# JOURNAL OF SPORTS SCIENCE ACADEMY

**e-ISSN: 3062-2883**
**https://ssajournal.com**
**DOI: 10.5281/zenodo.15692646**

*Original Article*

# Examination of the Relationship Between Single-Leg Jump Performance and Change of Direction Speed in Basketball Players

**İbrahim Avcı[1*], Hrvoje Ajman[2], Selcan Özkan[3]**

[1] Postgraduate Education Institute, Malatya Turgut Özal University, Malatya- 44050, Türkiye.
[2] Faculty of Kinesiology, "Josip Juraj Strossmayer" University of Osijek, Osijek- 31000, Croatia.
[3] Graduate Education Institute, Adıyaman University, Adıyaman- 02300, Türkiye.
*Correspondence: İbrahim Avcı; avciworkk@gmail.com

**Citation:** Avcı, İ., Ajman, H., & Özkan, S. (2025). Examination of the relationship between single-leg jump performance and change of direction speed in basketball players. *Journal of Sports Science Academy, 1*(2). 34-45. https://doi.org/10.5281/zenodo.15692646

Received: 12.05.2025

Revised: 15.06.2025

Accepted: 18.06.2025

Published: 11.09.2025



**Abstract**

In dynamic and high-intensity sports such as basketball, jumping and speed are fundamental motor skills that directly affect both offensive and defensive performance. Understanding the relationship between these abilities is crucial for designing training strategies that enhance players' on-court effectiveness. This study aimed to examine the relationship between single-leg jump performance and change of direction speed in adolescent male basketball players. The study included 29 participants with a mean age of 16.76 ± 1.09 years, height 179.28 ± 5.28 cm, weight 76.21 ± 6.65 kg, and BMI 23.76 ± 2.39. Based on Pearson correlation analysis, a weak and negative correlation ($r = -0.237$) was found between the two variables; however, this result was not statistically significant ($p = 0.216$). Additionally, the coefficient of determination ($R^2 = 0.056$) indicated that jump performance explained only 5.6% of the variance in change of direction speed. In conclusion, no significant association was found between single-leg jump performance and change of direction speed. This suggests that these two motor skills should be approached independently in physical training and performance assessment. Future studies involving larger and more diverse samples are recommended to achieve more generalizable and comprehensive results.

**Keywords:** Basketball, Youth athletes, Motor performance, Agility, Explosive power.

## Introduction

Basketball is a high-intensity intermittent sport that requires players to execute frequent accelerations, decelerations, and multidirectional movements throughout a game (Abian-Vicen et al., 2014). On average, a basketball player covers approximately 5000 meters per match, with heart rates exceeding 75% of their maximum capacity and an average heart rate of around 140 beats per minute (Puente et al., 2017). Given these physiological demands, basketball necessitates the integration of both aerobic and anaerobic energy systems to sustain repeated explosive movements such as sprints, lateral shifts, and vertical jumps.

Jumping ability is a fundamental component of basketball performance, as it directly influences offensive and defensive actions. Professional basketball players perform approximately 44±7 jumps per game, underscoring the critical role of lower-body strength and power in competitive play (Abdelkrim et al., 2007). Explosive jumping movements contribute to key performance tasks such as rebounding, shot-blocking, and layups, as well as enhancing overall agility and movement efficiency (Ramirez-Campillo et al., 2021; Saez de Villarreal et al., 2021). Additionally, high-intensity movements such as rapid acceleration, deceleration, and changes of direction are essential for optimizing game performance, and these abilities are closely linked to neuromuscular power and agility (Castagna et al., 2008).

Basketball requires players to execute both pre-planned and reactive movements, often within split-second decision-making scenarios (Versic et al., 2021). Change-of-direction speed (pre-planned agility) and reactive agility (unplanned agility) are widely recognized as key determinants of successful performance (Ben Abdelkrim et al., 2010; Scanlan et al., 2015; Sekulic et al., 2017; Vukasevic et al., 2020). Studies conducted on basketball players from various competitive levels have demonstrated significant differences in change-of-direction speed between first- and second-division athletes, highlighting the role of agility in distinguishing elite performers from lower-level competitors (Ben Abdelkrim et al., 2010; Köklü et al., 2011). More recent research has further reinforced the importance of reactive agility as a distinguishing factor in performance levels, particularly in high-intensity gameplay scenarios (Scanlan et al., 2015; Sekulic et al., 2017).

Given the dynamic and unpredictable nature of basketball, players must continuously adapt to fluctuating movement intensities and directional changes throughout a match. As a result, change-of-direction performance is considered a crucial determinant of overall on-court effectiveness (Ben Abdelkrim et al., 2010; Scanlan et al., 2012, 2015). This ability requires coordinated neuromuscular activity to decelerate rapidly without compromising balance while generating medial-lateral ground reaction forces to facilitate efficient directional shifts (Spiteri et al., 2014). Furthermore, basketball players frequently transition from lateral movements to maximal vertical jumps, particularly when executing fast-break layups or defensive shot-blocking attempts (Ziv & Lidor, 2010). Given the sport-specific nature of single-leg jumping, mastery of this skill is likely to enhance overall game performance and provide a competitive edge (Wen et al., 2018). Indeed, previous studies have revealed that elite-level basketball players demonstrate approximately 9% higher single-leg jump performance compared to collegiate-level athletes, emphasizing the role of lower-limb power in distinguishing top-tier competitors (Delextrat & Cohen, 2008).

In light of these findings, the ability to generate explosive power through single-leg jumps and maintain high-speed lateral movement is integral to basketball performance. In dynamic and fast-paced sports such as basketball, jumping ability and change of direction speed are fundamental skills that directly influence both offensive and defensive efficiency. Single-leg jump performance serves as a critical indicator of an athlete's capacity for rapid force production and movement adaptability, making it a key area of focus for performance optimization. This study seeks to investigate the relationship between single-leg jump performance and change of direction speed, thereby providing empirical evidence to support the development of targeted training interventions. By establishing potential correlations between these two performance variables, the findings of this research may contribute to the refinement of sport-specific conditioning programs designed to enhance agility, explosiveness, and overall game effectiveness. Understanding the interplay between single-leg jump capacity and change of direction speed will offer valuable insights for coaches, trainers, and athletes striving to maximize on-court performance. Therefore, the primary objective of this study is to examine the relationship between single-leg jump performance and change of direction speed in basketball players, with a focus on optimizing training methodologies for competitive success.

## Material and Methods

### *Participants*

The required number of participants for the study was determined using the G*Power statistical analysis software (version 3.1.9.3, Germany). To calculate the sample size, the "Exact" option under the "Correlation: Bivariate normal model" statistical test and a "Two-tailed" hypothesis test were selected. In this analysis, the expected correlation coefficient for the alternative hypothesis ($H_1$) was set at p = 0.50, with a Type I error rate ($\alpha$ err prob) of 0.05 and statistical power ($1-\beta$ err prob) of 0.80. The analysis indicated that the study required a minimum of 29 participants. In this context, 29 basketball players were included in the research.

*Inclusion and Exclusion Criteria*

Participants were included in the study based on specific inclusion criteria, which required them to be between the ages of 15 and 18 and to have at least three years of regular basketball training experience. It was mandatory for participants to have engaged in training at least three times per week and to have no history of acute injuries or chronic orthopedic conditions affecting the lower extremities. Additionally, the ability to safely perform the single-leg jump test with both legs was established as a prerequisite. All participants were required to voluntarily participate in the study and to provide signed informed consent.

According to the exclusion criteria, individuals who had undergone lower extremity surgery or experienced a severe injury within the past six months were excluded from the study. Those with neurological or musculoskeletal disorders that could impair motor skills were not permitted to participate. Furthermore, individuals who had trained less than three times per week in the past three months or were found to be using ergogenic aids or performance-enhancing substances were excluded. Athletes competing professionally in a sport other than basketball were also not eligible for inclusion. Additionally, individuals who did not sign the informed consent form or failed to provide data in accordance with the study protocol were excluded from participation. Descriptive statistics of the participants are presented in Table 1.

**Table 1.** Descriptive statistics of the participants

| Variables | n | Minimum | Maximum | Mean | Std. Deviation |
|---|---|---|---|---|---|
| **Age (year)** | 29 | 15.00 | 18.00 | 16.758 | 1.090 |
| **Hight (cm)** | 29 | 167.00 | 191.00 | 179.275 | 5.284 |
| **Weight (kg)** | 29 | 64.00 | 93.00 | 76.206 | 6.646 |
| **BMI (kg/m²)** | 29 | 18.90 | 28.40 | 23.762 | 2.394 |
| **Single-Leg Jump (cm)** | 29 | 154.00 | 192.00 | 172.827 | 9.599 |
| **Change of Direction Speed (sn)** | 29 | 4.29 | 4.89 | 4.581 | 0.137 |

In Table 1, the participants' ages ranged from 15 to 18 years, with a mean age of 16.76 years and a standard deviation of 1.09. The average height was measured as 179.28 cm, with a minimum of 167 cm and a maximum of 191 cm, and a standard deviation of 5.28 cm. The participants' body weights ranged between 64 kg and 93 kg, with a mean weight of 76.21 kg and a standard deviation of 6.65 kg. The Body Mass Index (BMI) had a mean value of 23.76, with the lowest value recorded as 18.90 and the highest as 28.40, and a standard deviation of 2.39. The single-leg jump distances varied between 154 cm and 192 cm, with a mean distance of 172.83 cm and a standard deviation of 9.60 cm. change of direction speed times ranged from 4.29 seconds to 4.89 seconds, with a mean duration of 4.58 seconds and a standard deviation of 0.14 seconds.

***Experimental Design***

This study employed a cross-sectional design within a quasi-experimental framework. The research commenced following approval from the İnönü University Scientific Research and Publication Ethics Committee and the Health Sciences Scientific Research Ethics Committee (Approval Number: 2025/7509). Participants were provided with detailed information regarding the study's purpose, scope, and procedure. Informed consent forms were signed, ensuring voluntary participation. Anthropometric measurements were conducted to assess participants' body composition, including height, body weight, and body mass index (BMI). In addition, the Single-Leg Hop Test and the Pro-Agility (5-10-5) Test were administered to evaluate single-leg jumping and change of direction speed capacities, respectively.

***Biometric Measurements***

Participants' body weight and height were measured using standardized protocols in accordance with the International Society for the Advancement of Kinanthropometry (ISAK) guidelines. Height was measured using a wall-mounted stadiometer (Holtain Ltd., UK) for precision, while body weight was recorded using a calibrated electronic scale (Seca, Germany). To ensure accuracy and reproducibility, all assessments were conducted between 09:00 and 09:30 AM, with participants wearing light clothing and no footwear. This scheduling minimized biological variations that could occur at different times of the day.

***Single-Leg Hop Test***

The Single-Leg Hop Test is a functional performance assessment with high reliability, demonstrating intraclass correlation coefficients ranging from 0.92 to 0.96 (Bang et al., 1990; Bolgla & Keskula, 1997). The test was conducted based on the methodology outlined by Noyes et al. (1991) and Dominguez-Navarro et al. (2023). During the test, a measuring tape was placed parallel to the ground on the surface used for jumping. Participants were instructed to stand on their dominant leg and jump forward with maximum effort. Upon landing, they were required to maintain balance on the same leg without shifting their support surface or using additional assistance. If any of these criteria were not met, the trial was deemed invalid. Once successfully completed, the jump distance was recorded in centimeters. The Single-Leg Hop Test is illustrated in Figure 1.

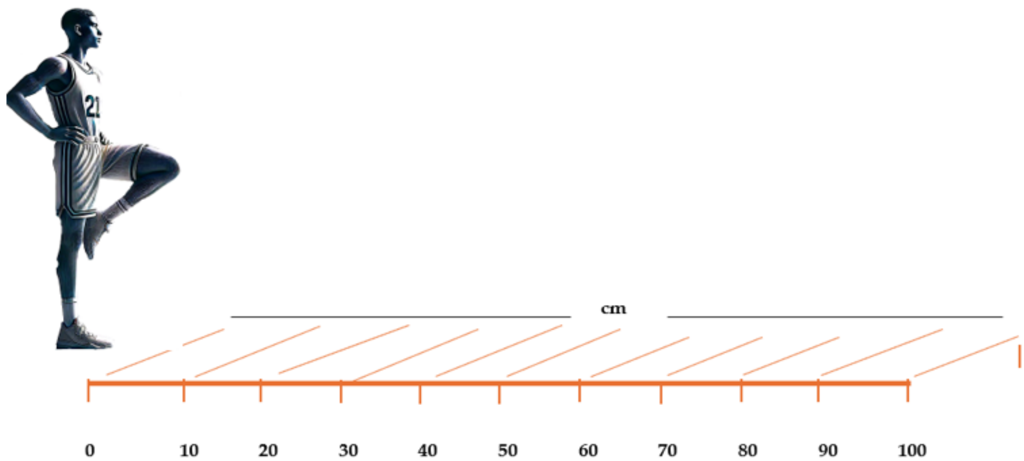

**Figure 1.** Single-leg hop test.

### *Pro-Agility (5-10-5) Test*

The Pro-Agility (5-10-5) Test is a widely used assessment for evaluating agility levels and change-of-direction speed in athletes (İlbak et al., 2023). At the start of the test, participants assumed a three-point stance while facing forward at the midpoint of the testing area, which helped them maintain balance and readiness. In the first trial, participants were free to initiate movement either to the left or right upon the start command. They sprinted 5 yards (4.57 m) in one direction and touched a cone with their right hand. Then, they changed direction, turning 180 degrees, and sprinted 10 yards (9.14 m) to touch another cone with their left hand. This phase was critical for assessing agility and directional change ability. Finally, participants made another 180-degree turn and sprinted 5 yards (4.57 m) back to the starting position, crossing the photocell timing gate to complete the test. The final results were recorded in seconds (Stewart et al., 2014). The Pro-Agility (5-10-5) Test is depicted in Figure 2.

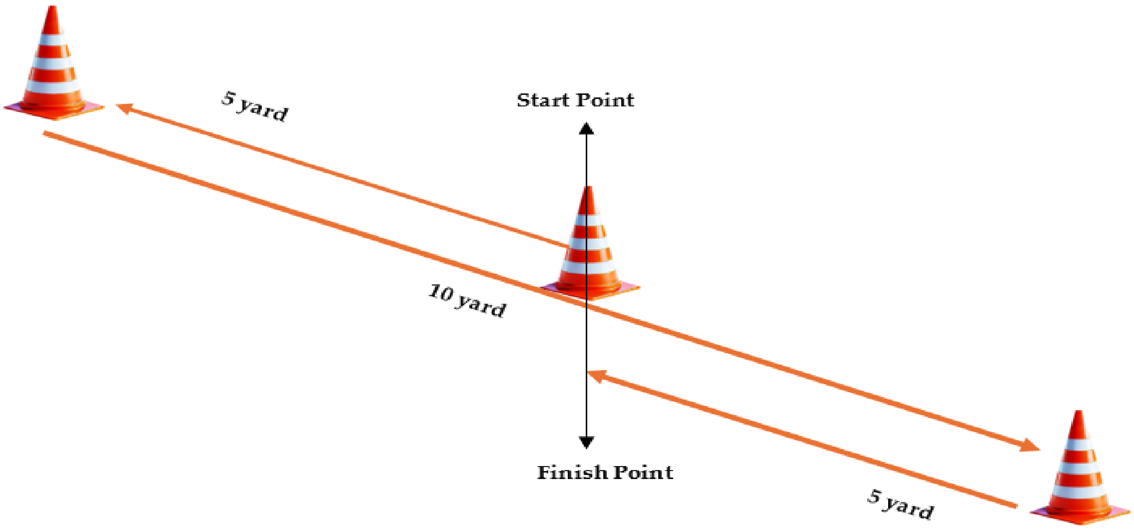


**Figure 2.** Pro-agility (5-10-5) test.

### *Statistical Analysis*

The collected data were analyzed using IBM SPSS Statistics software (version 26.0, Armonk, NY, USA). Descriptive statistics were used to summarize the participants' demographic characteristics and primary study variables. The normality of the data distribution was assessed by examining skewness and kurtosis values, with values between +2 and -2 considered acceptable for normal distribution (Kim, 2013; Mishra et al., 2019; Tabachnick & Fidell, 2019). To investigate the relationships between variables, Pearson correlation analysis was conducted. This method assesses the direction and strength of linear associations, with correlation coefficients (r) ranging from -1 to +1. These coefficients were interpreted as follows: weak correlation (±0.1 to ±0.3), moderate correlation (±0.3 to ±0.5), strong correlation (±0.5 to ±0.7), and very strong correlation (±0.7 to ±1.0) (Cohen, 1988; Hinkle et al., 2003). In addition to correlation analysis, linear regression analysis was employed to evaluate the predictive relationship between key performance variables. The coefficient of determination ($R^2$) was used to quantify the proportion of variance in the dependent variable explained by the independent variable.

All statistical analyses were performed within a 95% confidence interval, and the level of statistical significance was set at $p < 0.05$.

**Results**

The results obtained within the scope of this research are presented in the table below.

**Table 2.** Pearson correlation analysis results

| Sport Performance Parameter | n | r | p |
|---|---|---|---|
| Single-Leg Jump (cm) | 29 | -.237 | .216 |
| Change of Direction Speed (sn) | | | |

n: Sample number; r: correlation; p: p-value.

As presented in Table 2, the Pearson correlation coefficient between single-leg jump performance and change of direction speed was calculated as r = -0.237, indicating a weak and negative relationship between the two variables. This suggests that as jump performance increases, there may be a slight improvement in change of direction speed (reflected by reduced time); however, the strength of this association is minimal. Furthermore, the obtained p-value = 0.216 exceeds the commonly accepted threshold for statistical significance ($p < 0.05$), indicating that the observed relationship is not statistically significant. Therefore, no meaningful correlation can be concluded between the variables in this sample.

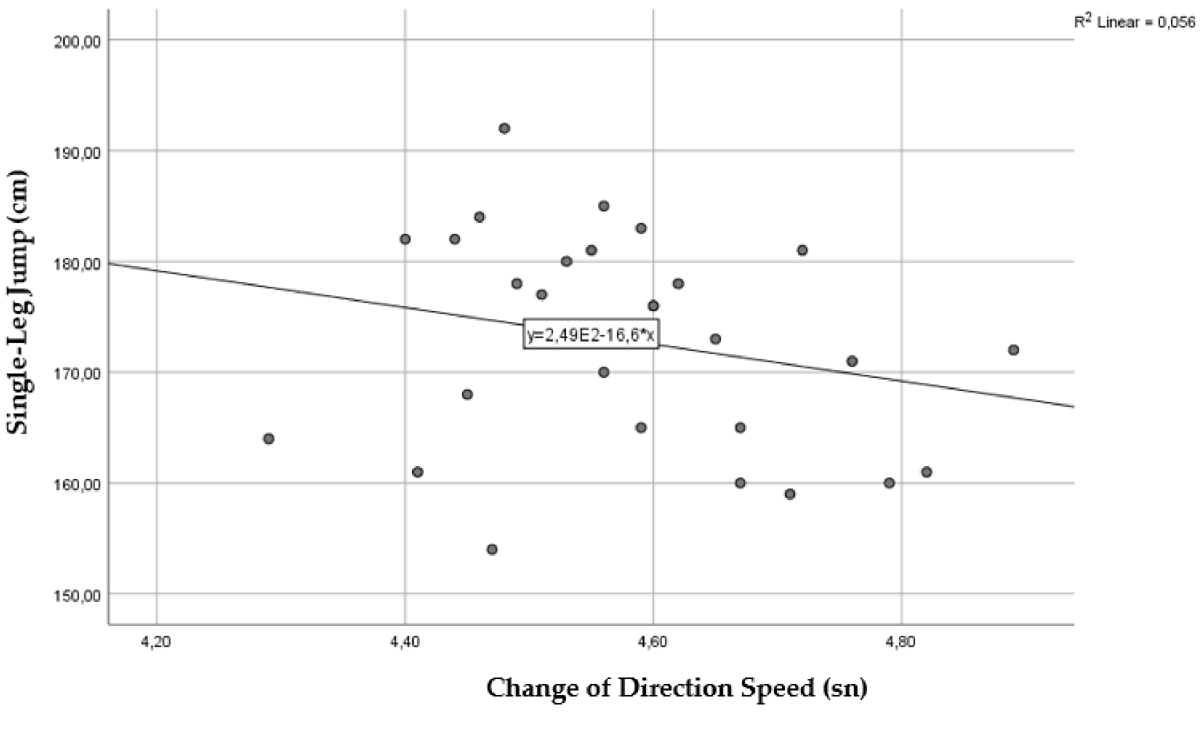


**Figure 3.** Linear regression analysis results.

In figure 3, according to the linear regression analysis, the obtained $R^2 = 0.056$ indicates that single-leg jump performance explains only 5.6% of the variance in change of direction speed. This reflects a very low explanatory power, suggesting that jump performance has a limited predictive effect on agility. Therefore, beyond being a weak correlation, the practical significance of the relationship is also minimal.

**Discussion**

The discussion section explores the meaning of the findings in depth and compares them with similar studies in literature. The alignment of the results with the research questions and hypotheses should be evaluated, and any unexpected outcomes should be highlighted. The theoretical or practical contributions of the study, along with the implications of the findings, should be discussed. Additionally, the study's limitations must be addressed objectively, explaining how these may have influenced the results. Lastly, suggestions for future research should be provided, pointing toward new areas of inquiry.

This study aimed to examine the relationship between single-leg jump performance and change of direction (COD) speed in adolescent male basketball players. The findings revealed no statistically significant relationship between single-leg jump performance and COD speed. The absence of a meaningful correlation between these two performance variables is thought to be associated with the fact that they rely on different physical and neuromotor components.

While the single-leg jump test predominantly assesses explosive strength and lower extremity power (do Amaral Vasconcellos et al., 2012; Tramel et al., 2019), COD speed involves not only muscular strength but also a variety of complex skills such as agility, balance, coordination, reaction time, and neuromuscular control (Matlák et al., 2016; Sattler et al., 2015). Therefore, an athlete may exhibit high jump performance yet lack the agility and body control necessary during directional changes.

Furthermore, while COD tests encompass multidirectional movements and sport-specific actions such as sudden stopping and starting (Hernández-Davó et al., 2021; Lockie et al., 2018), jump tests evaluate more linear and limited movement patterns (Church et al., 2001; Lockie et al., 2018). Additionally, factors such as limb asymmetries, technical differences, and the validity levels of the tests used may also contribute to the weak relationship observed between these variables. Consequently, COD speed and jump performance can be regarded as distinct motor characteristics.

The relationship between COD performance and jump performance appears to be multifaceted. The literature presents varying findings indicating both direct and indirect associations between these two physical performance indicators. For instance, Mikołajec et al. (2023) found a negative correlation between COD ability and countermovement jump height in basketball players, suggesting that greater COD ability might correspond with lower jump height. Conversely, a study conducted on female athletes identified countermovement jump height as a significant predictor of COD performance, indicating that improvements in jumping ability may enhance COD skills (Yamashita et al., 2024). In particular, the rate of force production during the concentric phase of the countermovement jump has been highlighted as an indicator of COD ability, emphasizing the critical role of explosive strength in both jumping and COD performance (Yamashita et al., 2024).

Moreover, research on young basketball players has reported significant relationships between COD performance and jumping ability, with age-related differences suggesting that developmental factors influence physical performance components (Perez-Ifrán et al., 2023). In this context, while the findings of the present study align with some previous research, they contrast with others. These discrepancies may be attributed to differences in the jump test protocols employed.

Swearingen et al. (2011), in a study examining the correlation among three different functional tests—Single Leg Vertical Jump (SLVJ), Single Leg Hop for Distance (SLHD), and Single Leg Hop for Time (SLHT)—reported a strong negative correlation between SLHT and SLHD in both legs ($r = -0.89$). In contrast, the correlation between SLVJ and SLHT was found to be weaker. These results suggest that SLHT and SLHD measure similar functional characteristics, while SLVJ reflects different functional components.

Although the literature generally reports strong relationships between COD and jump performance, it is important to recognize that these are distinct motor skills. Each is shaped by different physiological and biomechanical factors, and maximizing performance in either domain requires targeted training approaches. Therefore, while improvements in jumping ability may contribute to COD performance, developing both skills independently through specific training programs is essential for optimal athletic development (Suarez-Arrones et al., 2020). In this context, it is recommended that training programs for basketball players focus on the specific motor attributes intended for improvement. Training methods such as plyometrics (Asadi, 2013), electrical muscle stimulation (İlbak & Acak, 2022), air alert programs (Hulfian et al., 2023), and resistance training (Santos & Janeira, 2012) can be utilized for this purpose.

**Conclusions**

In conclusions, this study highlights the complex and non-linear relationship between single-leg jump performance and change of direction speed in adolescent basketball players. The lack of a statistically significant correlation between these two variables supports the notion that they rely on distinct physical and neuromuscular mechanisms. While explosive strength may contribute to both abilities, specific motor demands such as agility and neuromuscular control play a more critical role in COD performance. As such, basketball training programs should adopt a multifaceted approach, incorporating both generalized and targeted interventions to enhance motor performance. Future research is encouraged to explore longitudinal effects of training interventions and include larger, diverse athlete populations for more comprehensive insights.

**Author Contributions:** Authors of this article made the following contributions: conceptualization, İ.A., H.A.; methodology, İ.A., H.A., S.Ö.; software, İ.A.; validation, H.A., S.Ö.; formal analysis, İ.A.; investigation, İ.A., H.A., S.Ö.; resources, S.Ö.; data curation, H.A.; writing—original draft preparation, H.A., S.Ö.; writing—review and editing İ.A.; visualization, İ.A., H.A., S.Ö.; supervision, İ.A.; project administration, İ.A. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

**Ethical Approval Statement:** This research project received ethical approval from the İnönü University Scientific Research and Publication Ethics Committee and the Health Sciences Scientific Research Ethics Committee on 30 April 2025, with the approval number 2025/7509.

**Informed Consent Statement:** All participants provided written informed consent before participating in the study.

**Conflict of Interest:** The authors declare no conflicts of interest regarding this study.

**Data Availability Statement:** Data supporting this study is available from the authors upon reasonable request.

**Artificial Intelligence (AI) Usage Disclosure:** ChatGPT (OpenAI) was used solely for language editing, translation, and proofreading during the preparation of this manuscript. It was not used for generating scientific content, data analysis, interpretation, or drawing conclusions. All scientific contributions are solely the work of the authors. Additionally, ChatGPT was used to enhance the visual clarity of the figures in the manuscript; however, the content and design of the visuals were entirely determined by the authors.

**References**

Abdelkrim, N. B., Fazaa, S. E., & Ati, J. E. (2007). Time–motion analysis and physiological data of elite under-19-year-old basketball players during competition. *British Journal of Sports Medicine, 41*(2), 69–75. https://doi.org/10.1136/bjsm.2006.032318

Abián-Vicen, J., Puente, C., Salinero, J. J., González-Millán, C., Areces, F., Muñoz, G., Muñoz-Guerra, J., & Del Coso, J. (2014). A caffeinated energy drink improves jump performance in adolescent basketball players. *Amino Acids, 46*(5), 1333–1341. https://doi.org/10.1007/s00726-014-1702-6

Asadi, A. (2013). Effects of in-season short-term plyometric training on jumping and agility performance of basketball players. *Sport Sciences for Health, 9*(3), 133–137. https://doi.org/10.1007/s11332-013-0159-4

Bang, P., Brandt, J., Degerblad, M., Enberg, G., Kaijser, L., Thorén, M., & Hall, K. (1990). Exercise-induced changes in insulin-like growth factors and their low molecular weight binding protein in healthy subjects and patients with growth hormone deficiency. *European Journal of Clinical Investigation, 20*(3), 285–292. https://doi.org/10.1111/j.1365-2362.1990.tb01857.x

Ben Abdelkrim, N., Chaouachi, A., Chamari, K., Chtara, M., & Castagna, C. (2010). Positional role and competitive-level differences in elite-level men's basketball players. *The Journal of Strength & Conditioning Research, 24*(5), 1346. https://doi.org/10.1519/JSC.0b013e3181cf7510

Bolgla, L. A., & Keskula, D. R. (1997). Reliability of lower extremity functional performance tests. *Journal of Orthopaedic & Sports Physical Therapy, 26*(3), 138–142. https://doi.org/10.2519/jospt.1997.26.3.138

Castagna, C., Abt, G., Manzi, V., Annino, G., Padua, E., & D'Ottavio, S. (2008). Effect of recovery mode on repeated sprint ability in young players. *The Journal of Strength & Conditioning Research, 22*(3), 929–929.

Church, J. B., Wiggins, M. S., Moode, F. M., & Crist, R. (2001). Effect of warm-up and flexibility treatments on vertical jump performance. *The Journal of Strength & Conditioning Research, 15*(3), 332.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Routledge. https://doi.org/10.4324/9780203771587

Delextrat, A., & Cohen, D. (2008). Physiological testing of basketball players: Toward a standard evaluation of anaerobic fitness. *The Journal of Strength & Conditioning Research, 22*(4), 1066. https://doi.org/10.1519/JSC.0b013e3181739d9b

do Amaral Vasconcellos, F. V., Fonseca, R. T., & Dantas, E. H. M. (2012). Validity and reproducibility of the sargent jump test in the assessment of explosive strength in soccer players. *Journal of Human Kinetics, 33*, 115.

Dominguez-Navarro, F., Casaña, J., Perez-Dominguez, B., Ricart-Luna, B., Cotolí-Suárez, P., & Calatayud, J. (2023). Dynamic balance and explosive strength appears to better explain single leg hop test results among young elite female basketball athletes. *Scientific Reports, 13*(1), 5476. https://doi.org/10.1038/s41598-023-31178-7

Hernández-Davó, J. L., Loturco, I., Pereira, L. A., Cesari, R., Pratdesaba, J., Madruga-Parera, M., Sanz-Rivas, D., & Fernández-Fernández, J. (2021). Relationship between sprint, change of direction, jump, and hexagon test performance in young tennis players. *Journal of Sports Science & Medicine, 20*(2), 197–203. https://doi.org/10.52082/jssm.2021.197

Hinkle, D. E., Wiersma, W., & Jurs, S. G. (2003). *Applied statistics for the behavioral sciences*. Houghton Mifflin.

Hulfian, L., Kusmaedi, N., Suryansyah, & Kusuma, L. S. W. (2023). The air alert training program using the interval method can increase leg muscle power and endurance in basketball athletes. *International Conference of Sport for Development and Peace, 6*(1), Article 1.

İlbak, İ., & Acak, M. (2022). The effect of plyometric training combined with electrical muscle stimulation on sports performance parameters in basketball players. *Spor ve Performans Araştırmaları Dergisi, 13*(2), Article 2. https://doi.org/10.17155/omuspd.1078740

İlbak, İ., Yasul, Y., & Akçinar, F. (2023). Bireysel ve takım sporlarında aktif spor yapan bireylerin performans düzeylerini belirlemek amacıyla hazırlanan lisansüstü tezlerdeki ölçüm yöntemleri. *Kilis 7 Aralık Üniversitesi Beden Eğitimi ve Spor Bilimleri Dergisi, 7*(1), Article 1.

Kim, H.-Y. (2013). Statistical notes for clinical researchers: Assessing normal distribution (2) using skewness and kurtosis. *Restorative Dentistry & Endodontics, 38*(1), 52–54. https://doi.org/10.5395/rde.2013.38.1.52

Köklü, Y., Alemdaroğlu, U., Koçak, F. Ü., Erol, A. E., & Fındıkoğlu, G. (2011). Comparison of chosen physical fitness characteristics of Turkish professional basketball players by division and playing position. *Journal of Human Kinetics, 30*, 99–106. https://doi.org/10.2478/v10078-011-0077-y

Lockie, R. G., Moreno, M. R., Lazar, A., Orjalo, A. J., Giuliano, D. V., Risso, F. G., Davis, D. L., Crelling, J. B., Lockwood, J. R., & Jalilvand, F. (2018). The physical and athletic performance characteristics of Division I collegiate female soccer players by position. *The Journal of Strength & Conditioning Research, 32*(2), 334–343.

Matlák, J., Tihanyi, J., & Rácz, L. (2016). Relationship between reactive agility and change of direction speed in amateur soccer players. *The Journal of Strength & Conditioning Research, 30*(6), 1547. https://doi.org/10.1519/JSC.0000000000001262

Mikołajec, K., Gabryś, T., Gryko, K., Prończuk, M., Krzysztofik, M., Trybek, G., & Maszczyk, A. (2023). Relationship among the change of direction ability, sprinting, jumping performance, aerobic power and anaerobic speed reserve: A cross-sectional study in elite 3x3 basketball players. *Journal of Human Kinetics, 85*, 105–113. https://doi.org/10.2478/hukin-2022-0114

Mishra, P., Pandey, C. M., Singh, U., Gupta, A., Sahu, C., & Keshri, A. (2019). Descriptive statistics and normality tests for statistical data. *Annals of Cardiac Anaesthesia, 22*(1), 67–72. https://doi.org/10.4103/aca.ACA_157_18

Noyes, F. R., Barber, S. D., & Mangine, R. E. (1991). Abnormal lower limb symmetry determined by function hop tests after anterior cruciate ligament rupture. *The American Journal of Sports Medicine, 19*(5), 513–518. https://doi.org/10.1177/036354659101900518

Perez-Ifrán, P., Rial, M., Brini, S., Calleja-González, J., Del Rosso, S., Boullosa, D., & Benítez-Flores, S. (2023). Change of direction performance and its physical determinants among young basketball male players. *Journal of Human Kinetics, 85*, 23–34. https://doi.org/10.2478/hukin-2022-0107

Puente, C., Abián-Vicén, J., Areces, F., López, R., & Del Coso, J. (2017). Physical and physiological demands of experienced male basketball players during a competitive game. *The Journal of Strength & Conditioning Research, 31*(4), 956. https://doi.org/10.1519/JSC.0000000000001577

Ramirez-Campillo, R., García-de-Alcaraz, A., Chaabene, H., Moran, J., Negra, Y., & Granacher, U. (2021). Effects of plyometric jump training on physical fitness in amateur and professional volleyball: A meta-analysis. *Frontiers in Physiology, 12*. https://doi.org/10.3389/fphys.2021.636140

Saez de Villarreal, E., Molina, J. G., de Castro-Maqueda, G., & Gutiérrez-Manzanedo, J. V. (2021). Effects of plyometric, strength and change of direction training on high-school basketball player's physical fitness. *Journal of Human Kinetics, 78*, 175–186. https://doi.org/10.2478/hukin-2021-0036

Santos, E. J. A. M., & Janeira, M. A. A. S. (2012). The effects of resistance training on explosive strength indicators in adolescent basketball players. *The Journal of Strength & Conditioning Research, 26*(10), 2641. https://doi.org/10.1519/JSC.0b013e31823f8dd4

Sattler, T., Sekulić, D., Spasić, M., Perić, M., Krolo, A., Uljević, O., & Kondrič, M. (2015). Analysis of the association between motor and anthropometric variables with change of direction speed and reactive agility performance. *Journal of Human Kinetics, 47*, 137–145. https://doi.org/10.1515/hukin-2015-0069

Scanlan, A. T., Dascombe, B. J., Reaburn, P., & Dalbo, V. J. (2012). The physiological and activity demands experienced by Australian female basketball players during competition. *Journal of Science and Medicine in Sport, 15*(4), 341–347. https://doi.org/10.1016/j.jsams.2011.12.008

Scanlan, A. T., Tucker, P. S., & Dalbo, V. J. (2015). The importance of open- and closed-skill agility for team selection of adult male basketball players. *The Journal of Sports Medicine and Physical Fitness, 55*(5), 390–396.

Sekulic, D., Pehar, M., Krolo, A., Spasic, M., Uljevic, O., Calleja-González, J., & Sattler, T. (2017). Evaluation of basketball-specific agility: Applicability of performance tests. *The Journal of Strength & Conditioning Research, 31*(8), 2278–2288.

Spiteri, T., Nimphius, S., Hart, N. H., Specos, C., Sheppard, J. M., & Newton, R. U. (2014). Contribution of strength characteristics to change of direction and agility performance in female basketball athletes. *The Journal of Strength & Conditioning Research, 28*(9), 2415. https://doi.org/10.1519/JSC.0000000000000547

Stewart, P. F., Turner, A. N., & Miller, S. C. (2014). Reliability, factorial validity, and interrelationships of five commonly used change of direction speed tests. *Scandinavian Journal of Medicine & Science in Sports, 24*(3), 500–506. https://doi.org/10.1111/sms.12019

Suarez-Arrones, L., Gonzalo-Skok, O., Carrasquilla, I., Asián-Clemente, J., Santalla, A., Lara-Lopez, P., & Núñez, F. J. (2020). Relationships between change of direction, sprint, jump, and squat power performance. *Sports, 8*(3), Article 3. https://doi.org/10.3390/sports8030038

Swearingen, J., Lawrence, E., Stevens, J., Jackson, C., Waggy, C., & Davis, D. S. (2011). Correlation of single leg vertical jump, single leg hop for distance, and single leg hop for time. *Physical Therapy in Sport, 12*(4), 194–198. https://doi.org/10.1016/j.ptsp.2011.06.001

Tabachnick, B. G., & Fidell, L. S. (2019). *Using multivariate statistics* (7th ed.). Pearson.

Tramel, W., Lockie, R. G., Lindsay, K. G., & Dawes, J. J. (2019). Associations between absolute and relative lower body strength to measures of power and change of direction speed in Division II female volleyball players. *Sports, 7*(7), Article 7. https://doi.org/10.3390/sports7070160

Versic, S., Pehar, M., Modric, T., Pavlinovic, V., Spasic, M., Uljevic, O., Corluka, M., Sattler, T., & Sekulic, D. (2021). Bilateral symmetry of jumping and agility in professional basketball players: Differentiating performance levels and playing positions. *Symmetry, 13*(8), Article 8. https://doi.org/10.3390/sym13081316

Vukasevic, V., Mitrovic, M., & Masanovic, B. (2020). A comparative study of motor ability between elite basketball players from different regions. *Sport Mont, 18*(1), 3–7.

Wen, N., Dalbo, V. J., Burgos, B., Pyne, D. B., & Scanlan, A. T. (2018). Power testing in basketball: Current practice and future recommendations. *The Journal of Strength & Conditioning Research, 32*(9), 2677. https://doi.org/10.1519/JSC.0000000000002459

Yamashita, N., Sato, D., & Mishima, T. (2024). Change-of-direction performance and its deficits in relation to countermovement-jump height and phase-specific performance among female athletes. *International Journal of Sports Physiology and Performance.* https://doi.org/10.1123/ijspp.2024-0006

Ziv, G., & Lidor, R. (2010). Vertical jump in female and male basketball players—A review of observational and experimental studies. *Journal of Science and Medicine in Sport, 13*(3), 332–339. https://doi.org/10.1016/j.jsams.2009.02.009