



## Comparison of Physical and Motoric Characteristics by Playing Positions in Basketball

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 DOI: 10.31680/gaunjss.1173282

### Orijinal Makale / Original Article

Geliş Tarihi / Received: 09.09.2022

Kabul Tarihi / Accepted: 26.10.2022

Yayın Tarihi / Published: 23.12.2022

### Abstract

The purpose of this study was to compare of physical and motoric characteristics by playing positions in basketball. Seventy nine male adolescent basketball players from center (n=11), guard (n=39) and forward (n=29) playing positions voluntarily participated in the study (mean age respectively, centers: 14,9 ± 1,2 years, guards: 13,9 ± 0,8 years, forwards: 13,7 ± 1,5 years). The body height, body weight, 20 m sprint, Illinois agility test and jumping test (vertical & horizontal) were applied. One-way analysis of variance was used to determine the differences between the playing positions. Data which passed the equality of variance test were analyzed with Tukey statistics (p<0.05). It was found that centers had significant higher body height and body weight, guards had significant lowest body height and body weight. Physical characteristics of the participants were significantly different in all playing positions (p<0.05). On the other hand, although there was no significant difference between the playing positions in the selected motoric characteristics, the forwards had the highest vertical jump, the centers had the highest horizontal jump and the best speed performance, and the forwards had the best agility performance. It is thought that these physical and motoric characteristics, which differ according to playing positions in adolescent basketball players, will guide the coaches for the selection of athletes. However, the motoric differences determined between the positions should be used as an important indicator for the coaches during the planning training.

**Keywords:** Basketball, Center, Guard, Forward, Motoric Characteristics

## Basketbolda Fiziksel ve Motorik Özelliklerin Oyuncu Pozisyonları Arası Karşılaştırılması

### Öz

Bu çalışmanın amacı; basketbolda fiziksel ve motorik özelliklerin oyuncu pozisyonları arası karşılaştırılmasıdır. Çalışmaya pivot (n=11), oyun kurucu (n=39) ve forvet (n=29) oyuncu pozisyonlarından yetmiş dokuz erkek adolesan basketbolcu (ortalama yaşları sırasıyla, pivot: 14,9 ± 1,2 yıl, oyun kurucu: 13,9 ± 0,8 yıl, forvet: 13,7 ± 1,5 yıl) gönüllü olarak katılmıştır. Araştırmada boy uzunluğu, vücut ağırlığı, 20 m sprint, Illinois çeviklik testi, sıçrama testleri (yatay & dikey) uygulanmıştır. Oyuncu pozisyonları arası farklılıkların belirlenmesi için tek yönlü varyans analizi kullanılmıştır. Varyans homojenliğini sağlayan ölçüm değerleri Tukey istatistiği ile değerlendirilmiştir (p<0.05). Bu araştırmada pivotların anlamlı yüksek boy uzunluğu ve vücut ağırlığına; oyun kurucuların ise anlamlı en düşük boy uzunluğu ve vücut ağırlığına sahip olduğu belirlenmiştir. Katılımcıların fiziksel özellikleri tüm oyuncu pozisyonlarında anlamlı farklı olarak tespit edilmiştir (p<0.05). Diğer yandan seçilen motorik özelliklerde oyuncu pozisyonları arası anlamlı fark bulunmamasına rağmen; forvetler en yüksek dikey sıçramaya, pivotlar en yüksek yatay sıçrama ve en iyi sürat performansına, oyun kurucular ise en iyi çeviklik performansına sahip bulunmuştur. Adolesan basketbolcularda oyuncu pozisyonlarına göre ayrıışan bu fiziksel ve motorik karakteristiklerin antrenörlerin sporcu seçiminde rehber olacağı düşünülmektedir. Bununla birlikte pozisyonlar arası belirlenen motorik farklar, antrenman planlaması sırasında antrenörler için önemli bir gösterge olarak kullanılmalıdır.

**Anahtar kelimeler:** Basketbol, Pivot, Oyun Kurucu, Forvet, Motorik Özellikler

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## Introduction

Basketball is a sport discipline that tempo is constantly changing, requiring aerobic and anaerobic energy processes, including intense activities such as repetitive rebounding, driving, lay-ups, jump shooting, shot blocking, fast breaks and high speed play (Maud & Foster, 2006; Narazaki et al., 2009; Tessitore et al., 2006). In basketball, there are many features that affect the performance and the proper execution of technical and tactical elements according to playing positions.

During a match, each player performs about 1000 short-term activities that change approximately every 2 seconds, and professional players cover a distance of approximately 3500-5000 m (Janeira & Maia, 1998; Köklü et al., 2011). On the other hand, Hoffman et al. (1996) found that leg strength, vertical jump, speed, and agility explained 64 to 81% of the variance in playing time. In addition, explosive power, vertical jump, speed and agility are skills that contribute to the effectiveness of movement with and without the ball (Abdelkrim et al., 2010; Delextrat & Cohen, 2008; Torres-Unda et al., 2013).

Studies have shown that elite basketball players perform better than non-elite basketball players in jumping, speed, agility and anaerobic power (Delextrat & Cohen, 2008; Torres-Unda et al., 2013). On the other hand, time-motion analyses showed that short-term activities were performed at a different frequency depending on the player's position (Abdelkrim et al., 2007). However, playing positions in the basketball team are classified according to the specific individual role (point guard, shooting guard, small forward, power forward, and center) with the evolution of rules and tactics, and are often divided into 3 groups (guards, forwards, centers) that reflect position similarities (Abdelkrim et al., 2010; Harris et al., 2000). Depending on the different playing positions (guard, forward or center) of the basketball players, there are different skill and physiological demands according to the playing positions on the field and they are expected to develop these features (Hoare, 2000; Pojskić et al., 2015). Vázquez-Guerrero et al. (2019) stated that guards cover more distance in a match than centers and forwards, and forwards cover a much greater distance than centers. In addition, the authors report that forwards and guards have more peak acceleration and high-intensity accelerations than centers, while forwards and guards have more high-intensity deceleration than centers. In the light of this knowledge, playing positions should be taken into account when determining the training programs of the players.

In order to achieve peak performance, players must have optimally developed explosive power, agility, speed, anaerobic power and anaerobic capacity (Apostolidis et al., 2003; Delextrat & Cohen, 2009; Hoffman et al., 1996; Štrumbelj & Erčulj, 2014; Struzik et al., 2014). Although there are frequent studies examining the physical and motoric characteristics according to playing positions in senior category basketball players (Abdelkrim et al., 2010; Harris et al., 2000; Köklü et al., 2011; Küçük et al., 2014; Pion et al., 2018; Pojskić et al., 2015), the number of studies comparing playing positions in adolescent basketball players is limited (Bavlı, 2008; Kryeziu & Asllani, 2016). Especially for adolescent players to specialize in the proper playing position in the future, monitoring of sports performance, monitoring and evaluation of the physical and motoric development of young athletes is increasingly becoming more important (Cengizel et al., 2020). Therefore, the aim of this study was to compare the physical and motoric characteristics by playing positions in basketball.

## **Method**

### **Participants**

Seventy nine adolescent male basketball players from guard (n=39), forward (n=29) and center (n=11) playing positions voluntarily participated to this cross-sectional and comparative study. Inclusion criteria for the study were (a) to have been training in the 13-15 age group in the basketball team at least 3 times a week for the last 2 years (b) to participate in basketball training regularly (c) to be at least 2 years of basketball experience (d) to participate the basketball competitions. Players who had any injury or surgery in the last six months, did not attend basketball training regularly, and did not take time in the competitions were excluded. The written informed consent was taken from the players' parents before the study. The study was conducted according to the guidelines of the Declaration of Helsinki and approved by Gazi University Ethics Commission (Research Code: 2022-447).

### **Study Protocol**

The body height, body weight, 20 m sprint, Illinois agility test, horizontal and vertical jump tests were applied in this study.

Body height and body weight: The body height was measured standing up with a stadiometer (SECA 217, Seca Ltd, Vogel & Halke, Hamburg, Germany) which has a scale that displays measurements in millimeters. For body weight, clothes other than underwear were removed and a portable weight scale (SECA 750, Seca Ltd, Vogel &

Halke, Hamburg, Germany) with a sensitivity of 0.1 kg was used. Measurements were made by two experienced researchers.

20 m sprint: Before the test, the start and finish lines were determined and photocell device were placed (Newtest Power Timer, 2000, Finland). The athletes were asked to complete the 20 m distance at their maximum running speed. Participants were informed before the test that they should start the run by standing at the starting line and not slow down until they cross the finish line. Participants were given three attempts and the best scores were recorded in seconds.

Illinois Agility Test: Illinois agility test was used via photocell (Newtest Power Timer, 2000, Finland) to measure agility. Two cones at start and finish, photocell placed at start and end, and two other cones at turning point. The remaining 4 cones were placed in the middle at 3.3 m intervals in a 10 m long and 5 m wide area. Before the test, the test directions were introduced to the participants both verbally and visually. The participant started the test lying face down on the ground behind the starting line and completed the test at maximum speed with the start command. Three trials were performed and the best scores were recorded in seconds.

Horizontal Jump: Participants were asked to stand still in a designated area behind the starting line. However, for measurement, free arms and double feet were asked to jump forward. Before the test, they were informed about standing still without losing their balance after jumping. The distance between the starting line and the heel of the athletes standing still after jumping was measured in centimeters. Athletes were given three attempts for the test and their best scores were recorded.

Vertical Jump: Each participant performed three vertical jump with the instruction to jump as high as possible. The measurements completed via Optojump system (Optojump, Microgate, Bolzano, Italy). Three minutes passive rest were given between the trials. The best scores were recorded in centimeters.

### **Data analysis**

The descriptive statistical analyses was carried out by the use of Sigma Plot 11.0 (Systat Software, Inc) program. One-way analysis of variance was used to determine the differences between playing positions. Measurement data providing variance homogeneity were evaluated with Tukey statistics ( $p < 0.05$ ).

## Results

In this study, it has been determined that centers had significantly higher body height and body weight ( $184.0 \pm 6.2$  cm,  $81.1 \pm 8.3$  kg, respectively), while guards had the lowest body height and body weight ( $168.2 \pm 9.2$  cm,  $58.0 \pm 9.9$  kg, respectively). The physical characteristics of the participants were found to be significantly different in all playing positions ( $p < 0.05$ , Table 1).

**Table 1.** Age and physical characteristics of the adolescent basketball players according to playing positions

	Guard (n=39)		Forward (n=29)		Center (n=11)	
	$\bar{x} \pm SD$	95% CI	$\bar{x} \pm SD$	95% CI	$\bar{x} \pm SD$	95% CI
Age (year)	13.9 $\pm$ 0.8	13.6-14.2	13.7 $\pm$ 1.5	13.2-14.2	14.9 $\pm$ 1.2	14.2-15.6
Age of experience (year)	6.6 $\pm$ 2.1	5.9-7.3	7.1 $\pm$ 1.8	6.4-7.8	5.8 $\pm$ 1.7	4.8-6.8
Body height (cm)	168.2 $\pm$ 9.2 <sup>b,c</sup>	165.3-171.1	177.5 $\pm$ 9.1 <sup>a,c</sup>	174.2-180.8	184.0 $\pm$ 6.2 <sup>a,b</sup>	180.3-187.7
Body weight (kg)	58.0 $\pm$ 9.9 <sup>b,c</sup>	54.9-61.1	71.3 $\pm$ 12.6 <sup>a,c</sup>	66.7-75.9	81.1 $\pm$ 8.3 <sup>a,b</sup>	76.2-86.0

$\bar{x}$ : Mean, SD: Standard deviation, CI: Confidence Interval. a: Significant difference with guard, b: Significant difference with forward, c: Significant difference with center,  $p < 0,05$ .

There was no significant difference between playing positions in selected motoric characteristics (Table 2). Despite this, characteristics differ quantitatively according to playing positions. Forwards have the highest vertical jump, centers have the highest horizontal jump and best sprint performance, guards have the best agility performance.

**Table 2.** Motoric characteristics of the adolescent basketball players according to playing positions

	Guard (n=39)		Forward (n=29)		Center (n=11)	
	$\bar{x} \pm SD$	95% CI	$\bar{x} \pm SD$	95% CI	$\bar{x} \pm SD$	95% CI
Vertical jump (cm)	40.7 $\pm$ 9.7	37.7-43.7	45.5 $\pm$ 8.9	42.3-48.7	43.2 $\pm$ 7.0	39.1-47.3
Horizontal jump (cm)	190.9 $\pm$ 26.7	182.6-199.3	194.7 $\pm$ 27.9	184.5-204.9	201.3 $\pm$ 23.9	187.2-215.4
20 m sprint (sec)	3.50 $\pm$ 0.27	3.42-3.59	3.53 $\pm$ 0.29	3.32-3.75	3.41 $\pm$ 0.19	3.29-3.52
Agility (sec)	17.13 $\pm$ 1.04	16.80-17.46	17.37 $\pm$ 1.09	16.97-17.77	17.27 $\pm$ 0,66	16.88-17.66

$\bar{x}$ : Mean, SD: Standard deviation, CI: Confidence Interval. a: Significant difference with guard, b: Significant difference with forward, c: Significant difference with center,  $p < 0,05$ .

## Discussion and Conclusion

In this study, which aimed to compare the physical and motoric characteristics of adolescent male basketball players between playing positions, although there was a physically significant difference in guard, forward and centers, no significant difference was found in terms of motoric characteristics. However, it was determined

that the centers in the horizontal jump and speed test, the guards in the agility test, and the forwards in the vertical jump test had a better performance.

One of the most important factors determining the position of the player is the body height and body weight of the basketball players (Drinkwater et al., 2008). In addition, the physical characteristics of the athletes are among the important determinants of whether they can reach the highest level of sports discipline (Cengizel & Cengizel, 2021; Sallet et al., 2005). Therefore, following the development of physical characteristics in adolescence is of great importance for the continuity and specialization of the player.

Abdelkrim et al. (2010), reported by analysis of specific individual positional roles that centers are significantly taller and heavier than forwards and forwards are significantly taller and heavier than guards. In addition, in a study of senior basketball players, forwards and centers were found to be significantly taller than guards, while centers were found to be significantly heavier (Köklü et al., 2011; Sekulic et al., 2017). In another studies, the physical characteristics of elite basketball players were found to differ significantly between guards, forwards and centers (Pion et al., 2018; Pojskić et al., 2015). In parallel with these results, Bavlı (2008) found that adolescent centers have higher body height and more body weight than forwards and guards. As forwards and centers play more in the painted area or perform rebounds, it is usual for them to be preferred taller players due to the game requirements (Küçük et al., 2014). In these studies, the fact that physical characteristics differ between playing positions in both adolescents and senior categories due to the game structure of basketball is parallel to our study and also supports the findings of our research.

Pojskic et al. (2015), found only guards were significantly different from centers in countermovement jump performance in elite basketball players. Although there is no significant difference between forwards and centers, quantitatively, forwards have better jumping performance than centers. Küçük et al. (2014), measured jumping,  $VO_{2max}$ , reaction time, back strength, hand-grip strength and flexibility in their study comparing the physical fitness of senior basketball players according to playing positions, and found a significant difference between positions only in jumping performances. On the other hand, Abdelkrim et al. (2010), reported that guards and forwards in elite basketball players are faster and more agile than centers. In the same study, it was stated that centers had lower countermovement jump performance. Similarly, in another study investigating professional college players (Harris et al.,

2000), guards showed better agility and speed performances than players in other positions. Players in the guard position are expected to have better ball control, agility and speed with and without the ball, with lower body weight and body height, in addition, they are expected to control the tempo of the game with high ball possession and transition (Pojskić et al. al., 2015). Abdelkrim et al. (2010), supports the findings by showing that guards and forwards are the fastest in sprint performance. Contrary to these findings, in a study conducted in senior basketball players, guards and forwards performed significantly better than centers in sprint and agility tests, and they did not find a statistical difference between playing positions in countermovement jump and squat jump performances (Köklü et al., 2011). Findings differ in studies conducted at senior and elite levels. The physical abilities of the players vary greatly according to their individual specific positional roles (Abdelkrim et al., 2010). The reason for the difference in these findings could be the training history of the athletes and the level of play in the basketball leagues they play. Pojskic et al. (2015), explained the low-level performance of centers as having greater body height and body weight, limiting their ability to perform high-intensity movements effectively.

Bavlı (2008), determined that biomotor characteristics such as arm and leg strength, vertical jump and speed, except flexibility, were not differ according to player positions in adolescent basketball players. Kryeziu & Asllani (2016), had some motor skill tests applied to determine possible differences in the playing positions of 16-year-old basketball players and reported that there was no significant difference between positions in jump height and speed performance. Although these results in adolescent basketball players support our research, as in previous studies, motoric characteristics differ quantitatively between player positions.

In our research, while there was no significant difference between sprint, agility and jumping performance in the guards, forwards and centers, a significant difference was found between positions in physical characteristics. However, it was determined that the centers in the horizontal jump and speed test, the guards in the agility test and the forwards in the vertical jump test had better performance. As a result of this study, coaches can obtain information about what kind of physical and motoric characteristics should be possessed by athletes playing in different playing positions. In team sports, it will be useful to know the physical and motoric characteristics of the athletes playing in different positions, since the performance of all the athletes who build the team will affect the result. It should not be underestimated that adolescent players, especially in

the age of growth and development, can increase their development and performance with regular training sessions (Cengizel et al., 2020). In addition, coaches should take into account the physical and motoric characteristics of the players according to their positions while planning the training.

### **Acknowledgement**

The authors would like to thank all the players who participated in this study.

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