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Body height of female basketball players: Association with ranking at the Women's World Basketball Cup

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Abstract

Female basketball players at the FIBA basketball women's world cup (FIBA-WWC) are highly distinct individuals because they need to be tall and sufficiently skilled to score or defend the basket set at the height of 3.05 m. This study aimed to investigate whether players from the first eight teams at FIBA-WWC were taller than those ranked above the eighth place, and to what degree body height determines the ranking. This study included the body height of 575 female basketball players from three FIBA-WWC. They were sorted to point guards (PG), shooting guards (SG), small forwards (SF), power forwards (PF), and centres (C). The differences in players' height at each position were analysed between the ranking groups using an independent t-test. Linear regression analysis determined to what degree ranking at FIBA-WWC is associated with the height of players at each position. A significant large difference occurred between SF, PF, and C, with those from the first eight teams being taller. Linear regression showed that teams rank higher by each 1 cm of increase in the height of SG, SF, and C and 2 cm in PF. Body height significantly predicts the success at FIBA-WWC, suggesting that talent identification and selection could be improved in female basketball.

KEYWORDS: performance modelling, selection, talent identification, anthropology, morphology

Introduction

Basketball is a dynamic sport where two teams compete who is going to score more points by inserting the ball through the basket that is set at a height of 3.05 m. Basketball players can score from below the basket and a relatively short distance (i.e., two points) as well as from a long distance (i.e., 3 points). However, at the same time, the opposing players are trying to defend the basket either by guarding the space on the court by not allowing the offence to approach to basket or receive the ball, or by directly blocking the shots. Therefore, individual players' and teams' achievement and success depends on physical abilities supported by physiological profile, mental abilities and tactical skills embodied into specific body frame (Ostojic et al., 2006; Pehar et al., 2017; Cui et al., 2019; Zarić et al., 2020). In that regard, body height among elite basketball was found to be significantly different in comparison to those ranked higher to those ranked lower at the world cup organised by the International Basketball Federation (FIBA-WC) (Zarić et al., 2020).

Considering the height of the basket and that the winner is the one who scores more baskets, body height and weight have had the highest priority during the selection process and when establishing an in-court position (Dežman et al., 2001; Vaquera et al. , 2015). Each position is characterised by certain body height: point guards are the shortest, followed by shooting guards, small forwards, power forwards, and centers, who are the tallest (Bale, 1991; Carter et al., 2005; Zarić et al., 2020). However, Zarić et al. (2020) reported that players from different positions may overlap by height (i.e., tall point guards and short shooting guards), indicating that they could be used to cover these two positions if skilled for them as well. This finding further emphasises the importance of players height as a taller point guard may have an advantage in one-on-one play offensively by higher ball release point and defensively by higher blocking reach (Struzik et al., 2014).

In that regard, Garcia-Gil et al. (2018) found body height to be among the main predictors of performance index rating among elite female basketball players, while Pehar et al. (2017) found that players from the first division were significantly taller than the players from the second division. Another advantage of taller people could be the width of their arm span that highly depends on body height (i.e., taller people have wider arm span and contracting perimeter) (Popović, 2018), which Garcia-Gil et al. (2018) found height to be associated with performance index rating. These characteristics are of importance in in basketball game during jumping (i.e., rebounding and blocking), defending the space (i.e., covers wider and higher space), and shooting or dunking (i.e., over shorter players). Thus, body height provides the advantage in every aspect of the game (Struzik, Pietraszewski & Zawadzki, 2014; Zarić et al., 2020).

Several studies investigated the differences in anthropometric characteristic and body composition of elite female basketball players (Bale, 1991; Carter, et al., 2005; Bayios et al., 2006). Moreover, the association of these characteristics to player physical performance and basketball performance were found to be significant (Garcia-Gil et al., 2018; Zarić et al., 2020). However, whether body height varies among the female basketball players at the FIBA women's World Cup (FIBA-WWC) has not been investigated, which is significant because the FIBA-WWC national teams select only the 12 best players from each country. Also, the countries need to qualify for this competition by following strictly defined rules, limiting the number of teams that can qualify. Therefore, the players who come to the FIBA-WWC could be considered to be the most elite in their countries and in the world. The competition system at FIBA-WWC includes 16 teams that play a group phase, reducing to the selection to 12 teams, a quarter-final qualification reducing it to eight teams, followed by quarter-finals, semi-finals, and finals. In a group phase, four teams within one group play among each other and the best two teams from each group go into the knockout phase. Given the nature of competition from quarter-finals to finals and the quality of teams that entered, where the winner can be any team, it could be assumed that the teams from the knockout phase are in some characteristics better than the teams that did not reach to this phase FIBA-WWC.

Considering that the data on body height, team position and FIBA-WWC ranking are public and easily available, the possibility emerges to investigate whether the players from better-ranked teams (i.e., quarter-finals) are significantly taller than those whose teams ranked lower. This simple and straightforward, but yet important information could be useful for basketball scouts and performance analysts to identify potential talents, and for strength and conditioning coaches for modelling the body height of elite female basketball players. This study, therefore, aimed to evaluate if the players from the teams that entered quarter-finals of FIBA-WWC were significantly taller than the players from the teams who did not enter this phase of competition. It is hypothesised that the players from the quarter-finals phase are significantly taller than those from who did not advance to this phase and that the ranking is linearly associated with the body height of the female basketball players. Accordingly, if the hypothesis is confirmed, this study will provide the body height model of the most elite female basketball players for each position.

Methods

Participants

A retrospective data for body height was administered of 575 elite female basketball players who competed at three FIBA-WWC (2010, 2014, and 2018). Body heights were obtained from sixteen teams that competed at each FIBA-WWC from the official FIBA web page. The study is conducted in accordance with the Helsinki Declaration regarding the ethical principles for medical research involving human subjects (Williams, 2008). The study design was approved by the Ethical Board (number 484-2) of the Faculty of Sport and Physical Education, University of Belgrade, Belgrade, Serbia.

Procedures

National teams provided the body heights of players to FIBA at registration for competition. Although it has not been defined how each team obtained these data, it is reasonable to assume that the professionals who did the measurements provided accurate and reliable data of players chosen to play. The teams from three FIBA-WWCs were allocated to two groups based on their ranking. The first group included eight teams that passed the group phase and pre-quarterfinals. Therefore, these teams ranked from first to eighth place, and this group was named "1–8th"; it had a mean age 28.4 ± 2.0 years. Considering that all teams had to go through the prequalification for the FIBA-WWC and then through the group phase and pre-quarterfinals of the FIBA-WWC, it could be considered that the eight teams that passed these stages were a homogenous group, meaning that it had players with similar skills and body characteristics. The second group consisted of teams that did not pass to quarter-finals and who accordingly ranked below eighth place; it was named "9-16th". The mean age of this group was 28.6 ± 2.5 years. Note that all teams that qualified to the FIBA-WWC consist of rigorously selected and professionally trained athletes, suggesting that those who do not reach the quarter-finals are, to some degree, different in some characteristics compared to those who do reach that stage.

Body height was analysed relative to a player's position in the team and as an average team height and compared between the groups. Players were sorted into five positions (point guards (PG), shooting guards (SG), small forwards (SF), power forwards (PF) and centres (C)) that were their specialities at the FIBA-WWCs. This information was also collected from the FIBA web page, where each player has a profile with information about the position. For guards and forwards, whose position was not defined precisely (i.e., PG or SG and SF or PF) on the web page, authors conducted the video analysis of two to three different matches (FIBA 2020) following procedures explained elsewhere (Huges & Franks 2004). The rationale was to determine if the PG, SG, SF, PF, and C from the 1–8th group were taller than those from the 9–16th.

Statistical analysis

The statistical analyses were conducted using the Microsoft Excel and Statistical Package for Social Sciences (SPSS, version 22.0). The data were analysed descriptively for mean, standard deviation (SD), minimum, maximum, coefficient of variation, and 95% confidence interval. The Kolmogorov-Smirnov test was used to evaluate the normality of distribution. The differences between the groups were analysed with an independent sample t-test. The parametric test was chosen because the sample size was large enough and because non-parametric tests in large studies may provide answers to the wrong question (Fagerland & Sandvik, 2009; Fagerland, 2012). A linear regression analysis was used to determine to what degree body height of players defines the success of basketball teams at FIBA-WWC. The significance level for used analyses was set at $p < 0.05$. In the end, descriptive statistics with quartile distribution was conducted for the first eight teams to define the body height model of the most elite basketball players. The mean, minimum, and maximum values were calculated from each teams' average values for each position, similar to Zarić et al. (2020). In this way, minimum and maximum values were not the extremes on both sides, even though quartile analysis includes them. The Cohen's effect size analysis was used to calculate the magnitude of differences between the groups and the magnitude of association between body height and ranking (Sullivan & Feinn 2012). The magnitude of difference was calculated as $(M_2-M_1)/SD$, where M_1 and M_2 were the means of the groups, while SD was a pooled standard deviation of compared groups. The magnitudes of differences were defined as small = 0.2-0.5, moderate = 0.5-0.8, and large ≥ 0.8, while magnitudes of associations were defined small = 0.04-0.24, medium = 0.24-0.64, and large ≥ 0.64.

Results

Descriptive statistics for mean, standard deviation (SD), coefficient of variation (CV), minimum (Min), maximum (Max) and 95% confidence interval are shown in Table I. The results are presented for each position and for all three FIBA-WWCs. There was no significant between-competition difference in body heights of players ($F = 0.09$, $p = 0.91$), while between-position differences in body height were significant ($F = 190.60$, $p < 0.001$), with PGs being the shortest and C the tallest.

An independent sample t-test revealed significant differences at three positions as well as in teams' average height between the players who played for the teams ranked 1-8th place and those who played for teams ranked 9-16th place (Table II). Differences were observed between shooting guards, small forwards, power forwards, and centres. The observed differences were of moderate magnitude among shooting guards and of large magnitude among small forwards, power forwards and centres (Figure 1). Furthermore, small difference occurred among point guards and in average team height.

The regression analysis determined significant linear associations between body height SG, SF, PF, and C as well as of team's average body height and ranking at FIBA-WWC, producing significant coefficients of change in body height at these position and teams average (Table III). The association was moderate in SG, PF, and C and large in SF and team average (Figure 2).

Table 1: Body height of women's basketball players from three FIBA-WWCs relative to position on team

FIBA-WWC	Positions	N	Mean (cm)	SD	CV%	Min	Max	95% CI	
								Lower	Upper
FIBA-WWC 2010	Point guard	16	171	5	3	165	180	168	173
	Shooting guard	49	176	5	3	165	190	174	177
	Small forward	53	184	5	3	172	196	183	186
	Power forward	18	187	3	2	180	193	185	189
	Centre	55	192	5	3	181	203	191	193
	All positions	191	183	9	5	165	203	182	185
FIBA-WWC 2014	Point guard	33	172	4	2	164	180	171	174
	Shooting guard	48	177	5	3	165	186	175	178
	Small forward	59	184	6	3	170	194	183	186
	Power forward	19	188	4	2	182	193	186	189
	Centre	33	192	5	3	181	203	190	194
	All positions	192	182	8	5	164	203	181	183
FIBA-WWC 2018	Point guard	32	170	5	3	161	182	169	172
	Shooting guard	50	177	6	3	165	191	176	179
	Small forward	49	185	6	3	170	196	183	186
	Power forward	27	187	5	3	180	198	186	189
	Centre	34	193	6	3	180	205	191	195
	All positions	192	182	9	5	161	205	181	183

Table 2: Differences in body height between players from the top 8 teams and the rest of the teams, relative to position on team

Positions	Ranking 1 – 8th	Ranking 9 – 16th	Mean difference	95% CI
	Mean ± SD	Mean ± SD		
Point guard	171.6 ± 3.8 cm	170.7 ± 4.5 cm	0.86	-1.94 - 3.65
Shooting guard	177.0 ± 3.7 cm	175.3 ± 3.3 cm	1.62	-0.41 - 3.65
Small forward	186.2 ± 3.3 cm	181.7 ± 4.5 cm	4.43**	2.12 - 6.74
Power forward	189.1 ± 2.4 cm	186.0 ± 3.2 cm	3.08**	1.16 - 4.99
Centre	194.0 ± 3.4 cm	190.4 ± 4.2 cm	3.60**	1.32 - 5.87
Team average	183.9 ± 8.7 cm	180.9 ± 8.0 cm	2.99*	0.76 - 5.23

** Significant at $p < 0.05$, ** Significant at $p < 0.01$.*

Table 3: Correlation coefficients and linear regression analysis coefficients

Positions	Body height r	R Square	SEE	F	B	Std. Err.
Point guard	0.328	0.107	4.7	1.68	0.68 cm	0.53 cm
Shooting guard	0.503*	0.253*	4.3	4.75	1.25 cm	0.57 cm
Small forward	0.820**	0.673**	2.8	28.78	1.19 cm	0.22 cm
Power forward	0.773*	0.597*	3.2	19.27	1.71 cm	0.39 cm
Centre	0.777**	0.604**	3.1	21.34	1.26 cm	0.27 cm
Team average	0.871**	0.759**	2.4	44.20	2.19 cm	0.33 cm

**Significant at $p < 0.05$, **Significant at $p < 0.001$. SEE – standard error of the estimate, Std. Err. – standard error.*

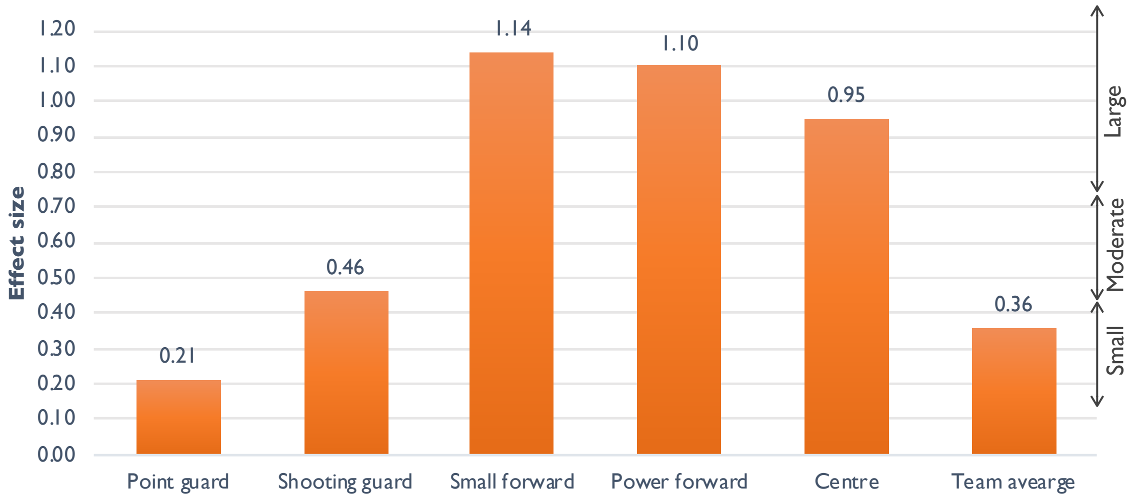

Figure 1: Magnitude of differences between 1-8th and 9-16th place groups

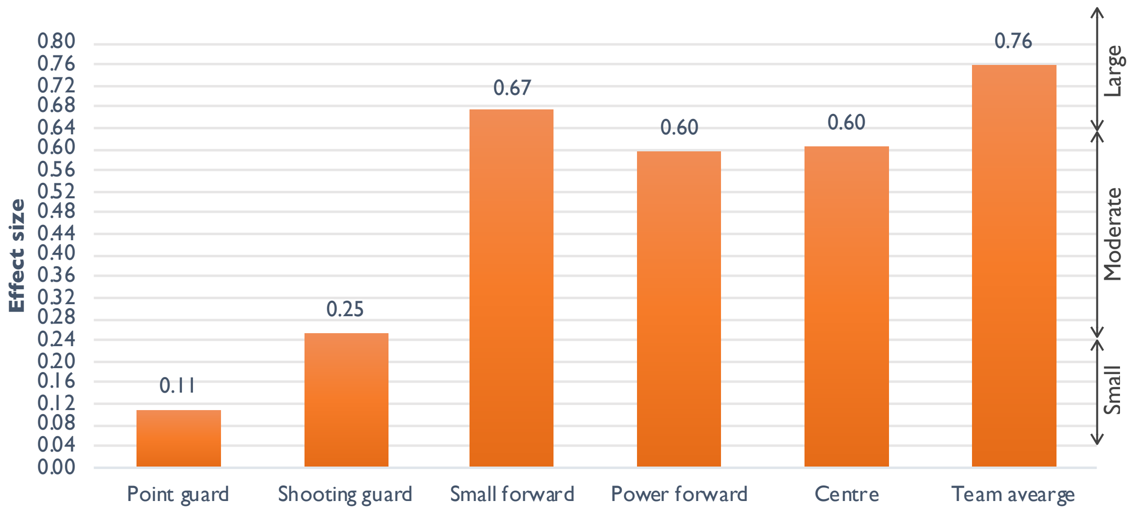

Figure 2: Magnitude of determination of ranking from players' body height

Body height model for the most elite female basketball players is presented in Table IV. Mean values are fallowed by quartiles to define the space for possible discrimination of shorter and taller players as well as possible shifting between positions.

Table 4: Descriptive statistics for each position for the teams that ranked 1–8

Positions	Mean (cm)	SD	Min	Max	Quartiles		
					25th	50th	75th
Point guard	171.6	3.8	165.0	176.5	168.2	172.0	175.0
Shooting guard	177.0	3.7	165.0	181.5	176.1	177.5	178.9
Small forward	186.2	3.3	179.0	191.0	183.3	186.6	188.9
Power forward	189.1	2.4	185.0	193.0	187.3	189.3	190.3
Centre	194.0	3.4	185.0	199.5	191.4	194.8	196.0

Discussion

This study aimed to investigate if players from the teams ranked 1–8th place at the FIBA-WWC were taller than players from the teams ranked below the 8th place (i.e., 9-16th) and to establish body height model of elite female basketball players. Differences in body height were investigated at each position as well as teams' average body height. The main findings indicate that teams with taller players on certain positions and teams taller in average were ranked higher at the FIBA-WWC. Moreover, the ranking was linearly associated with the body height of players from three positions and with teams' average body height. Therefore, both hypotheses were true, with the only exception being at the position of PG and SG in the first and PG in the second hypothesis, for which the results did not meet the set level of significance. However, the effect size analysis suggests the same trends of small size even at these two positions, which bears importance given the rigorous selection process that each player need to go through before reaching to this level of competition.

The descriptive statistics consistently showed that starting from the position of PG towards C, body height gradually increases, which is in line with previous studies (Abdelkrim et al., 2010; Vaquera et al., 2015), which could be attributed to the specificity of tasks that each position needs to fulfill, which (to a large measure) determines the body height of the players (Pehar et al., 2018). For instance, PG should dribble the ball the most while being chased by defenders whose task is to disrupt the action. Thus, they need to be quick and agile with remarkable ball control in offence and able to move quickly defensively, responding to unpredictable offence. In that regard, players with lower centres of body mass are well suited to accelerate and decelerate quickly and also possess good agility (Abdelkrim et al., 2010; Sattler et al., 2015). Thus, PG are usually somewhat shorter than the other positions, even though they are taller than the average adult female (Fryar et al., 2012; NCD-RisC, 2016; Popovic, 2017). During the game, it is common for SG and SF to complete multiple running tasks without the ball as they are opening or closing the space for the action to be completed. However, SG may get more balls further to basket to either shoot or play openly one-on-one, or they even move to the position of PG if needed. Thus, although the SG and SF are both taller than the point guards are, the SG are shorter, thus more adjusted to these tasks than the SF are (Ziv & Lidor, 2009).

Finally, PF and C are tall and strong (Abdelkrim et al., 2010; Ferioli et al., 2018), and are better able to shoot over the opponent or block the player. Their main tasks are also to jump for the ball under the basket (C) or little further from the basket (power forwards) and collect the balls offensively as well as defensively. Additionally, when close to the basket, they often play in close contact, pushing the opponent towards (offence) or off (defense) the basket, where their greater height and body weight are advantages. Therefore, between-position differences are common and task-influenced or needed for the team hierarchy to work effectively.

However, within-position characteristics are also important as they may decide who wins or loses the game. Namely, SF, PF, and C of the first eight teams were significantly taller than the players at the same position from the teams ranked below the eighth place. These differences were large in magnitude, indicating the importance of body height in the selection process for the elite level of play. Moreover, although the differences in PG and SG were not statistically significant, the effect size calculation revealed small differences, suggesting that considerable amount of higher-ranked teams chose taller players on these positions as well. Considering this, teams ranked higher were significantly taller than the teams ranked lower even when the teams' average heights were compared. Similar results were observed in male basketball players (Zarić et al. , 2020) in which PG, SG and SF of the first 16 teams at FIBA-WC were taller than the players at the same positions from teams ranked below 16th place, while PF and C had the same heights regardless of ranking. According to task specificity of each position, the results suggest that among SG, SF, PF and C of similar skill level, those who are taller are a better fit for the more successful teams (i.e., perform better) (Zarić et al., 2018).

Given that PF and C are the tallest, and mostly belong to tallest people in the world (i.e., the highest percentiles of population (Fryar, Gu & Ogden, 2012; Popovic, 2017), and they are selected for this specific role, it seems unexpected that not all teams actually selected the tallest females for their teams. One could argue that teams ranked below 8th place performed wrong selection. However, whether wrong selection occurred due to mistake of scouts and coaches or simply because of not having better choice is not clear and should be further investigated.

Taller players have higher blocking reach, cover wider space by arm span, possess higher body mass and absolute strength, which all contribute to successful one-on-one play under the 3.05-m basket (Pojskic, Separovic, Muratovic & Uzicanin, 2014; Ziv & Lidor , 2009; Zarić, Dopsaj & Marković, 2018; Ranisavljev, Mandic, Cosic, Blagojevic & Dopsaj, 2020). Furthermore, they are likely to be physically more dominant in one-on-one play offensively and defensively as they have higher ball releasing point while shooting or in defensive jumping, and they could guard wider space by their arm span. When guarded by an aggressive defender, SG if taller performs the shot at the high enough so the shorter defender cannot block and vice versa, taller SG is more likely to stop shorter SG of same skill. Note that, the two-legged jump shot may amount to over 70% of all the shots during a game, whereby greater performance in executing the jump shot depends on the height at which the ball is released (Struzik, Pietraszewski & Zawadzki, 2014). Thus, a SG, SF, PF and C may have advantage both ways, higher releasing point or higher reach while blocking the shot, especially considering that females rarely dunk but rather score by shooting. There is also a tactical advantage of having taller players, especially after screens when players from shorter positions need to defend against the players from taller positions. When having taller players, coach may set the action plan that would frequently employ pick-and-roll so C or PF would play one-on-one against significantly shorter players (Zarić et al., 2020). In addition, PFs often posses' good distance-shooting skills, which they use when opening from pick-and-pop, especially if the defender is shorter. In relation to characteristics of our sample, it could be concluded that the first eight teams had advantage in both aspects of play, physical and tactical. Not only that PF and C could use pick-and-roll and pick-and-pop to play against shorter players, but they played against shorter opponents even on their specific positions. Even SG and SF played against shorter SG and SF but also had higher chances of defending pick-and-roll and pick-and-pop because they needed to stop relatively shorter PFs and Cs.

In that regard, the significance of body height among female basketball players reflected medium to large linear association between players' body height and ranking at four positions and at the level of the whole team, thus defining constant of change in ranking as function of player's height. The results suggest that for each about 1 cm of increase in body height of SG, SF, and C and 2 cm of body height of PF, the team had ranked higher at FIBA-WWC. This could be a supporting evidence that selection process still did not reach the pick where more national basketball teams will select the players with best biological and physical potential for each position, especially for taller positions. Thus, the body height model of the most elite female basketball players defined in results could be considered as a currently valid reference model. Note that body heights of players from different positions overlap, whereby some PG and SG or SF and PF or PF and C may have the same body height, forming three body height clusters. Therefore, although they are different position, if skilled, these players can shift positions (Zarić et al., 2020). In that regard, each position could be divided into three subclassifications, short, average, and tall; short PG (<168 cm), average PG (168-175 cm), tall PG (≥175 cm); short SG (<176 cm), average SG (176–179 cm), and tall SG (≥179 cm); short SF (<183 cm), average SF (183–189 cm), and tall SF (≥189 cm); short PF (<187 cm), average PF (187–190 cm) and tall PF (≥190 cm); short C (<191 cm), average C (191–196 cm), and tall C (≥196 cm).

Body height certainly is not the only factor important in talent acquisition and the selection process, nor could this study define whether body height is the most important factor. In that regard, the inclusion of variables such as players' age, body mass, body composition (i.e., percentage of skeletal muscle mass and body fat), physical abilities and specific basketball performance should be included for a more comprehensive analysis. However, the study clearly shows that body height is an important factor for teams ranking at FIBA-WWC, thus providing guidance to talent acquisition and team selection specialists and coaches.

Conclusion

Body height seems to be among the main pillars of success in basketball. Teams that perform better have significantly taller players on almost every position, which also reflects on the level of the whole team. Therefore, positionally and in average taller teams (i.e., ranked 1-8th) seem to be dominant in competing with teams with shorter players (i.e., ranked 9-16th) as they obtain better results at FIBA-WWC. Team scouts, coaches and personnel involved in the selection process must take this fact into account when tracking young talented female basketball players and when building the team. This study provides a referent body height model for each position and potential position interactions. This model could enable scouts and coaches to be more precise and accurate when evaluating the body height of players. Moreover, younger female players could be compared to this model during growth in order to determine the rate (%) of their biological development, which is of utmost importance for talent acquisition. Of course, body height is just one factor of talent acquisition and selection; if a player, shorter or taller than explained by this model, contributes to her team equally or more than the taller/shorter one at the same position, she should not be discriminated against based merely on body height.

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Povzetek

Košarkarice, na FIBA svetovnem prvenstvu v košarki (FIBA-WWC), so izbrane posameznice, ker morajo biti visoke in spretne, da dosežejo ali ubranijo koš, postavljen na višini 3.05 m. Cilj te študije je bil raziskati, ali so bile igralke iz prvih osmih ekip na FIBA-WWC višje od tistih, ki so se uvrstile nad osmim mestom in do katere stopnje telesna višina določa uvrstitev. Študija je vključevala telesno višino 575 košarkaric iz treh FIBA-WWC. Razvrščene so bile kot organizatorke igre (PG), branilke (SG), krila (SF), krilni centri (PF) in centri (C). Razlike v višini igralk na posameznem položaju so bile analizirane med skupinami za uvrstitev z neodvisnim t-testom. Linearna regresijska analiza je pokazala, do katere stopnje je uvrstitev na FIBA-WWC povezana z višino igralk na posamezni poziciji. Značilna velika razlika se je pokazala med SF, PF in C, pri čemer so bile igralke iz prvih osmih ekip višje. Linearna regresija je pokazala, da se ekipe uvrščajo višje za vsakih 1 cm povečanja višine SG, SF in C ter 2 cm v PF. Telesna višina pomembno napoveduje uspeh na FIBA-WWC, kar kaže na to, da bi bilo mogoče v ženski košarki izboljšati prepoznavanje in izbiro talentov.

KLJUČNE BESEDE: modeliranje uspešnosti, selekcija, prepoznavanje talentov, antropologija, morfologija

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