectively (Morral-Yepes et al., 2020). However, sprint tests measure the player's speed and acceleration, which is essential for fast breaks, defensive coverage, and transitioning between offense and defense (Lockie et al., 2014).

Research has shown that females are more susceptible to injuries compared to their male counterparts (McGroarty et al., 2020; Raya-González et al., 2020; Owoeye et al., 2020). Therefore, this study aimed to investigate the potential relationship between dynamic balance and lower extremity performance (jump performance, change of direction, and sprint) among female basketball players. This study seeks to discover how variations in dynamic balance correlate with these performance metrics, a critical but often overlooked aspect of athleticism in basketball. A focus on this relationship is crucial, as it provides insights into players' physical capabilities and informs therapists and coaches of injury prevention and improvement opportunities.

Method

A Cross-sectional pilot study design was used for this study. We included healthy female basketball players, ages ranging between 18 and 23 years old recruited between May to August 2024, from King Saud University's basketball teams. Players with a history of LE injury within six months or surgery within 2 years of testing were excluded. For this study, 14 participants were sufficient based on the recommended sample size for a pilot study (Hertzog, 2008). Ethical approval was obtained from the Institutional Review Board of the Standing Committee for Scientific Research Ethics at King Saud University (No: KSU.HE-24-278). All participants were informed about the study's purpose and methods, and all participants signed the consent form before participating in the study. Data collection sheets were used to gather demographic characteristics such as age, height, weight, body mass index (BMI), years of training, training days per week, and duration of normal games.

The dynamic balance was measured using the modified Star Excursion Balance Test (mSEBT), which is a valid and reliable tool (Onofrei, Amaricai, Petroman, & Suciu, 2019). During the test, three lines are drawn at a 135° angle, labeled anteriorly (ANT), posterior-medially (PM), and posterior-laterally (PL) according to their direction of excursion relative to the stance leg. To ensure proper neuromuscular control of the leg stance, the test was performed slowly and carefully. Each lower extremity was scored three times in each direction, and the mean was calculated. A composite score was calculated by adding up the means of the three directions and dividing them by three. If the participant was unable to return to their starting position, touched the line too lightly, or lost balance, the trial was considered invalid. A three-second break was provided between reach attempts to reduce fatigue and ensure maximum effort on each trial.

Jump performance

It was measured via two tests: the Vertical Jump Test and the Standing Broad Jump Test. The vertical jump test is valid and reliable for measuring leg power (Ab Rahman, Kamal, Noor, & Geok, 2021). In this test, the participant was instructed to stand side by side with a wall and reach up with the hand closest to the wall. Standing reach height was measured as the point of the fingertips was marked while keeping the feet flat on the ground. The participant then stepped back from the wall and jumped as high as possible, propelling herself upward at the highest point of the jump with her legs and arms to contact the wall. The score was calculated as the difference in height between the standing reach height and the jump height. Three of the best jump attempts were recorded for evaluation. Adequate rest and recovery were provided between jump attempts to allow optimal performance. The standing broad jump is also a valid and reliable test for measuring leg power (Ab Rahman et al., 2021). The participant positioned her feet slightly apart behind a line drawn on the ground. To generate forward momentum, she bent her knees and swung her arms, jumping as far as possible and landing on both feet without falling backward. Three attempts were made, and the measurement was taken from the takeoff line to the point of closest contact on the landing, at the back of the heels. The longest leap distance was recorded out of the three attempts.

10-meter sprint test

This test was used to measure sprint ability and is valid and reliable (Duthie et al., 2006). Participants were instructed to sprint over the 10-meter course as quickly as possible, with feet shoulder-width apart at the starting line. The participant exerted maximum effort to cover the distance as quickly as possible. A stopwatch recorded the sprint time from the start to the finish line. Sufficient rest and recovery time was provided between sprints to ensure maximum effort on each trial and minimize fatigue, allowing optimal performance.

The Agility T-test

This test was used to measure change of direction performance and is considered valid and reliable (Morral-Yepes, Moras, Bishop, & Gonzalo-Skok, 2022).The test was performed using four cones (A, B, C, D), with cone A serving as the starting point. Once the participant reaches cone B, she uses her right hand to touch the cone base. She then moves left to cone C, where she touches the cone base with her left hand. Next, she moves right to cone D, where she touches the cone base with her right hand. As soon as she returns to cone B, she touches the cone base with her left hand. Finally, the participant runs backwards to cone A. The trial will not be counted if the participant crosses one foot in front of the other while shuffling, fails to look forward throughout the test, or fails to touch the cone's base. In three successful attempts, the fastest time was recorded. During each attempt, participants rested enough and gave their best effort.

Procedures

The data collection was conducted in three sessions as follows: 1st session, participants were given instructions about what to avoid and were familiarized with all the tests. A consent form was signed by the participants. Further, the participants' anthropometric characteristics were recorded. At the second session, one week after the familiarization session, sprinting and jumping tests (vertical and standing broad) were conducted. A dynamic balance test and other tests were conducted 72 hours after the second session in the third session. A standardized warm-up consisted of submaximal running for 10 minutes followed by light stretching and a specific warm-up was performed before all tests.

Data Analysis

For analysis, IBM SPSS Version 29 for Windows (IBM SPSS, Armonk, NY, USA) was used. A Shapiro-Wilk test was used to determine if the data distribution was normally distributed. A descriptive analysis was conducted to calculate and summarize the demographic, anthropometric, balance, and LE performance scores The descriptive analysis is presented by means and standard deviations.

Based on the normality of data, Pearson's correlation coefficient (r) was used to evaluate the correlation between mSEBT and other performance measures, including vertical jump, broad jump, sprint, and agility. A level of statistical significance of 0.05 was set for the correlation analysis. A correlation is interrupted as <.1; weak, .1–.3; moderate, .4–.6; and strong, .7–.8.

Results

The demographic, anthropometric parameters, balance, and LE performance tests of the participants are presented in Table 1.

Table 2 shows the correlation between mSEBT and other performance tests. The Pearson correlation results indicate no correlation between the right leg of mSEBT and VJT. However, a strong positive correlation was observed between the left leg of mSEBT and VJT. Similarly, for the mSEBT and SBJT, there is no correlation between the right leg of mSEBT and SBJT, while there is a medium positive correlation between the left leg of mSEBT. The sprint test demonstrates a strong to very strong negative correlation between the right and left leg of mSEBT and the 10-meter sprint test. Furthermore, the T-agility test observed a strong negative correlation with both the right and left legs of mSEBT.

Table 1: Sociodemographic Characteristics of the participants.

Variables (N=14)		Mean±SD
Age (years)		20.8±1.3
Weight (kg)		67.7±15.8
Height (cm)		164.2±7.3
BMI (kg/m^{2})		24.9±4.4
mSEBT (cm)	composite score Rt	82.3±9.9
	composite score Lt	86.1±11.2
Jump performance (cm)	Vertical Jump test	31.3±7
	Standing broad jump test	131±22.7
10-meter sprint test (s)		2.7±0.2
The Agility T-test (s)		17.5±2.3
N= number of participants, kg= kilograms cm= Centimeters, Rt,=Right, Lt= left, mSEBT = the modified star excursion balance test		

Table 2: The correlation between mSEBT and other performance tests.

Lower extremities performance		mSEBT					
		composite score Rt			composite score Lt		
		r	95% Confidence Intervals (2-tailed)		r	95% Confidence Intervals (2-tailed)	
			Lower	Upper		Lower	Upper
Jump performance	Vertical Jump test	.414	-.149	.775	.657*	.193	.880
	Standing broad jump test	.150	-.413	.631	.562*	.045	.842
10mBEST		-.786**	-.929	-.438	-.824**	-.943	-.522
agility test		-.644*	-.875	-.172	-.731**	-.909	-.327
r= Pearson Correlation, Rt,=Right, Lt= left, mSEBT = the modified star excursion balance test. * p<0.05, **p<0.01							

Discussion

Dynamic balance was positively correlated with vertical jump, broad jump, and negatively correlated with 10-m sprint and T-agility tests. This means that individuals who demonstrate better dynamic balance tend to perform well in other skills.

This study showed a positive correlation between mSEBT and the vertical jump test. This result was contradicted by Asadi and Arazi (2018), who conducted a study on young male basketball players and found no significant correlation between dynamic balance and VJ, as determined by SEBT and countermovement jump. Wilczyński et al. (2021) were in agreement with this study, as they found a significant positive correlation between the CMJ and Y Balance Test (YBT) composite scores in both legs as measured in healthy adolescent male rugby players (age: 14.3 ± 1.6 years). Also, Nikolaidou et al. (2023) observed a weak positive correlation between dynamic balance and vertical jump performance in active and retired volleyball players. However, there was no correlation in the non-athlete control group.

This study also revealed a positive correlation between mSEBT and SBJT, which was consistent with the findings of Asadi and Arazi (2018), who found a positive correlation between broad long jump (BLJ), and the anterior (A), anterolateral (AL), and lateral (L) directions of SEBT. However, Kartal (2020) found no correlation between the standing long jump (SLJ) and SEBT in any direction in junior soccer players (mean age, 9.78 ± 1.6 years).

The results of this study indicate a negative correlation between the 10-meter sprint test and mSEBT. Similar to this, a study conducted by Jouira et al. (2024) found that the 100-meter sprint test and YBT in athletes with intellectual disabilities showed a strong negative correlation. In addition, a moderate-to-significant correlation was found in 5 m, 10 m, and 20 m sprint times with SEBT in the study of Gonzalo-Skok et al. (2015), elucidating why individuals with a higher lower-body range of motion had slower sprint timing. There may be an optimal amount of flexibility that promotes better sprinting performance, with excessive or insufficient range of motion impairing efficiency. Conversely, Asadi and Arazi (2018) found a significant positive correlation between the A, AL, PL, and M directions of SEBT and the 20-meter sprint time. This contradiction may be attributed to the fact that sprints shorter than twenty meters will almost always involve acceleration. Because of the extended period spent in touch with the ground during acceleration, this technique might reduce the effect of dynamic stability while simultaneously focusing on force production in the initial stages of a sprint.

The findings of this study also showed a negative correlation between mSEBT and the T-agility test, which is similar to the results of Rokaya et al. (2021), who observed a significant negative correlation in soccer players between dynamic balance measured by the Y Balance Test – Lower Quarter (YBT-LQ) and agility (measured by modified agility T-test), reporting that during the T-test, the individuals moved laterally.

Such actions lead the feet to rotate, compromising stability due to the restricted lateral flexibility of the ankle and knee. Consequently, the influence of balance is much more noticeable during such a performance. Therefore, Rokaya explained that to pass the agility test, candidates must also be able to quickly change directions, accelerate, and decelerate while moving forward. Also, effective neuromuscular control adaptations are necessary to compensate for the regular center of gravity (COG) disruptions caused by these movements; therefore, agility performance can be positively impacted by an individual's capacity to maintain dynamic balance.

In contrast to the results of this study, Asadi and Arazi, found a positive correlation between the M direction of the SEBT and the T-agility test. Furthermore, a significant positive correlation was found between the A, L, and M directions of SEBT and the 4x9-meter shuttle run [16]. This result may be attributed to the fact that the abductor and vastus muscles are strongly used during the L and A excursions. Along with helping with direction changes by braking and re-acceleration, the abductor and vastus muscles also aid in accelerating running speed. It draws attention to how the leg muscles work together and how this may support both dynamic stability and the capacity for multidirectional speed and direction change.

One possible explanation for the contradictory results lies in the specific populations and methods used. Previous studies focused on athletes of different age groups and genders. These studies employed varying sample sizes, training regimens, and performance metrics, which could lead to differing outcomes. Additionally, some research incorporated controlled environments, while others observed athletes in real-world settings. Such methodological differences can significantly impact the consistency and comparability of the results.

Limitation of the study

It is necessary to acknowledge the limitations of a pilot study. The sample size was small and the participants were recruited from one area, which made the results difficult to generalize. The study did not cover other factors, such as anthropometric measurements, sociodemographic variables, range of motion, strength, or pain. Therefore, full-scale studies are recommended

Conclusion

The dynamic balance is a crucial aspect of a basketball player's performance. It significantly impacts their ability to excel in various skills, making it essential for coaches to incorporate dynamic balance exercises into their training programs. Improving dynamic balance enhances a player's ability to change direction quickly and maintain control during fast-paced plays. It also contributes to enhancing agility, enabling players to navigate through defenses more effectively. By prioritizing dynamic balance training, basketball players can enhance their overall game and minimize the risk of injuries.

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Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to their containing information that could compromise the privacy of research participants.

Disclosure

The authors report no conflicts of interest in this work.

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