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Original Article

Differences in Motor Abilities Among Basketball Players Based on Playing Position

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Abstract

Understanding whether motor abilities differ according to playing position is important for designing effective and position-specific training programmes in youth basketball. The aim of this study was to determine whether motor abilities differ among young basketball players according to playing position. The sample consisted of 15 young basketball players (age: 16.25 ± 0.74 years; body mass: 71.97 ± 11.82 kg; body height: 183.68 ± 6.7 cm), divided into sub-samples according to their playing position: guards (n = 5), forwards (n = 7), and centers (n = 3). Explosive power, sprint speed, and agility were assessed using standard field-based tests, including vertical jump tests, short-distance sprint tests, and agility tests with and without the ball. One-way analysis of variance (ANOVA) was used to examine differences between playing positions, while Tukey's HSD post hoc test was applied where appropriate. The results showed no statistically significant differences between guards, forwards, and centers in any of the assessed motor abilities ($p > 0.05$) These findings may indicate a relatively homogeneous motor profile among young basketball players across positions, possibly reflecting similar training demands, incomplete positional specialization, or the broader motor requirements of contemporary basketball. From a practical perspective, coaches should be cautious when assuming clear position-based differences in motor abilities among youth players and should combine general motor development with progressively more position-specific training. Future research should include larger samples and basketball-specific tests to better clarify the development of positional motor profiles.

Keywords: Agility, Speed, Explosive power, Basketball, Playing positions.

Introduction

Differences in motor abilities according to playing position represent an important issue in basketball training, particularly in young players whose physical and positional profiles may still be developing. Although basketball players are commonly classified according to specific tactical roles, the extent to which these roles are reflected in explosive power, speed, and agility remains an important question for both research and practice (Trninic, Perica, & Dizdar, 1999; Saavedra et al., 2018). Basketball is a dynamic and intermittent team sport characterized by frequent transitions between offense and defense, repeated accelerations and decelerations, changes of direction, jumps, and short high-intensity actions (McInnes, Carlson, Jones, & McKenna, 1995; Ben Abdelkrim et al., 2007; Stojanović et al., 2018). Successful performance depends on the interaction of anthropometric characteristics, motor abilities, functional capacities, technical skills, tactical knowledge, and psychological attributes (Narazaki et al., 2009). Among these factors, motor abilities are particularly important because they directly support the execution of basketball-specific actions during training and competition.

Speed, agility, and explosive power are among the most relevant motor abilities in basketball. Speed is important for fast breaks, defensive recovery, creating space, and rapid transitions between different phases of play. Agility enables players to perform efficient changes of direction, react to opponents, and maintain control during offensive and defensive actions. Explosive power contributes to jumping, rebounding, shot blocking, acceleration, and physical contests near the basket (Karalejić & Jakovljević, 1998; Delextrat & Cohen, 2009). Therefore, these abilities are not isolated physical qualities, but essential components of basketball performance. Playing position may influence the development and expression of these motor abilities. Guards are generally involved in ball control, organization of offense, rapid changes of direction, and frequent acceleration. Forwards often combine movement patterns typical of both guards and centers, contributing to transition play, defensive coverage, and actions near the basket. Centers are usually more involved in rebounding, screening, positioning under the basket, and physical contact situations (Sallet, Perrier, Ferret, Vitelli, & Baverel, 2005). These different positional demands suggest that players may develop distinct motor profiles; however, the magnitude and consistency of such differences are not always clear. Previous research has shown that match activity and physical demands in basketball can vary according to playing position. Time-motion analyses indicate that centers perform less high-intensity movement than guards and forwards, while forwards may spend a greater proportion of time running during games (Grosgeorge, 1990; Miller & Bartlett, 1994). Other studies have reported positional differences in maximal aerobic power, speed, agility, muscular strength, and other performance-related characteristics among basketball players (Smith & Thomas, 1991; Harris et al., 2000; Hoare, 2000; Sallet et al., 2005; Cormery, Marcil, & Bouvard, 2008). These findings support the assumption that playing position may be associated with specific physical and motor demands.

However, the available literature does not provide fully consistent conclusions, particularly when young basketball players are examined. In youth categories, positional specialization may still be incomplete, and players are often exposed to similar training content regardless of their position. As a result, differences between guards, forwards, and centers may be less pronounced than in senior or elite players. This is especially relevant when general field-based tests of explosive power, sprint speed, and agility are used, because such tests may reflect overall motor preparation rather than highly specific positional performance. Despite the growing interest in position-specific basketball preparation, there is still a need for clearer evidence on whether young basketball players already demonstrate distinct motor profiles according to playing position. Understanding these differences, or the absence of them, may help coaches decide whether training at this age should emphasize general motor development, position-specific conditioning, or a combination of both.

Therefore, the aim of this study was to determine differences in motor abilities among young basketball players according to playing position. More specifically, the study examined differences in explosive power, sprint speed, and agility among guards, forwards, and centers. The findings may contribute to a better understanding of positional motor profiles in youth basketball and provide practical information for planning training programmes adapted to the developmental and positional characteristics of players.

Material and Methods

Participants

The sample consisted of 15 young basketball players (age: 16.25 ± 0.74 years; body mass: 71.97 ± 11.82 kg; body height: 183.68 ± 6.7 cm), divided into sub-samples according to their playing position: guards (n = 5; age: 16.3 ± 0.35 years; body mass: 61.58 ± 1.92 kg; body height: 176.9 ± 3.5 cm), forwards (n = 7; age: 16.19 ± 0.46 years; body mass: 73.74 ± 21.52 kg; body height: 185.8 ± 8.26 cm), and centers (n = 3; age: 16.24 ± 0.50 years; body mass: 85.16 ± 7.25 kg; body height: 190.06 ± 3.98 cm). The participants competed in the ARDU Junior League of Serbia and regularly participated in 3–4 training sessions and one official match per week. The study was approved by the Ethics Committee of the Faculty of Sport and Physical Education, University of Niš (Approval No. 04-869/2, approved on 08.06.2024. and was conducted in accordance with the ethical standards of the Declaration of Helsinki. Written informed consent was obtained from all adult participants prior to testing. For participants younger than 18 years, written informed consent was obtained from their parents or legal guardians before participation. All tests were conducted on the same day.

Measures

Anthropometric characteristics

Anthropometric characteristics were measured before motor ability testing under standardized conditions, with participants barefoot and wearing standard sports attire. Body height was measured using a Martin anthropometer (GPM Anthropological Instruments, Switzerland), while body mass and body composition were assessed using an Omron BF 511 scale (Omron Healthcare Co., Kyoto, Japan). The same testing procedure was applied to all participants in order to ensure consistency of measurement conditions. Anthropometric variables were used descriptively to characterize the sample and playing-position groups, and were not included as control variables in the main statistical analysis.

Explosive power assessment tests

Lower-extremity explosive power was assessed using three vertical jump tests: the Counter Movement Jump (CMJ), Counter Movement Jump with Arm Swing (CMJA), and Squat Jump (SJ). These tests were selected because they provide complementary information on explosive strength performance in basketball-related movements. The SJ was used to assess concentric explosive power from a static starting position, the CMJ to assess explosive power involving the stretch-shortening cycle, and the CMJA to assess jump performance when arm swing contribution is allowed, which is closer to basketball-specific jumping actions. Each participant performed two trials of each jump, with a 30-second rest interval between individual trials and a 5-minute rest interval between different jump tests. The highest value of vertical jump height was included in the statistical analysis. The best trial was used because the aim was to assess each participant's maximal performance capacity, while reducing the influence of possible technical errors or submaximal execution in individual attempts. Vertical jump height was measured using an Optojump system (Optojump, Microgate, Bolzano, Italy), whose validity and reliability have been previously confirmed.

Speed assessment tests

Sprint speed was assessed using maximal sprint tests over 5 m, 10 m, and 20 m. All sprint tests were conducted [on the same testing day] and were performed before the explosive power tests and before the agility tests. Before testing, all participants completed a standardized warm-up consisting of [10–15 minutes of low-intensity running, dynamic mobility exercises, progressive accelerations, and practice trials]. The same warm-up

protocol and testing order were applied to all participants. Each participant completed two sprint trials, with a 30-second rest interval between repetitions, and the fastest time was retained for statistical analysis. A photocell timing system (Witty System, Microgate, Bolzano, Italy) was used. The photocells were positioned at distances of 5 m, 10 m, and 20 m from the starting line and were set at hip height for all participants in order to minimize the influence of arm swing during gate passage.

Agility assessment tests

Agility was assessed using the T-test, the slalom test, and the slalom test with ball. These tests were selected to evaluate both general change-of-direction ability and basketball-specific agility under ball-handling conditions. The inclusion of both ball and non-ball conditions was intended to distinguish between general movement ability and the ability to maintain movement efficiency while controlling the ball, which represents an important basketball-specific demand. For the slalom test, participants started from a standing position behind the starting line and moved through a course consisting of 5 cones, where first cone was places 1 m from the start and other 4 cones were placed 2 m apart. Participants were instructed to run through the course as quickly as possible while following the marked slalom path without touching or displacing the cones. In the slalom test with ball, the same course and procedure were used, but participants performed the test while dribbling a basketball. Timing started when the participant crossed the first photocell gate and stopped after crossing the finish line. Each participant repeated each agility test two times, with a 30-second rest interval between trials of the same test and a 5-minute rest interval between different agility tests. The fastest time on each agility test was retained for statistical analysis. Agility performance was measured using a photocell timing system (Witty System, Microgate, Bolzano, Italy), and the same procedure was applied to all participants.

Statistical analysis

Data were processed using IBM SPSS statistical software (version 26.0; SPSS Inc., Chicago, IL, USA). Descriptive statistics were calculated for all variables and are presented as mean ± standard deviation. The normality of data distribution was examined using the Kolmogorov-Smirnov test. One-way analysis of variance (ANOVA) was used to determine differences in motor abilities among basketball players according to playing position. Tukey's HSD post hoc test was applied where appropriate. The level of statistical significance was set at $p < 0.05$. Given the small and unequal group sizes, particularly the small number of centers, the results were interpreted with caution. The potential influence of low statistical power due to the small sample size was considered when interpreting non-significant results.

Results

The results of this study are presented in the tables below:

Table 1. Descriptive statistics of participants

Variable (unit)	N	Min	Max	Mean ± SD
Age (years)	15	15	16	16.25 ± 0.74
Basketball experience (years)	15	2	9	5.88 ± 1.86
Body mass (kg)	15	59.5	95.2	71.97 ± 11.82
Body height (cm)	15	174	194	183.68 ± 6.7
Body fat (%)	15	5.8	26.6	11.95 ± 6.18
Muscle mass (%)	15	35.6	44.9	42.21 ± 2.75

Legend: N – number of participants; Min – minimum; Max – maximum; SD – standard deviation; BE – basketball experience; BM – body mass; BH – body height; BF – body fat; MM – muscle mass.

The descriptive characteristics of the total sample are presented in Table 1. The participants were relatively similar in age and basketball experience, while expected positional differences were observed in anthropometric characteristics, particularly body height and body mass.

Table 2. Descriptive statistics of participants by playing position

Position	N	Age (years)	BE (years)	BM (kg)	BH (cm)	BF (%)	MM (%)
Guards	5	16.3 ± 0.35	6.50 ± 1.64	61.58 ± 1.92	176.9 ± 3.5	9.82 ± 2.69	43.04 ± 0.60
Forwards	7	16.19 ± 0.46	4.67 ± 2.06	73.74 ± 10.78	185.80 ± 5.35	13.14 ± 8.90	41.87 ± 4.00
Centers	3	16.24 ± 0.50	6.75 ± 0.96	85.16 ± 8.96	190.06 ± 3.40	12.23 ± 1.25	41.63 ± 1.26

Legend: N – number of participants; BE – basketball experience; BM – body mass; BH – body height; BF – body fat; MM – muscle mass; values presented as Mean ± SD

The playing-position groups are presented in Table 2. Centers showed higher values for body height and body mass compared with guards and forwards, which is consistent with the typical anthropometric profile of this playing position. These variables were presented descriptively in order to characterize the sample and provide context for the interpretation of motor ability differences between playing positions; they were not used as control variables in the main analysis. It should also be noted that the distribution of participants across playing positions was unequal, particularly in the centers group (n = 3), which limits the strength of comparisons between positions. In addition, larger standard deviations observed in some anthropometric variables, especially body fat percentage among forwards, indicate heterogeneity within positional groups. Therefore, descriptive differences between positions should be interpreted with caution.

Table 3. ANOVA results for the CMJ, CMJA and SJ tests

Variable	Sum of Squares	Df	Mean Square	F	p
CMJ Between Groups	40.451	2	20.225	.687	.522
Within Groups	353.507	12	29.459		
Total	393.957	14			
CMJA Between Groups	32.475	2	16.238	.448	.649
Within Groups	434.792	12	36.227		
Total	467.204	14			
SJ Between Groups	56.859	2	28.429	1.543	.253
Within Groups	221.135	12	18.428		
Total	277.993	14			

CMJ – counter movement jump; df – degrees of freedom; F – ANOVA value; p – level of significance; CMJA – counter movement jump with arm swing; df – degrees of freedom; F – ANOVA value; Sig. – level of significance; SJ – squat jump; df – degrees of freedom; F – ANOVA value; Sig. – level of significance

The results of the one-way analysis of variance for explosive power variables are presented in Table 3. No statistically significant differences were observed between guards, forwards, and centers in the Countermovement Jump (CMJ), Countermovement Jump with Arm Swing (CMJA), or Squat Jump (SJ). Therefore, explosive power performance was relatively similar across the three playing positions.

Table 4. ANOVA results for the B5m, B10m and B20m tests

Variable	Sum of Squares	Df	Mean Square	F	p
B5m Between Groups	0.018	2	0.009	1.215	.331
Within Groups	0.087	12	0.007		
Total	0.104	14			
B10m Between Groups	0.008	2	0.072	1.062	.376
Within Groups	0.392	12	0.068		
Total	0.400	14			
B20m Between Groups	0.008	2	0.004	0.012	.888
Within Groups	0.392	12	0.033		
Total	0.400	14			

Legend: B5m – sprint speed over 5 m; df – degrees of freedom; F – ANOVA value; p. – level of significance; B10m – sprint speed over 10 m; df – degrees of freedom; F – ANOVA value; Sig. – level of significance; sprint speed over 20 m; df – degrees of freedom; F – ANOVA value; Sig. – level of significance

The results of the one-way analysis of variance for sprint speed variables are presented in Table 4. No statistically significant differences were observed between guards, forwards, and centers in sprint performance over 5 m, 10 m, or 20 m. These findings indicate that short-distance sprint performance was relatively similar across the three playing positions.

Table 5. ANOVA results for the T-test, Slalom test and Slalom test with ball

Variable	Sum of Squares	Df	Mean Square	F	p
T-test Between Groups	1.213	2	0.607	2.513	.123
Within Groups	2.897	12	0.241		
Total	4.110	14			
Slalom test Between Groups	0.838	2	0.419	0.913	.427
Within Groups	5.508	12	0.459		
Total	6.346	14			
Slalom B Between Groups	2.373	2	1.186	2.990	.088
Within Groups	4.762	12	0.397		
Total	7.135	14			

df – degrees of freedom; F – ANOVA value; p – level of significance Slalom B – slalom test with ball

The results of the one-way analysis of variance for agility variables are presented in Table 5. No statistically significant differences were observed between guards, forwards, and centers in the T-test, Slalom test, or Slalom test with ball. Although the Slalom test with ball showed the lowest p-value among the agility tests, the difference did not reach the predefined level of statistical significance.

Discussion

The aim of the present study was to examine differences in lower-extremity explosive power, sprint speed, and agility among young basketball players according to their playing position. The main finding was that no statistically significant differences were observed between guards, forwards, and centers in any of the assessed motor ability tests. Therefore, the results suggest that, within this sample, young basketball players showed a relatively homogeneous motor ability profile across playing positions. The absence of statistically significant differences should not be interpreted as evidence that positional demands are identical, but rather as an indication that clear position-based motor differences were not confirmed in the present sample. This may be related to several factors. First, the participants were young players, and positional specialization may not yet be fully developed at this stage. Second, players in youth categories are often exposed to similar training content regardless of playing position, which may reduce between-position differences in general motor tests. Third, the small and unequal group sizes, particularly the low number of centers, may have limited the statistical power of the analysis and reduced the ability to detect meaningful differences.

Regarding explosive power, no statistically significant differences were found for CMJ, CMJA, or SJ. This finding suggests that vertical jump performance was relatively similar across playing positions in this sample. Although basketball positions differ in technical and tactical responsibilities, explosive lower-limb actions such as jumping, accelerating, rebounding, and changing direction are required from players at all positions (de Pedro-Múñez, Álvarez-Yates, Serrano-Gómez, & García-García, 2025). Previous studies have reported mixed findings regarding positional differences in explosive power (Sallet et al., 2005; Delextrat & Cohen, 2009; Stanković et al., 2022). Some authors have suggested that positional demands may influence jump performance,

particularly because forwards and centers are often involved in rebounding and contact situations, while guards frequently perform rapid accelerations and dynamic movements (Stanković et al., 2022). However, other findings (Siquier-Coll, Bartolomé, Perez-Quispe, Toro-Román, & Muñoz, 2025) indicate that differences in jump performance between positions may be small or inconsistent, especially when athletes share similar training backgrounds. The present results support the view that explosive power may represent a general performance requirement in youth basketball rather than a clearly position-specific characteristic.

Sprint speed over 5 m, 10 m, and 20 m also did not differ significantly between playing positions. This may indicate that acceleration and short-distance sprinting are important for all players, regardless of their role on the court. In basketball, sprint actions usually occur over short distances and are often linked to transitions, defensive recovery, cutting movements, and fast-break situations (Siquier-Coll et al., 2025). Although previous studies (Drinkwater et al., 2008; Delextrat & Cohen, 2009; Erčulj, Bračič, & Jakovljević, 2011; Cengizel & Cengizel, 2021) have reported that guards and forwards may perform more high-intensity movements than centers during match play, the present findings did not confirm statistically significant positional differences in sprint performance. This inconsistency may be explained by differences in sample characteristics, competitive level, age category, training background, and testing protocols.

The agility results followed a similar pattern. No statistically significant differences were found for the T-test, slalom test, or slalom test with ball. However, the slalom test with ball showed the lowest p-value, suggesting a possible non-significant tendency toward between-position variability. This result should be interpreted cautiously, because the predefined level of statistical significance was not reached. From a practical perspective, this tendency may still be relevant because ball-handling agility is more basketball-specific than general change-of-direction tests (Zhang, Li, Jiao, Liang, Gomez, & Scanlan, 2025). Guards and forwards are typically more frequently exposed to dribbling, rapid direction changes, and ball-control actions in open play, which may partially explain why ball-related agility could be more sensitive to positional differences (Erčulj, Bračič, & Jakovljević, 2011). Nevertheless, the present study cannot confirm such differences statistically.

The comparison with previous literature (Delextrat & Cohen, 2009; Köklü, Alemdaroğlu, Koçak, Erol, & Fındıkoğlu, 2011; Cengizel & Cengizel, 2022) indicates that positional differences in basketball motor abilities are not always consistent. Studies involving senior or elite players often report clearer positional profiles (Sallet et al., 2005; Köklü et al., 2011; Pojskić et al., 2015), while findings in younger athletes may be less pronounced (Cengizel & Cengizel, 2022). This may be due to the developmental stage of the players, incomplete role specialization, and similar conditioning programmes across positions. Therefore, the absence of statistically significant differences in the present study may reflect the characteristics of youth basketball, where general motor development is still highly relevant and position-specific physical profiles may not yet be clearly established.

Several limitations should be considered when interpreting these findings. The most important limitation is the small total sample size and unequal distribution of participants across playing positions, particularly the small number of centers. This imbalance may have reduced statistical power and increased the risk of not detecting true differences

between groups. In addition, the observed heterogeneity in some anthropometric variables suggests that players within the same positional group were not fully uniform. Another limitation is the use of general motor tests, which may not fully capture the complexity of basketball-specific performance. Although the selected tests are relevant for assessing explosive power, speed, and agility, future research should include more basketball-specific assessments, such as reactive agility tasks, decision-making components, and tests combining movement with ball control.

Despite these limitations, the present study provides useful information for understanding motor ability profiles in young basketball players. The findings suggest that coaches should be cautious when assuming clear position-based differences in explosive power, sprint speed, and agility at this age. Training programmes for young players should continue to emphasize broad motor development, while gradually introducing more position-specific content as players mature and their tactical roles become more defined. Future studies should include larger and more balanced samples, players from different competitive levels, and more specific testing protocols in order to better clarify how positional motor profiles develop in basketball.

Conclusions

The results showed no statistically significant differences between guards, forwards, and centers in explosive power, sprint speed, or agility tests. Therefore, the findings do not confirm clear position-based differences in the assessed motor abilities within this sample. These results suggest that young basketball players may show relatively similar motor ability profiles across playing positions, possibly due to incomplete positional specialization, similar training exposure, or the general physical demands of youth basketball. However, this interpretation should be made with caution, considering the small total sample size and the unequal distribution of participants across positions, particularly the small number of centers. From a practical perspective, the findings indicate that coaches should be cautious when assuming distinct motor profiles based solely on playing position in young basketball players. Training programmes at this age should continue to emphasize broad motor development, while position-specific conditioning may be introduced progressively as players mature and their tactical roles become more clearly defined. Future research should include larger and more balanced samples, players from different competitive levels, and more basketball-specific testing protocols, including reactive agility and ball-related movement tasks.

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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.

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