

ANTHROPOMETRIC PROFILE OF ELITE U16 BASKETBALL PLAYERS

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ABSTRACT

The purpose of the study was to examine and record the anthropometric profile of U16 elite male basketball players of national teams per competitive position as well as to compare the differences of anthropometric profiles between the playing positions. The study involved 17 young male basketball players (average weight 84 kg, average height 1.97 m, average age 15.9 years). Players were classified according to their position in Guards (G: n = 7), Forwards (F: n = 6), and Centers (C: n = 4). In order to determine the anthropometric profile of the elite players of the study, the following anthropometric characteristics were measured in each position: height, weight, wingspan, standing reach, body fat percentage and body mass index (BMI). The sample was analyzed separately for three different positions of the players, the Guards, the Forwards and the Centers. One-way analysis of variance (one-way ANOVA) was used to look for differences between the mean values of the variables measured in relation to the athlete's position on the court. The main findings suggest that the anthropometric profile of the U16 male players of the Greek National Basketball Team is at a high level. Specifically, Guards recorded an average height of 190.29 ± 4.64 cm, weight 77.26 ± 5.91 kg and body fat percentage 10.33 ± 1.11 (%). Accordingly, Forwards recorded height of 197.5 ± 4.89 cm, weight 84.06 ± 10.62 kg, body fat percentage 9.85 ± 2.39 (%) and the Centers recorded height of 205.5 ± 3.11 cm, weight 94.99 ± 4.5 kg and body fat percentage 11.78 ± 1.95 (%). Furthermore, the findings showed that the players of the Center position were significantly superior in almost all anthropometric measurements compared to the other two positions. In particular, the Centers had the highest height, weight, body fat percentage and standing reach compared to the Guards and Forwards although they were younger. No differences were found in the other measurements.

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INTRODUCTION

Performance in the sport of basketball is determined by many factors, the most important of which are related to the anthropometric and physiological characteristics of basketball players as well as their technical and tactical skills. Anthropometric measurements, the determination of the physical composition of basketball players and the differences between the various levels and positions of basketball have recently become fundamental research areas for all the scientists who study this sport. The anthropometric profiles of basketball players have been recognized as a critical factor in the selection process, while specific anthropometric variables such as height, weight and length of the upper and lower limbs seem to be positively associated with increased performance in the sport of basketball (Nagar et al., 2012). In fact, it seems that as anthropometric characteristics increase over time, some of the technical skills of basketball players (eg rebounding, passing, shooting) improve as well, although this increase does not seem to have any effect on the physical ability of agility at least in adolescence and pre-adolescence (Begu et al., 2018; Eroğlu et al., 2021; Clemente et al., 2019). Previous analyzes of anthropometric characteristics in basketball players show that body measurements are necessary in the general selection process and in the assignment of positions in which each basketball player specializes from a young age. Measurements on both young and professional players revealed that people who were taller and heavier usually played closer to the basket, covering the Center and Forwards positions, while the shorter and lighter players filling the Guards positions (Ostojic et al., 2006; Pojskic et al., 2014; Vaquera et al., 2015). The crucial anthropometric parameter in the process of assigning specific playing positions in basketball seems to be first of all the height and secondarily weight, wingspan and the length of the limbs, with these differences at the highest level being even more important than physical fitness (Hoffman, 2020). In particular, the height of the players as an anthropometric variable alone can divide teams into good and less good with teams having taller players in specific positions prevailing over opponents (Zarić et al., 2020; Zarić, Ivan et al., 2020). In addition, according to Cui (Cui et al., 2019), in the best basketball league in the world, the NBA, the selection of players per playing position is largely based on anthropometric characteristics, with the tallest and heaviest players being selected more often in all 5 playing positions (PG, SG, SF, PF, C).

The weight and height of basketball players are not the only anthropometric parameters on which the international literature has focused on. Other variables such as body circumference and diameter, length and width of the limbs are taken into account when examining the anthropology of elite basketball players as well as players of different ages and levels of basketball. Consequently, Torres-Unda (Torres-Unda et al., 2013) in their study on young players found that elite players were superior to non-elites in all anthropometric and physiological measurements, while similar findings on the superior characteristics of elite basketball players versus non-elites in the same age categories (U14 to U18) are recognized by other researchers (Joseph et al., 2021; Viviani, 2020). In addition to the level of basketball players, there are also findings about the differences in anthropometric measurements between young and male professional players. Male professional basketball players are naturally taller, heavier, with greater wingspans and fat percentages in all playing positions versus adolescent/young players and female players (Gryko et al., 2018; Štrumbelj & Erčulj, 2014). However, differences in anthropometric measurements are also observed between the age categories of adolescent players, with the U17/U18 teams showing mainly greater height, weight and wingspan compared to the U15/U16 teams, despite the fact that at the ages of 12 to 15 the height, weight and arm's

length of basketball players increases more (Calleja-González et al., 2018; Matulaitis et al., 2019; Forte et al., 2019). In recent years, the constant evolution of the rules and basic techniques-tactics in basketball have resulted in greater physiological and anthropometric differentiation between basketball players and players of other sports. More specifically, the anthropometric profile of basketball players is much higher in terms of height, weight, length and circumference compared to soccer players and better in terms of lean body mass, BMI and fat percentage than volleyball players (Bjelica et al., 2020; Can Pasa et al., 2019; Toselli et al., 2021). Based on the above, it seems that the anthropometric profile of basketball players plays a very important role in their selection in the sport, with taller, stronger and more mature players having more chances of success, especially at developmental ages (Arede et al., 2021; Ramos et al., 2019). Given the existing knowledge in this field, it is considered useful to further investigate the anthropometric profile of young basketball players and in particular the elite U16 national team players. Given that there is perhaps only one study in the international literature that examines in detail the anthropometric profile of elite U16 basketball players (Borovi & Garafoli, 2016, p. 16), dividing players into 3 positions (Guards, Forwards, Centers) it seems that there is a lack of data in the specific field. In particular, in Greece there are no surveys examining the anthropometric profile of the elite male players of national U16 national teams in the sport of basketball. An earlier study by Kostopoulos (Kostopoulos, 2015) on players of the same age group revealed some findings about the anthropometric profile of the Guards, Forwards and Centers of the country but it was carried out on amateur non-elite players. Therefore, the aim of this study was: a) to examine and record the anthropometric profile of the elite U16 national team players per playing position, b) to compare the differences of the anthropometric profiles between the playing positions.

MATERIALS AND METHODS

Participants

The sample size consisted of 17 young male basketball players, who participated in this study (average weight 84 kg, average height 1.97 cm, average age 15.9 years). Players were classified according to their positions in Guards (G: n = 7), Forwards (F: n = 6), and Centers (C: n = 4). The players participated in the Development Program of the Hellenic Basketball Federation in the year 2021 and were preparing for their possible selection and participation in the Greek National Team, which would participate in the U16 European Basketball Championship of the same summer. Upon their arrival at the practice facilities, the players and their parents were thoroughly informed about the procedures and content of the research, the risks involved and the benefits that the players would gain from the obtained results. The written consent form was then obtained from the parents or legal guardians for their children's participation in the study procedures, while the research was reviewed and approved by the ethics committee of the University of Peloponnese of the School of Human Movement and Quality of Life, Department of Sports Organization and Management, University of Peloponnese, Sparta, Laconia and was in accordance with the Principles of the Helsinki Declaration (2008).

Procedures

The anthropometric measurements were carried out on the first day of the players' presence in the procedures of the National Team U16 Training camp. Before taking the measurements, all examinees completed a questionnaire about their state of health and signed a consent form that allowed the examinations to be performed. All procedures

were performed at the same time before the players' breakfast (08.30-10.00 am), with the evaluation being done in an indoor basketball court with wooden floor-parquet- with the temperature inside being controlled (25°C-27°C). Players were divided into playing positions in Guards, Forwards and Centers and were grouped separately. In order to determine the anthropometric profile of the elite players of the study, the following anthropometric characteristics were measured in each position: height, weight, wingspan, standing reach, body fat percentage and body mass index (BMI). All measurements were performed according to the International Society for the Advancement of Kineanthropometry protocol (ISAK) by the same three (3) certified experienced examiners, who have performed these procedures many times either at national team level or at domestic level clubs.

Anthropometric measurements

Each player was weighed in light training clothes using a 0.1kg electronic precision scale (Model UC-231, A&D Mercury Pty. Ltd., Tokyo, Japan) and their upright height was recorded with a portable stadiometer without shoes with a deviation of 0.1 cm (SECA 242, Hamburg, Germany). The wingspan was recorded from the tip of the left hand to the tip of the right hand using a tape measure, while the player stretched their arms horizontally and similarly the standing reach was measured in ascent with the player standing upright and raising both hands high so that they were perpendicular to the floor, with the height of the tips of the hands being recorded using a measuring tape. The percentage of body fat was assessed by measuring the thickness of the skin folds of the chest, abdomen and quadriceps using a dermatometer (Harpenter® Adipometer, British Indicators LTD, UK) and at the same time the body mass index (BMI) of the players was calculated.

Statistical analysis

The data was recorded using Microsoft Excel software. The data were then transferred to IBM statistical software, Statistical Package for Social Sciences (SPSS), version 25. For descriptive analysis of the results, mean values and standard deviations were used to form the general image of the sample. The sample was studied separately for three different positions of the players on the field, the Guards, the Forwards and the Centers. In the inductive analysis, the possible differences between the different positions of the players were examined. One-way analysis of variance (one-way ANOVA) was used to determine differences between the mean values of the variables measured in relation to the athlete's position on the court. In addition, to investigate which subgroups of the sample identified significant differences, the Bonferroni multiple comparison criterion was applied to statistically significant results. As there were three athlete positions (Guards, Forwards, Centers) studied, Bonferroni's multiple-comparison post-hoc control was applied for significant results. The significance level of the research was set at $\alpha = 0.05$.

RESULTS

The sample consisted of 17 young male players of the Greek National Basketball U16 Team 2021 with an average age of 15.9 years. The sample was analyzed separately for three different positions of the players, the Guards, the Forwards and the Centers. The descriptive characteristics of all anthropometric position measurements are presented in Table 1. Center players had the highest average Height ($M = 205.5$ cm) compared to Forwards ($M = 197.5$ cm) and Guards ($M = 190.29$). cm). Similar results are found in the weight of the players and their body mass index. In terms of fat percentage, the Center

players recorded the highest percentages (M = 11.78%), followed by the Guards (M = 10.33%) and finally the Forwards with the lowest percentages (M = 9.85%). In addition, Forward players have the largest wingspans (M = 199.5 cm), followed by Centers (M = 199.38 cm) and Guards (M = 191.71 cm). Finally, the Center players recorded the highest standing reach measurements in ascent (M = 260.25cm), compared to Forwards (M = 253.83cm) and Guards (M = 240.86cm).

Table 1. Mean and standard deviations of anthropometric characteristics between positions.

Variables	Mean ± SD		
	Guards	Forwards	Centers
Age (years)	16 ± 0	15.83 ± 0.41	15.75 ± 0.5
Height (cm)	190.29 ± 4.64	197.5 ± 4.89	205.5 ± 3.11
Weight (kg)	77.26 ± 5.91	84.06 ± 10.62	94.99 ± 4.5
BMI	21.4 ± 1.99	21.16 ± 2.46	23.38 ± 0.96
Body fat percentage (%)	10.33 ± 1.11	9.85 ± 2.39	11.78 ± 1.95
Wingspan	191.71 ± 5.28	199.5 ± 5.09	199.38 ± 5.5
Standing reach (cm)	240.86 ± 4.49	253.83 ± 11.11	260.25 ± 11.18

Source: personal data

Inductive analysis of the results revealed statistically significant differences in four anthropometric characteristics, height, weight, wingspan and standing reach. In the other measurements the differences were not significant at 95% certainty.

Positional differences in height measurement

A significant difference in the player's height was found in relation to their position (One-way ANOVA, $F(2,14) = 15.117, p < 0.001$). From the post hoc analysis with the Bonferroni criterion, it was found that all three positions differ significantly from each other. As shown in Graph 1, Center players have the highest height (M = 205.5 cm), Guards the smallest (M = 190.3 cm) and Forwards are in between (M = 197.5 cm).

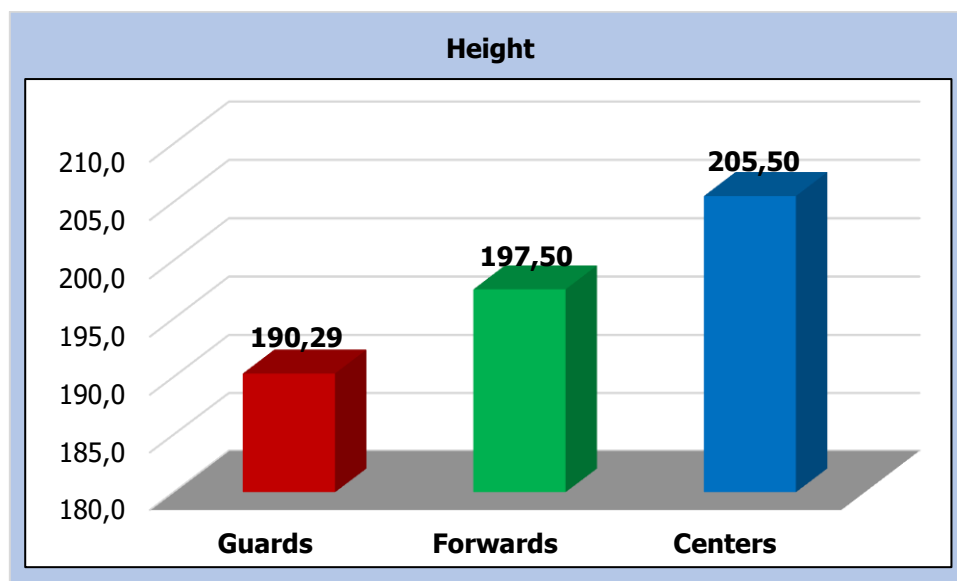


Figure 1. Average height (cm) of players in relation to their position

Positional differences in weight measurement

In addition, there was a significant difference in the weight of the players in terms of their position (One-way ANOVA, $F(2,14) = 6.720, p = 0.009$). From the post hoc analysis

(Bonferroni) it was found that the Guards (M = 77.3 kg) and Forwards (M = 84.1 kg) have significantly lower weight than the Centers (M = 95.0 kg) but do not differ significantly from each other. The above are illustrated in Graph 2.

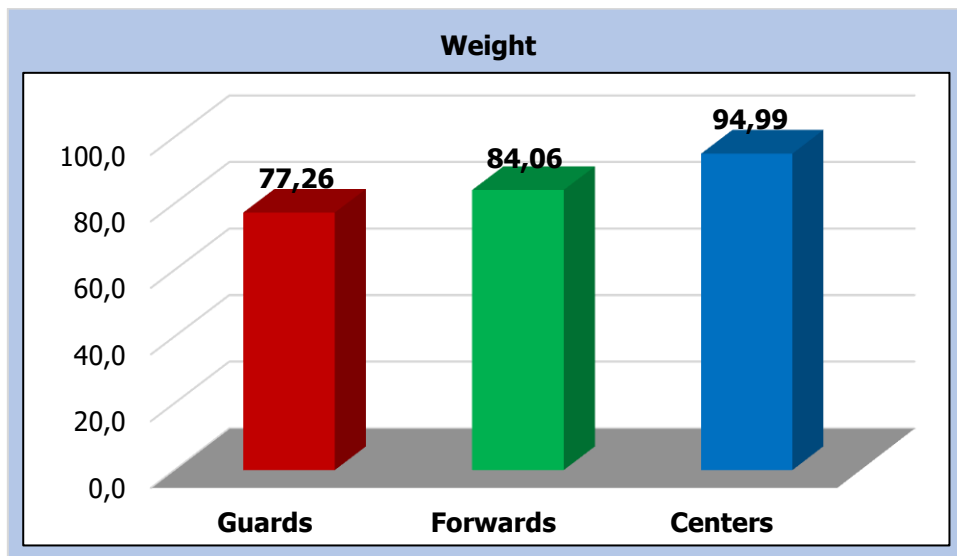


Figure 2. Average weight (kg) of players in terms of their position

Positional differences in wingspan measurement

In the measurement of the wingspan, a significant difference was found between the positions (One-way ANOVA, $F(2,14) = 4.451$, $p = 0.032$). The mean values per position are presented in Graph 3. From the post hoc analysis (Bonferroni) it was found that there are no significant differences between the groups, but the difference between Forwards (M = 199.5 cm) and Guards (M = 191.7 cm) was marginal but not significant ($p = 0.056$).

Figure 2 shows the percentage of basketball dribbling results for male and female students. The category is sufficient to get the highest percentage both for men with an achievement of 75.73% and for women with an achievement of a percentage of 70.37%. Furthermore, the lowest achievement is shown in the very good category with a percentage of 0% for men and women.

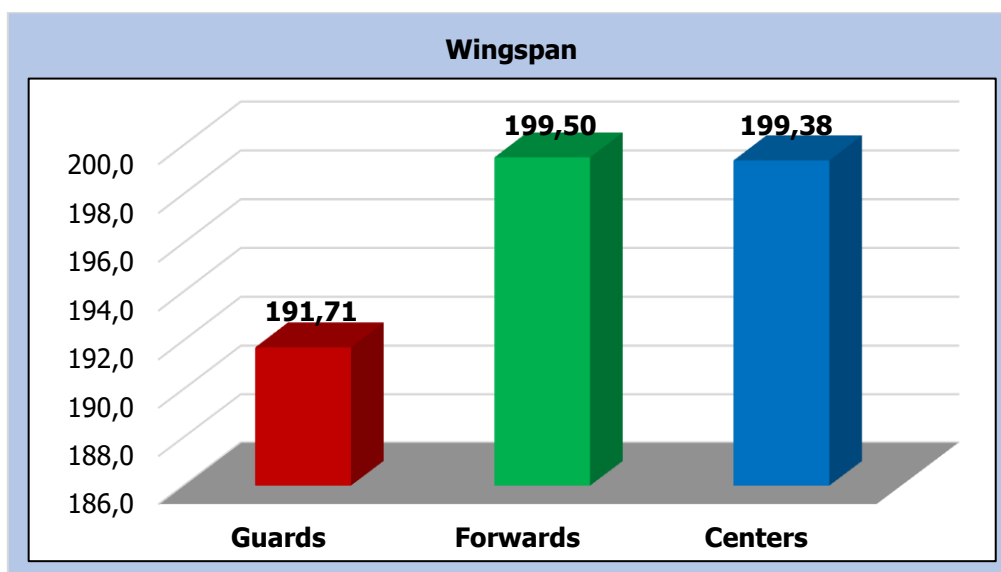


Figure 3. Average measurement of wingspan (cm) in relation to the position of the players

Positional differences in standing reach measurement

In the measurements of the standing reach in ascent, a significant difference was found between the positions (One-way ANOVA, $F(2,14) = 6.881$, $p = 0.008$). The mean values per position are presented in Graph 4. The post hoc analysis showed that the only statistical difference is between the Guards ($M = 240.9$ cm) and the Centers ($M = 260.3$ cm).

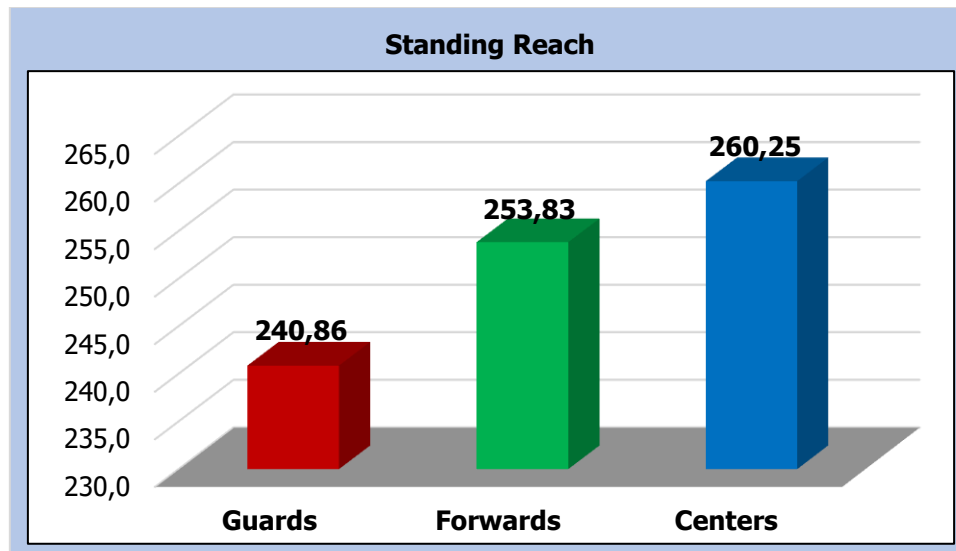


Figure 4. Average measurement of the standing reach (cm) in relation to the position of the players

DISCUSSION

The present study is one of the first attempts to record and compare between the playing positions the anthropometric profile of the elite U16 basketball players in Greece. The first objective of the study was to record the anthropometric profile of the U16 elite players of national teams per playing position. The main findings suggest that the anthropometric profile of the U16 male players of the Greek National Basketball Team is at a high level, similar to that of similar national teams of other countries. Specifically, the Guards recorded an average height of 190.29 ± 4.64 cm, weight 77.26 ± 5.91 kg and body fat percentage 10.33 ± 1.11 (%). Forwards recorded an average height of 197.5 ± 4.89 cm, weight 84.06 ± 10.62 kg, body fat percentage 9.85 ± 2.39 (%) and the Centers recorded an average height of 205.5 ± 3.11 cm, weight 94.99 ± 4.5 kg and body fat percentage 11.78 ± 1.95 (%). The results of the anthropometric profile of the players of the 3 positions are almost similar to Croatian elite players of the same level and age (Borovi & Garafoli, 2016) with the players of the present study showing better / lower values in the percentage of body fat in all 3 positions (Guards, Forwards, Centers). Next, the results of the players of the present study are better in the measurements of height, weight, BMI and fat percentage (%) compared to male professional basketball players of the domestic championships of Bosnia, France and Spain while they are slightly inferior, mainly only in the position of the Center, by Serbian male professional players of the 1st category of Serbia (Ostojic et al., 2006; Pojskic et al., 2014; Sallet et al., 2005; Vaquera et al., 2015). Still, in comparison with the amateur players of Kostopoulos study (Kostopoulos, 2015) conducted on players of the same age in the same country (Greece), the players of the present study far outweighed all 3 positions in all the anthropometric variables examined. Although the players analyzed were members of the U16 national basketball team, in which the most mature, tallest and heaviest players are usually selected (Arede et al.,

2021), the aforementioned results showed that Greek elite players of developmental age have high level anthropometric characteristics.

The second objective of the study was to compare the differences of anthropometric profiles between the 3 playing positions Centers-Forwards-Guards. The main findings showed that the players of the Center position were significantly superior in almost all anthropometric measurements compared to the other two positions. In particular, the Centers had the highest height, weight, body fat percentage and standing reach compared to the Guards and Forwards although they were younger. No differences were found in the other measurements. These results are in line with all previous records in the international literature regarding the superiority of the anthropometric profile of the Center's position over the other two (Altavilla et al., 2018; Köklü et al., 2011; Pion et al., 2018; Pojskic et al., 2014; Vaquera et al., 2015). Surprisingly, a notable finding of the study was that the players in the Forward position had the largest wingspan and the lowest body fat percentage (although not statistically significant) compared to the other two positions. This fact can be explained from the point of view that the players who are called to play this position must possess the technical skills of the Guard but also the anthropometric characteristics of the Centers as they must be able to play near the basket scoring and getting rebounds but also, they must be able to handle the ball and shoot from long distances.

The results of the present study on body fat percentages and BMI measurements are consistent with other studies of the same age in basketball players. Viviani (Viviani, 2020) in his research recorded values of 12.9 (%) percentage of body fat and 21.21 BMI values in elite U-17 basketball players, values that were quite similar to those of the present study. Respectively, the players in this study showed similar values in both variables, with Spanish top players aged U17 / 18 and better values especially in the percentage of body fat from players U14 / 15 years old (Calleja González et al., 2018; Gryko et al., 2018). The low body fat percentages recorded in all 3 examined positions on this study ($9.8 \pm 3\%$), enable the players to perform a large number of fast and intense movements, both in defense and in offense, while numerous researches have been carried out in the past and have shown that excess adipose tissue can have a negative effect on speed, agility and endurance.

The study also recorded the players' wingspan as well as their standing reach. In addition, the level of players seems to largely determine their anthropometric characteristics as Eroğlu (3) and rtrumbelj & Erčulj (Štrumbelj & Erčulj, 2014), in their study conducted on amateur adolescents and young basketball players, recorded significantly smaller wingspans than the elite players of our study. On the other hand, Spanish top U17 / 18 year old players as well as college basketball players recorded slightly better values in this measurement (Calleja González et al., 2018; Lockie et al., 2020). In regards to the standing reach, minimal research has been carried out on this anthropometric measurement in elite U16 basketball players. The Guards of the present study recorded values of 240 cm, Forwards 253 cm and Centers 260 cm. These values are not at a good level in relation to male professional players. Cui (Cui et al., 2019) in his research recorded better standing reach values in all 3 positions in professional players selected to play in the NBA. In contrast, the standing reach values of the players in this study were almost identical to those of the NCAA first-division college players (Lockie et al., 2020). In this light, this measurement needs further evaluation to draw safer conclusions.

The present study has encountered some limitations. Initially, the sample size could be quite larger including other players from older years or from other age groups (eg

U18), which was not possible. The larger number of samples would give even greater integrity and reliability to the results so that the anthropometric profiles of the elite Greek U16 basketball players can be diagnosed even better and more clearly. Secondly, due to the limited processing time, the research did not carry out more anthropometric measurements (eg circumference, limb length, body type) so that there is a more complete picture of the profiles of each position separately. Thirdly, the study did not take into account the biological maturation of the players in the sample. The researchers were not able to know the biological maturation of the players of each position separately.

CONCLUSION

The main findings suggest that the anthropometric profile of the U16 male players of the Greek National Basketball Team is at a high level in all 3 examined positions that were analyzed. In addition, players in the Center position were found to be significantly superior in almost all anthropometric measurements compared to the other two positions. The findings of the research can be used as an aid by the coaches and all those involved in the selection processes of players in the sport of basketball both for the staffing of the national teams of the countries, as well as for the staffing of domestic championship clubs.

CONFLICT OF INTEREST

All the authors state that there is no conflict of interest.

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