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Speed, Agility and Power Potential of Young Basketball Players

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ABSTRACT

Background. As basketball constantly evolves, physical performance becomes more and more important. Physical fitness assessments are the most reliable way to find out at what level a basketball player is prepared to perform. Therefore, the main aim of this research was to determine if the speed, agility and power of under-16-year-old (U16) basketball players is related to their playing positions.

Methods. The study included (n = 40) young basketball (aged 14.99 ± 0.84 years) players. The variables included height, body mass, body mass index (BMI), fat-free mass (FFM), the percentage of body fat (BF%), the counter movement jump (CMJ), counter movement jump with free arms (CMJ free arms), squat jump (SJ), 5m, 10m, 15m and 20m sprints, T-test, Illinois test and 505 test.

Results. The results showed that centers are taller and heavier than other positions, while the speed, agility and power of forwards are greater than other positions.

Conclusions. At the youth basketball level there are differences in anthropometric and physical fitness testing results between positions. This supports the fact that athletes may be more likely to be selected for a given position based on how their anthropometric and athletic abilities pair with the demands of a given position.

Keywords: *body composition; physical testing; playing position; performance.*

INTRODUCTION

Basketball is played by several million athletes, making it one of the most popular sports in the world today (Čaušević, 2015; Čaušević, Ćirić, Čović, & Ormanović, 2017). Perhaps due the level of skill required to successfully handle and shoot a basketball, athlete anthropometrics and performance characteristics in basketball may be overlooked compared to more specialized sports such as track and field where the implications are clear. This may result in assumptions being made by coaching staff regarding athlete body type and the ideal playing position that may not agree with youth athletes' short-term performance optimization, or their long-term athletic development (Sisic et al., 2015).

Regarding the demand for various movement types, basketball is defined as a polystructural complex sport. The main characteristics of basketball involve jumping, sprinting, and changes of direction with and without the ball. Although basketball is not primarily considered an endurance sport, it requires a high level of cardiorespiratory fitness in order to endure the high intensity activities included in a basketball game (Čaušević, 2016). Accordingly, high levels of power, speed, and agility are the motor skills which characterize top basketball players, while speed and power are the base of most movement activities in basketball. Many authors (Abdelkrim, El Fazaa, & El Ati, 2007; Abdelkrim et al., 2010a; Abdelkrim et al., 2010b;

Scanlan et al., 2011; Scanlan, Dascombe, Reaburn, & Dalbo, 2012; Wen et al., 2018) have characterized basketball as an intermittent high-intensity sport involving various multidirectional movements, thus emphasizing the importance of power for success. This is exemplified by the rapid generation of force required to efficiently sprint, jump, and cut that is a hallmark of basketball. Additionally, improvements in technique, decision-making time, and recognition of perceptual cues are crucial for success (Young & Farrow, 2006). This is likely because improvements in these factors decreases the available response time in between when a player makes a move, and when the other player is able to perceive and respond before giving up position on the court or a shot on basket. Superior speed, power, and agility are related to basketball performance by allowing this same advantage (Cui et al., 2019).

All physical fitness tests used in team sports aim to evaluate physical fitness levels. Their use contributes to a player's optimal training and physical development (Matulaitis, Skarbalius, Abrantes, Gonçalves, & Sampaio, 2019; Čaušević et al., 2021; Matulaitis, Sirtautas, Kreivytė, & Butautas, 2021).

Anthropometric characteristics also have a very important role in the development of young players. The body height of a player largely determines his or her position in the team, and it implies that taller players play closer to the basket, while shorter players play further away from the basket (Hoare, 2000; Ostojic, Mazic, & Dikic, 2006). The main aim of this research was to the determine if the speed, agility and power of U16 basketball players is related to their playing positions.

METHODS

Participants

The sample of participants in this research included 40 basketball players (aged 14.99 ± 0.84 years) who were members of two basketball clubs from Sarajevo. Participants were starters for U16 teams which were competing at the national championship level. All players were healthy and without injuries or other neurological disorders. The day prior to testing, participants did not engage in any vigorous physical activity or training sessions. The participants were divided into three groups according to their playing positions (guards, forwards, centers). Parents gave their written consent after receiving information concerning the study. Full ethical approval for this study has been obtained from the Research Ethic Committee of University of Sarajevo – Faculty of Sport and Physical Education.

Measurement Procedure

All the tests were performed by the Institute of Sport at the Faculty of Sport and Physical Education, University of Sarajevo. Players were instructed to refrain from exercising for at least 48 hours and to eat 2 hours prior to testing. The testing session was performed in the morning between 09:30 and 12:00. The players were familiar with all the tests and procedures before the start of the experiment. Prior to testing, players had completed a standard warm-up consisting of five minutes of jogging, five minutes of dynamic stretching, and five minutes of acceleration-deceleration. The basketball athlete evaluation protocol includes anthropometric measurements, sprint events (5m, 10m, 15m, 20m), change of direction events (T-test, Illinois test, 505 test) and vertical jump events (CMJ, CMJ free arms, SJ).

Anthropometry

Anthropometric measurements were performed in the morning before other testing. Body height of the participants was measured with an accuracy of 0.1 cm using a body stadiometer (In Body BSM370; Biospace Co., Ltd., Seoul, Korea). Body mass (BM), body mass index (BMI), free fat mass (FFM) and percentage of body fat (PBF) were measured by using a direct segmental high-frequency bioelectrical impedance scale (In Body 720; Biospace Co., Ltd., Seoul, Korea). All anthropometric measurements were done according to the manufacturer's guidelines.

Speed, agility and power testing

Power was evaluated by using counter movement jump with free arms (CMJ free arms), counter movement jump (CMJ), and squat jump (SJ). The tests were performed by using photoelectric cells (OptoJump Next, MicroGate, Bolzano, Italy), according to the protocol by Mašić et al. (2020). Speed was evaluated with a timed sprinting test measured at 5 m, 10 m, 15 m and 20 meters by photo cells (Witty Micro Gate photocell, Bolzano, Italy) according to the protocol by Čović et al. (2017). Each participant had two attempts, and the better result of the two was used for further data analysis. Agility assessment included the T-test; Illinois test, and the test 505. These tests were also measured by photo cells (Witty Micro Gate photocell, Bolzano, Italy) according to the protocol by Čaušević et al. (2021).

Statistical analysis

Data processing was done using SPSS 23 for the Windows operating system (IBM Corp. Chicago Il USA). Mean, standard deviation, and maxD (KS test) were presented for all measurements. One way analysis of variance (ANOVA) with LSD post hoc assessment was performed to determine differences between playing positions.

RESULTS

Anthropometric and body composition data are presented in Table 1, according to playing position. Results of physical fitness tests for speed, agility, and power are presented according to playing position in Table 2. It can be observed that, in terms of positions, forwards were better than guards and centers in the majority of analyzed tests. Values of height, body mass, and FFM showed that players in center and forward positions are significantly taller (centers – 190.45 ± 5.94 cm; forwards – 182.27 ± 2.74 cm) and heavier (centers – 79.00 ± 10.31 kg; forwards – 67.13 ± 5.66 kg) than guards (173.80 ± 5.62 cm; 58.32 ± 9.72 kg.). Also, statistically significant differences in power were found between positions, where vertical jump height was significantly higher in centers (CMJ – 34.54 ± 6.08 cm; CMJ free arms – 43.28 ± 6.90 cm) and forwards (CMJ - 34.49 ± 4.45 cm; CMJ free arms – 43.92 ± 3.74 cm) in comparison to guards (CMJ – 29.36 ± 3.76 cm; CMJ free arms – 38.17 ± 6.13 cm).

Table 1. **Anthropometric and body composition data by playing positions (mean ± SD)**

Variables	Guards (n = 15)	Forwards (n = 13)	Centers (n = 12)
Body mass (kg)	58.32 ± 9.72°	67.13 ± 5.66°	79.00 ± 10.31$^{*\times}$
Height (cm)	173.80 ± 5.62$^{\times\circ}$	182.27 ± 2.74$^{*\circ}$	190.45 ± 5.94$^{*\times}$
Body mass index (kg/m²)	19.21 ± 2.44°	20.22 ± 1.85	21.71 ± 2.05*
Fat-Free mass (kg)	52.22 ± 8.46$^{\times\circ}$	61.35 ± 4.56°	72.16 ± 9.88
Percentage of body fat (%)	10.38 ± 3.02	8.48 ± 3.09	8.73 ± 2.41

*ANOVA statistical differences (bold text) ($p < 0.05$). * – statistical differences with guards ($p < 0.05$); × – statistical differences with forwards ($p < 0.05$); °– statistical differences with centers ($p < 0.05$)*

Table 2. **Results of speed, agility and power tests relative to playing positions (mean ± SD)**

Variables	Guards (n=15)	Forwards (n=13)	Centers (n=12)
CMJ (cm)	29.36 ± 3.76$^{\times\circ}$	34.49 ± 4.45*	34.54 ± 6.08*
CMJ free arms (cm)	38.17 ± 6.13$^{\times\circ}$	43.92 ± 3.74*	43.28 ± 6.90*
SJ (cm)	28.94 ± 3.37$^{\times}$	34.13 ± 3.97*	32.86 ± 6.68
5 m (s)	1.14 ± 0.07$^{\times}$	1.07 ± 0.08*	1.10 ± 0.07
10 m (s)	2.03 ± 0.27$^{\times\circ}$	1.84 ± 0.10*	1.85 ± 0.11*
15 m (s)	2.62 ± 0.15°	2.49 ± 0.17	2.45 ± 0.13*
20 m (s)	3.32 ± 0.17$^{\times\circ}$	3.13 ± 0.17*	3.13 ± 0.17*
T – test (s)	11.14 ± 0.71$^{\times\circ}$	10.34 ± 0.46*	10.36 ± 0.64*
Illinois test (s)	15.38 ± 0.93$^{\times}$	14.43 ± 0.92*	14.67 ± 0.62
505 test (s)	5.21 ± 0.71	5.02 ± 0.69	5.17 ± 0.72

*ANOVA statistical differences (bold text) ($p < 0.05$). * – statistical differences with guards ($p < 0.05$); × – statistical differences with forwards ($p < 0.05$); °– statistical differences with centers ($p < 0.05$)*

DISCUSSION

The main aim of this research was to determine the speed, agility and power potential of U16 basketball players in relation to their playing positions. The results showed the existence of statistically significant differences in the speed and power potential of players in different positions.

Results of height, body mass, and FFM indicate that players in centers and forward positions are significantly taller and heavier than guards, and have a higher FFM. Similar results can be found in previous studies (Sallet et al., 2005; Köklü et al., 2011; Te Wierike et al., 2015). Height and body mass are factors that can largely determine which position someone will play (Drinkwater et al., 2008). These results support that body composition plays an important role in the selection of playing position, perhaps due to the different demands of each position.

The findings of the present study also showed statistically significant differences in sprint and agility times between different playing position such that forwards were faster. The results of this study are in contrast to the results of previous studies (Köklü et al., 2011; Abdelkrim et al., 2007). This was interesting considering that guards make the highest number of sprints and quick changes of direction during a basketball game. Similar results were obtained by Nikolaos (2015) and can be attributed to the specificity of age. Given that these were younger players who mature earlier, they may be "forced" to play inside positions (forwards and centers), while smaller players play guard positions. This is supported by Te Wierike et al. (2015) who stated that players' physical maturity levels are related to their height. According to Ibáñez et al. (2018), basketball age categories (cadets, juniors) consists of players who were born in two consecutive calendar years. This means that there are players competing within leagues that are up to two years apart in age. In America specifically, primary and secondary school sport organizations often include 4-year differences in age. Such an age difference implies greater motor experience, greater physical development, and more cognitive development, which enables the achievement of better physical performance in older athletes when compared with their younger peers (Musch & Grondin, 2001; Wattie et al., 2008). Considering that coaches determine the athletes' playing positions, it is very likely that an athletes' playing position is heavily influenced by their anthropological characteristics. When considering that over extended periods of time athletes may undergo dramatic changes to their performance (Moran et al., 2020), coaches should acknowledge the value in allowing athletes to fully mature and develop before selecting their permanent playing position (Arede et al., 2021). This is in agreement with the research of Rees et al. 2016 which states that smaller players are placed in guard positions due to the transfer of the ball, while taller and stronger players (centers and forward centers) are placed closer to the basket due to the frequency of jumping and high percentage of shots on the basket. The superior results of forward players in this study can also be attributed to the fact that they spend the most time running during a basketball game (Abdelkrim et al., 2010b).

Further, statistically significant differences in power were found between positions, where vertical jump height was significantly higher in centers and forwards in comparison with guards. These are the same results found in research by Ostojić et al. (2006). Similarly, Ferioli et al. (2018) showed that strength and power as well as the ability to sustain high intensity intermittent efforts can differentiate levels of competitive play.

Those results are expected considering that players in inside positions (forwards and centers) typically perform more jumps, particularly during the attack actions, with the goal of achieving second chance point or in defence when rebounding. Basketball players during the game perform 40–50 jumps (Wen et al., 2018), which further supports the importance of an athlete's jumping ability in basketball. Aksović et al. (2020) state that the best players on the team have a tendency to jump more than others. This is also evident in our research such that the best results in jumps, and other tests, were achieved by players in forward positions.

The results presented in this study support that there are differences in anthropometric measures and physical fitness ability between player positions in younger groups of basketball players. These factors may play a large role in the position an athlete is selected for and their performance in that role. This selection pressure is in conjunction with their genetic endowment, health status, specific training, psychological, sociological, and other capabilities.

CONCLUSION

The results of this study indicate the existence of statistically significant differences in the speed, agility, and power of basketball players in different positions within the game. According to the present study, particular player positions have different demands and specific physical attributes in youth basketball. These results can provide coaches with insight into the current state of their athletes and indicate which physical attributes may be beneficial and specific to each position. Based on this, it is possible to adjust training programs and athlete selection to the specific demands of each playing positions.

Conflict of Interest Statement. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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