

## **Anaerobic ability and explosive leg strength of youth female basketball players according to different position in the team**

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Published online: January 31, 2023

(Accepted for publication January 15, 2023)

DOI:10.7752/jpes.2023.01024

### **Abstract**

The primary objectives of the research are related to the examination of anaerobic capacity and explosive power of the legs young woman basketball players aged 14 to 16. The obtained values will be compared in relation to the positions (guard/forward/center) in the team. The hypothesis of the research refers to the fact that, due to the sensitivity of growth and development and consequently the sensitivity of developing motor skills in this period, there is no difference in anaerobic ability and explosive strength in basketball players according to positions in the team. The 48 female basketball players with an average age of 15.9±0.86 years participated in the study. The girls are divided into three groups of 16 players according to the position they play in the team. Anaerobic endurance was measured by the 300 yard shuttle test on the basketball court. Explosive power of standing vertical jump with hands on hips (counter movement jump - CMJ) was evaluated using a jumping platform (Globus Ergo Tester Platform). The platform is connected to a digital timer that records the time and height of the jump, and the power is estimated based on the reaction force of the surface and the duration of the flight phase. Statistical data processing (ANOVA) did not show any statistical significance regarding the differences in anaerobic endurance in girls in relation to the position in the team (p=0.714). In the case of the vertical jump, there was also no statistically significant difference (p=0.245). One of the reasons for the obtained results may be that there is no distinct selection in women's basketball at that age due to the insufficient number of girls who train basketball in the Belgrade region. Another reason why there is no statistically significant difference in the results is that early specialization is done in the younger categories, and some players have not reached the maximum in their development. Girls are placed in certain positions in relation to their basketball skills, and very rarely in relation to anthropological and motor skills.

**Keywords:** vertical jump./ 300 yards test/training/ selection/functional abilities

### **Introduction**

Basketball is an extremely dynamic game of polystructural type with a lot of changes in speed, tempo and alternating cyclic and acyclic movements. This type of game also requires special characteristics in individuals, and the success of the game may depend on them. In addition to morphological characteristics, basketball also requires good functional and motor skills. Basketball is a predominantly anaerobic sport, given the fact that energy is used for activities that include jumping, sprinting, rapid changes of direction, and sudden acceleration and braking, driving the ball, kicking gets it from anaerobic energy sources, primarily from the creatine-phosphate system (Yusuf, Aşci, Koçak, Alemdaroglu, & Dündar, 2011). However, aerobic metabolism and high aerobic capacity are important for the recovery process after intense anaerobic activities. As a result, it can be concluded that basketball is an anaerobic-aerobic sport and that work on improving both abilities is equally important for achieving top results (Marinković & Pavlović, 2013; Ransone, 2016). The primary goals of this research are related to the examination of anaerobic ability and explosive leg strength (vertical jump) of female basketball players aged 14 to 16 years. The obtained values of the above mentioned motor skills will be compared in relation to the positions (guard/forward/center) of basketball players in the team. Two tests were used to test these values, the 300-yard shuttle test and the vertical jump from the diving platform. Some earlier research (Jones, 1991), showed that the 300-yard test is considered the best indirect indicator of anaerobic capacity and agility in athletes. At the same time, vertical jump according to some authors (Živanić, S, et. Al; 2010) is a good indicator of explosive leg strength in basketball players.

Recent studies (Hadziev & Dzimbova, 2020), showed that adolescent girls can have anaerobic abilities at the level of senior basketball players. Scanlan, et al. (2021) found that in girl basketball team guards have a better Vo<sub>2</sub>max compared to wings and centers.

Furthermore, White et. al; (2015) researched how does it affect 300-yard shuttle test on anaerobic capacity of high school-aged female basketball players (14-18 years). The study showed that high school basketball players were at the approximate level of elite level soccer players at the age of 18. At the same time,

no study has addressed the differences in anaerobic capacity and explosive power of leg muscles in young female basketball players in relation to team position. Hakinen et. al; (1993) investigated the impact of explosive leg strength training in female basketball players during the season and observed a significant increase in vertical jump height after only two explosive strength training sessions per week. Also a study (Fort, Romero, Bagur, & Guerra, 2012), showed that training on a vibration machine can improve the explosive leg strength of young basketball players aged 14-18 years, in the vertical jump on the CMJ platform after 15 weeks of training compared to a group that did not do this type of training.

Studies from Serbia were more concerned with the differences in aerobic abilities of basketball players in relation to the position in the team. Research (Stojmenović D, et. al; 2022), showed at the senior level there is a statistically significant difference in  $V_{O2max}$  between guards and centers but there no difference between guards and forwards, and forward and centers. On the other hand, the centers show better explosive power in terms of vertical jump values achieved, which is explained by the taller growth and stronger leg musculature of the players who play inside positions in the team (Ostojić, S. M et.al; 2006).

The results of previous research on senior players are in favor of better anaerobic abilities in the backs and wings compared to the central positions, which is mainly explained by the lower growth and consequently better motor skills of the players in these positions. A study from Turkey (Korkmaz & Karahan, 2012) found that explosive strength (vertical jump) and free muscle mass (FFM) are better predictors for playing basketball in the elite level, although it was not clear whether such characteristics are due to certain differences in the quality of training in the competition ranks or from simple selection. Some recent studies on a larger sample of players, of different competitive levels, have confirmed that there are certain differences in anaerobic abilities. Study from Italy (Ferioli, et al., 2018), compared players from four Italian leagues (elite, professional, semi-professional and amateur leagues) and showed that the physiological responses to high-intensity interval anaerobic physical activity were better in more elite players. However, the question arises whether the results of such research can be applied in practice when it comes to younger categories, i.e. girls who train basketball in the period of growth and development. Incomplete physical maturation can be an obstacle for the adequate development of many motor skills, and thus anaerobic endurance and explosive power. In this sense, early specialization, i.e. determining positions in the team in this sensitive period can greatly contribute to obtaining results that are exactly the opposite of those we see in the literature, which refer to already formed senior players.

### **Material and methods**

For the purposes of this research, a cross-sectional observational study was used. All measurements were made in one day. After the population sample was taken, the distribution of variables in the sample was monitored in order to determine the difference in anaerobic ability and explosive strength of female basketball players in relation to the position in the team. The parents of the girls were informed about the needs of the research and the effects that the research should provide, and they gave written consent for the children to participate in the study.

#### *Sample of respondents*

48 female basketball players with an average age of  $15.9 \pm 0.86$  years, height  $169.0 \pm 6.48$  participated in this study. The basketball players included in the study train basketball at a competitive level (3-5 times a week, 4-9 hours a week) and belong to the Belgrade region of the Serbian Basketball Association. The girls chosen for this study are members of four Belgrade basketball clubs: BC Flash, BC Girl Basket, BC Voždovac and BC Red Star. The girls were divided into three groups according to the position they play in the team (guards/forwards/centers). There were 16 basketball players in each group. Before conducting the motor tests, anthropometric measurements of the basketball players were performed. Height was determined using a Seca height measuring instrument, while body composition values were measured using a Tanita BC-418MA scale. Before the beginning of the study, the parents of the basketball players gave verbal and written consent for their children's participation in this study, after the method and purpose of the research were explained to them.

#### *Procedures*

After the selection of a sample of 48 female basketball players from the Belgrade basketball region, data collection was started through conducting tests. Anaerobic endurance was measured by the 300 yard shuttle test. On the basketball court, a section of 25 yards (22.85 meters - 1 yard=0.914 meters) is marked with lines. A stopwatch was used to record the test results. The basketball players were told to run as fast as they could from one end of a marked 25-yard stretch to the other, touch the line with their foot, turn and run as fast as they could to the start of the stretch. This was repeated six times without stopping (a total of 300 yards) and the score recorded with a stopwatch. After a break of five minutes, the same procedure was repeated once more. The mean value of the two obtained results was taken as valid for this study.

Explosive power (vertical jump) was assessed using a jumping platform (Globus Ergo Tester Platform). The players were told to stand on a platform connected to a digital timer that recorded the time and height of the jump. The timer starts as soon as the player separates her legs from the platform, and stops at the moment of contact again, i.e. landing on the platform, and the power is estimated based on the reaction force of the surface and the duration of the flight phase. The vertical jump was performed by allowing the players to make a swing

with their arms before performing the jump, with a slight bend in the knee joints. At the highest point, the players' arms and legs were fully extended. Each player had three jump attempts, and the best jump value was recorded and used for statistical data processing. This study was approved in advance by the ethics committee of the Sports Medicine Association of Serbia. The conducted research does not violate the rights of the examined players, according to the ethical standards of the Helsinki Declaration of the Committee on Human Rights (WMA Declaration of Helsinki, 2013).

*Statistical analysis*

Statistical analysis was performed using IBM SPSS Statistics version 20.0 software. The Shapiro Wilk test was conducted to check the normality of the data distribution, and the one-factor ANOVA test was used to determine the existence of differences in anaerobic endurance and explosive power between the three groups of girls (backs/wings/centers). A value of p less than 0.05 ( $p < 0.05$ ) was considered statistically significant. Group results are presented in the form: mean  $\pm$  SD (standard deviation).

**Results**

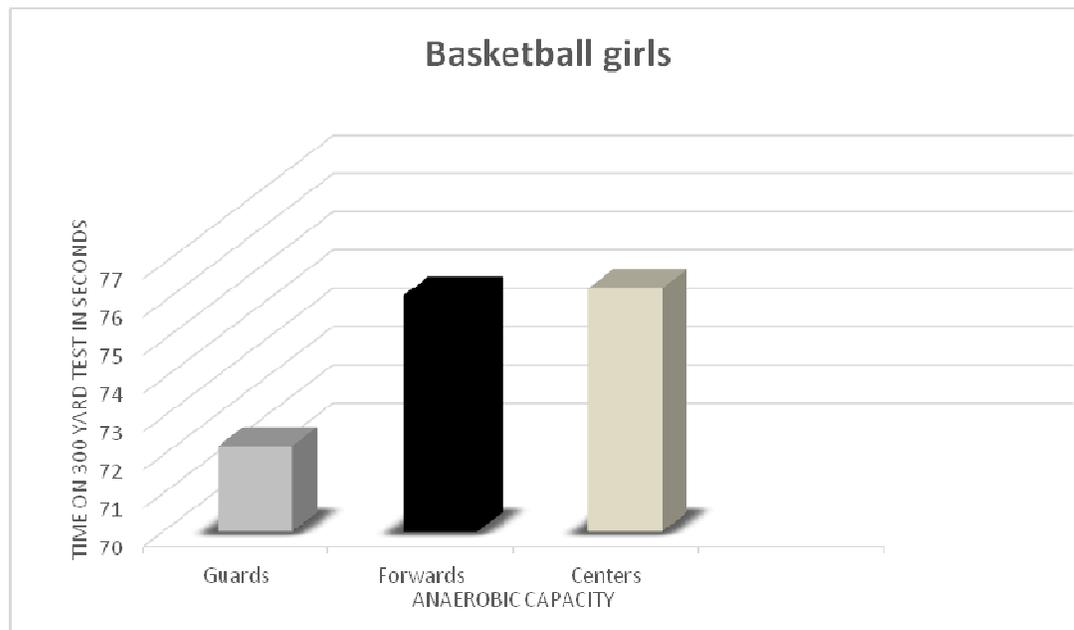
Anthropometric characteristics of female basketball players are shown in Table 1. The average height of all subjects was 169 cm, while the maximum mean height was 176.48 cm. The average weight of the subjects was 59 kilograms, while the maximum average weight was 68.24 kg. The body mass index was 20.7 on average for this group, while the percentage of body fat was 25.38%

**Table 1. Anthropometric characteristics of female basketball players**

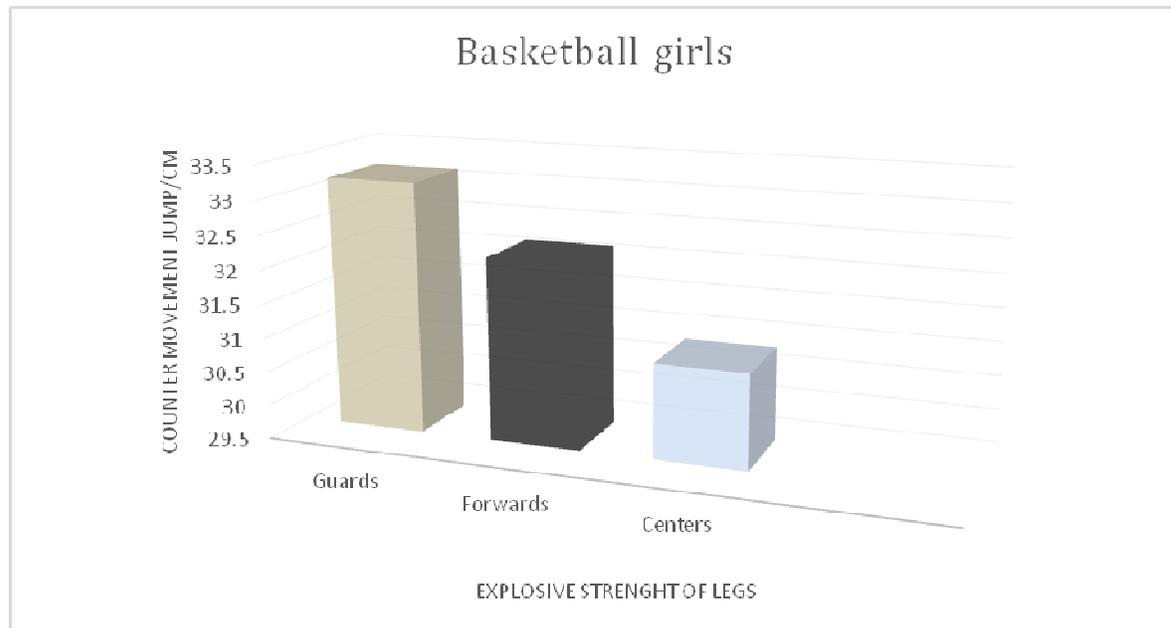
Height (cm)	169.0 $\pm$ 6.48
Weight (kg)	59.75 $\pm$ 7.56
BMI (body mass index)	20.7 $\pm$ 2.2
Body fat percentage	25.38 $\pm$ 3.37

Achieved values for anaerobic endurance and explosive power, i.e. vertical jump of female players, by position in the team, are presented in Graph 1 and Graph 2. Statistical data processing (ANOVA test) did not reveal any statistical significance regarding the differences in anaerobic endurance in girls in relation to the position in the team ( $p=0.714$ ). It was noticed that fullbacks have a better result on the 300-yard test, but there was no statistically significant difference compared to wings and centers.

**Graph 1. Anaerobic endurance values of female basketball players by position in the team.**



In terms of vertical jump, there was also no statistically significant difference ( $p=0.245$ ). Again, the guards performed better than the wings and centers in terms of time spent on the jump, but it was not statistically significantly better than the wings and centers.

**Graph 2: Vertical jump values of female basketball players by position in the team**

### Discussion

After processing the data, it was concluded that there is no statistically significant difference in explosive power and anaerobic ability in basketball players in relation to the position in the team. One of the reasons may be that there is no distinct selection in women's basketball at that age due to the insufficient number of girls who train basketball in the Belgrade region. This practically means that the girls are not selected for this sport based on their physical characteristics, but the teams are made based on how many girls train this sport. A similar study from Iceland (Hreinsdóttir, 2021) measured explosive leg strength using the CMJ platform in 15, 16 and 18 year old female basketball players. The research showed that there is no statistically significant difference in explosive power in these age categories. The study showed that female basketball players from Serbia have slightly better results in the vertical jump from the platform than girls from Iceland. Results from our study showed that girls from Belgrade have lower results in the vertical jump than 14-year-old female basketball players from Ukraine (Chukhlantseva, N., Cherednichenko, I., & Bruhno, E. 2021).

Research with American NCAA leagues (Heishman, 2019) measured the jump height of basketball players from the CMJ platform after intense and moderate training. The results showed that although there was a significant difference between the exercise intensities, these differences did not seem to affect the changes in CMJ performance.

Similar research (de Villarreal, 2021) compared differences in CMJ in two groups of 15-year-old basketball players, divided into point guards and point guards. It was observed that the defenders have better explosive power, but not statistically significant, while both groups improved the result on the test after the seven-week explosiveness training. In measuring the connection between the explosive power of the legs through the CMJ platform and the agility test Y shaped test (Vencurik, 2021) the results showed a strong relationship between these two parameters in female basketball players. Also, girls from Serbia have better results on CMJ test than girls in other country (Marques, C. F. et al.; 2022). In Serbia, many clubs approach training sessions with younger categories of girls in an inadequate way, where the primary goal is immediate results and not the development of motor characteristics. As a result, very important sensitive periods in growth that are suitable for the development of motor skills are missed (Trunić, 2007) During the training sessions, basketball tactics and techniques are worked on more, and less general exercises for the development of the entire musculature, endurance, speed, and strength. Attene, G. et. al; (2015) showed that 6 weeks of plyometric training improved jump height for girl age 15 in Italy. Nevertheless, the girls from Serbia had better results on the CMJ test compared to the girls from Italy.

The study from Banks, S. (2020) also showed that 6-Week Plyometric Exercise Program on Vertical Jump Height can increase results in CMJ for 4% on young basketball girl age 13-17. Birat, A. et.al; (2020) show that drop height training affects the improvement of the vertical jump in adolescent children, but the height from which they drop is also important.

Furthermore, research conducted on young female basketball players in Serbia at that age showed that our girls are much weaker in anaerobic abilities compared to high school basketball players in the USA. (White, DeBeliso, Sevene, & K, 2015). This is in favor of the fact that incomplete physical maturation can be an obstacle

to the adequate development of many motor skills, and therefore anaerobic endurance and explosive power.(Stojmenovic, 2016). In this sense, early specialization, i.e. determining positions in the team in this sensitive period can greatly contribute to obtaining results that are exactly the opposite of those we see in the literature, which refer to already formed senior players. At the same time, the situation in women's basketball is such that whoever wants to can train and play basketball in these clubs, which actually leads to the fact that it is very difficult to make the right selection adequate to the requirements of the basketball game at this age.

Girls are placed in certain positions in relation to their basketball skills and very rarely in relation to anthropometric and motor skills. This practically means that girls in the positions of backs could be the same height as wing players or centers. Another reason why there is no statistically significant difference in the abilities of these basketball players may be that early specialization is done in the younger categories, and some players have not reached the maximum in their development. Practically, the positions they will play in are determined by their current physical status. That is why it is very important to think in the direction that at this age girls work more on acquiring basic motor and aerobic skills and work on basketball technique more than on tactical variants, which is often the case in our country.

### Conclusion

The null hypothesis of non-difference was confirmed in the paper, namely that there is no statistically significant difference in anaerobic abilities and explosive leg strength in basketball players aged 14-16 compared to team training. Consequently, in the younger age categories, the basis of the work should be on the development of general basic abilities first, and then specific motor abilities, and that in precisely predicted sensitive periods in children. Along with the development of those abilities, one can work on technique, but never on the collective tactics of the game before the complete growth and development is completed. The theoretical significance of this research is reflected, first of all, in the synthesis of previous knowledge about the physical maturation and motor development of young basketball players, in determining the level of physical development, motor abilities, psychological characteristics and social status of young basketball players, as well as in determining the changes that take place in them under the influence of systematic training. Therefore, the results of the research contribute to a more comprehensive overview of the impact of basketball, as a means of physical culture, on the development of personality as a whole in older school age. The obtained results also have practical significance, especially for selection processes, control of training and for modeling the state of female basketball players and their development path. On the basis of these results, it is possible to draw up, in certain years, orientation norms for physical development and motor skills. Norms can serve primarily to diagnose the initial state of young basketball players and to monitor a part of the dynamics of individual sports development, as a very important element of selection. The applied elements are, in a certain way, verified by this research. The results of the research differentiated them according to their importance for distinguishing basketball players from non-athletes and according to their importance for monitoring the results of young people during their development. This research is in itself a contribution to research methodology in physical culture.

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