



ANTHROPOMETRIC CHARACTERISTICS OF VOLLEYBALL PLAYERS WITH RESPECT TO PLAYING POSITIONS: IN ETHIOPIAN FEMALE PREMIER LEAGUE

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Abstract The aim of this study was to investigate the anthropometric characteristics of Ethiopian female premier league volleyball players in relation to playing positions. The study encompassed 42 female premier league volleyball players (age: 25.60 ± 6.4 years). The players were categorized on the bases of playing position: including: -setters ($n = 5$), middle blockers ($n = 7$), outside-hitters ($n = 11$), opposite hitters ($n = 11$), and liberos ($n = 8$). Anthropometric measurements such as: five basic, six body lengths, six body circumferences, and five skinfolds were assessed. Descriptive statistics and One-Way ANOVA were used to identify the differences among the anthropometric characteristics of the players' at different playing positions. Significant mean differences were separated using the Tukey B^{a,b} mean difference test at $P < 0.05$. The result revealed that there were significant differences in standing height, sitting height, standing reach height, arm and leg lengths among female volleyball players in different playing positions. However, the differences in weight, BMI, body circumferences, and skinfolds were not significant. Up on the results, it was possible to conclude that players' anthropometry is among the factors that affect success in a game. Considering players' anthropometry seems to be crucial at the time of selection and assigning of players to playing positions.

Keywords anthropometric characteristics, playing positions, premier league, volleyball

Introduction

In team sports, the specificities of each player's position must be considered along with their anthropometric characteristics. In volleyball, middle hitters, passer hitters, opposites, setters, and liberos differ in their roles and

require different skills and tactics during matches (Grgantov Padulo, Milić, Ardigò, Erceg, Cular, 2017). Previous studies showed the necessity of players with appropriate anthropometric characteristics, which heavily influence the player's position in the team (Katic et al., 2007; cited in Goran, Majstorovic, Osmankac, Milenkoski, Uslu, 2014).

Tian, (2006), cited in Zhang, (2010), found that the height advantage over the volleyball net always means mastery of the game. He further reported that height is decided by a combination of the athlete's body height and the jumping height, and usually it is shown in blocking height and spiking height. He also explained that if a team does not have net dominance, it will lose its ability to score. Gualdi-Russo and Zaccagni (2001) cited in Zhang (2010) also found that the volleyball players had significantly different anthropometric characteristics according to their game roles. They indicated that the setters were the lightest, the shortest, and the fattest; the spikers were the heaviest; and the second spikers were the tallest.

Trajković, Milanović, Sporiš, Radisavljević, (2011) also found that significant differences exist among youth volleyball players in different playing positions in body height, body weight, and standing reach height. Their finding was supported by Ling (2007), who mentioned that volleyball players at different positions had different anthropometric characteristics, especially in height. Ling (2007) reported the height of prominent volleyball players in the world. The average height of setters was 180–185 cm, of the spikers' 185–190 cm, of the second spikers' 190–200 cm, and of the second setters it was 185–195 cm.

In Ethiopia, though a few researches were conducted in the area of volleyball players, no scientific evidence was generated on female premier league volleyball players regarding their anthropometric characteristics related to their playing positions and hence their current status is not well known. Therefore, the purpose of this study was to investigate the anthropometric characteristics of Ethiopian female premier league volleyball players in relation to playing positions.

Methods

Study Design

The study was conducted using a cross-sectional research design to investigate the anthropometric characteristics of Ethiopian female volleyball premier league players in relation to their playing position.

Subjects

The participants of the study were female volleyball players from Ethiopian premier league clubs, namely Wolaita Sodo University, Maremia Betoch (Federal Prison), Geta Zeru, and National Alcohol Industry clubs. These premier league clubs were actively participating in the 2020/21 Ethiopian Premier League competition year.

Therefore, 42 female volleyball players, with an average age of 25.60 (± 6.4) years old, and with 2.40 (± 2.91) years of project level training experience, 7.62 (± 6.4) years of club level playing experience, 3-6 training days per week, participated.

Procedures

All participants were informed about the objective and methodology of the study, and they voluntarily participated by signing a written informed consent form. Measurements were taken in the month of February 2021, when players were in between the end of preseason and the beginning of the season.

Personal profiles of players like age, project experience, club level playing experience, by week training dates and playing positions were documented by asking the players and cross-checked with the clubs' roster. For each of the variables, the instruments were adopted from different sources.

To achieve the intended outcome of the research, anthropometric measurements were collected from players through practical tests. Height, weight, body length, and circumferences were measured using a tape meter and weighing machine; BMI was calculated by the formula: Body Mass Index = Weight/Height; Skin folds were measured using caliper. Players' positions were: setters (n = 5), middle blockers (n = 7), outside hitters (n = 11), opposite hitters (n = 11), and liberos (n = 8).

All measurements were conducted by skilled, trained, and experienced sport science professionals and volleyball coaches.

Statistical Analysis

The Statistical Package for Social Sciences software (SPSS, version 26) was used to analyze the data. Descriptive statistics and One-Way ANOVA were used to identify the differences among the anthropometric characteristics of the players at different playing positions. Significant mean differences were separated using Tukey B ^{a,b} at 5% (p < 0.05) significance level.

Results

The findings pertaining to the anthropometric characteristics per playing position of female volleyball players are presented in Table 1.

Table 1. Anthropometric measurements by playing position (Mean + SD)

AVs	MB (n = 7)	OpH (n = 11)	OIH (n = 11)	S (n = 5)	L (n = 8)
1	2	3	4	5	6
Standing Height (cm)	174.43 ±4.89	173.91 ±5.22	176.36 ±4.01	166.80 ±6.26	164.00 ±5.98
Sitting Height (cm)	83.57 ±5.77	83.00 ±4.84	84.55 ±3.67	77.40 ±3.91	77.50 ±5.73
Standing Reach Height (cm)	230.00 ±6.22	229.91 ±13.69	232.27 ±5.53	216.00 ±4.9	214.00 ±6.41
Weight (kg)	68.00 ±6.38	63.82 ±12.18	65.73 ±5.97	66.60 ±11.44	61.37 ±10.89
BMI kg/m ²	22.36 ±1.87	21.02 ±3.35	21.12 ±1.78	23.86 ±3.02	22.66 ±2.77
Arm Length (cm)	58.86 ±3.13	57.82 ±2.75	59.18 ±2.96	55.00 ±2.55	54.00 ±3.16
Forearm Length(cm)	28.43 ±1.62	28.09 ±1.87	28.64 ±2.29	26.20 ±0.84	27.38 ±1.41
Upper Arm Length (cm)	36.00 ±2.38	35.00 ±1.84	35.73 ±2.28	32.80 ±2.78	33.25 ±1.67
Leg Length(cm)	92.00 ±3.46	91.82 ±4.09	94.82 ±3.28	85.40 ±3.65	85.00 ±5.13

	1	2	3	4	5	6
Upper Leg Length (cm)		52.00 ±3.96	49.36 ±3.26	51.82 ±2.56	48.00 ±2.45	48.25 ±3.06
Lower Leg Length (cm)		47.00 ±1.53	47.09 ±1.92	48.55 ±1.64	43.60 ±2.07	43.13 ±2.10
Upper Arm Circumference (cm)		28.29 ±2.69	27.18 ±3.03	26.82 ±2.18	27.70 ±1.72	27.75 ±3.66
Forearm Circumference (cm)		24.00 ±1.83	23.45 ±1.44	23.45 ±1.64	23.20 ±1.48	24.00 ±1.93
Chest Circumference (cm)		89.57 ±4.39	87.18 ±6.68	86.55 ±1.64	91.40 ±7.99	86.88 ±6.58
Waist Circumference (cm)		84.14 ±9.51	76.55 ±7.44	77.55 ±5.61	83.40 ±11.97	78.13 ±8.20
Hip Circumference (cm)		99.00 ±6.83	97.91 ±8.29	97.73 ±5.42	98.80 ±10.83	95.63 ±6.61
Calf Circumference (cm)		35.43 ±3.36	34.91 ±2.63	35.73 ±1.74	35.60 ±2.70	35.25 ±4.30
Triceps (mm)		22.57 ±7.09	20.45 ±6.31	20.09 ±4.23	21.00 ±2.24	21.00 ±5.93
Biceps (mm)		18.57 ±6.08	17.27 ±7.5	17.73 ±5.48	21.20 ±3.9	16.88 ±6.73
Sub Scapular(mm)		18.00 ±5.80	18.82 ±6.49	14.64 ±4.78	21.00 ±6.25	16.50 ±3.51
Supra Spinal(mm)		21.29 ±10.24	16.91 ±6.17	15.64 ±5.37	22.20 ±10	19.00 ±7.62
Medial calf		18.43 ±4.20	20.36 ±5.16	20.55 ±4.78	20.80 ±2.39	21.75 ±6.88
Sum skinfold		98.86 ±24.44	93.82 ±26.39	88.64 ±17.81	106.20 ±20.13	95.13 ±25.27

AVs = anthropometric variables, MB = middle blockers, OpH = opposite hitters, OtH = outside hitters, S = setters, L = liberos, sum skin folds = the sum of triceps, biceps, sub scapular, supra spinal and medial calf.

The statistical analysis showed that there were differences in standing height among the playing positions (Table 1). The highest mean standing height was obtained from the outside hitters (OtH) followed by middle blockers (MB) and opposite hitters (OpH), while the lowest was obtained from liberos (L) and setters (S) (Table 1). Similarly, there were differences in sitting height among the playing positions (Table 1). A relatively higher sitting height was recorded for OtH followed by MB and OpH while the lowest was recorded for S and L.

Alike the above, the statistics of standing reach indices differentiate female volleyball players of one playing position from the others. The highest mean standing reach was recorded for OtH followed by MB and OpH, whereas the lowest was recorded for S and L (Table 1). Body weight and BMI were taken as two comparative variables for players at different playing positions. A relatively higher body weight was recorded for MB followed by S, OtH, OpH, and L. The result revealed that MB had a relatively higher body weight while L had a relatively lower body weight. On the other hand, a relatively higher BMI was recorded for S followed by L, MB, OtH and OpH (Table 1).

As presented in Table 1, OtH players had relatively higher mean arm length, forearm length, leg length, and lower leg length than other players, while MB players had relatively higher mean upper arm length and lower leg

length than other players. On the contrary, S and L had relatively lower arm and leg lengths. But, OpH players had medium body length.

There was a slight difference in body circumference among female volleyball players by their positional category. MB position players had relatively higher mean upper arm, forearm, waist, and hip circumferences compared to other positions. Whereas, OtH players had relatively higher mean calf circumference but lower mean upper arms, chests, waists, and hips. On the other hand, OpH players had comparatively lower mean upper arm, waist, and calf circumferences and moderate forearm, chest, and hip circumferences compared with other position players. While L players had relatively higher mean upper arm, forearm, moderate waist, and small chest, hip, and calf circumference (Table 1). S players had relatively large mean chest, waist, hip, and calf circumferences, moderate upper arm, and low forearm circumferences.

The statistical analysis on skinfold measurement (Table 1) indicated that S had relatively larger biceps, subscapular, supraspinal and sum skinfolds while MB had relatively higher triceps, moderate biceps, subscapular, supraspinal, and sum skinfolds, and a low medial calf average score. In addition, OpH and OtH had relatively similar mean skinfold measurements except subscapular (OpH moderate and OtH low). They had relatively low mean values in triceps, supraspinal and sum skinfold and moderate mean values in biceps and medial calf (Table 1).

Table 2. Base measurements by playing position (Mean difference)

PPs	StH	SiH	SrH	W	BMI
MB	174.43a	83.57ab	230.00a	68.00a	22.36a
OpH	173.91a	83.00ab	229.91a	63.82a	21.02a
OtH	176.36a	84.55a	232.27a	65.73a	21.12a
S	166.80b	77.40b	216.00b	66.60a	23.86a
L	164.00b	77.50b	214.00b	61.38a	22.66a
p	***	**	***	NS	NS

** = significant at $p < 0.01$; *** = significant at $p < 0.000$, NS = none significant $p > 0.05$; PPs = playing positions of players, StH = standing height, SiH= sitting height, SrH = standing reach height, W = weight, MB = middle blockers, OpH = opposite hitters, OtH = outside hitters, S = setters, L = liberos.

Analysis of variance showed highly significant differences in StH, SiH and SrH among the playing positions but no significant difference in W and BMI (Table 2). Hence, the highest StH and SiH were obtained from OtH followed by MB and OpH while the lowest was from L for StH and S for SiH (Table 2). However, the mean StH, SiH and SrH were at par for OtH, MB and OpH. In addition, there was no significant difference between S and L in StH, SiH, and SrH (Table 2).

Table 3. Length measurements by playing position (Mean difference)

PPs	AL	FAL	UAL	LL	ULL	LLL
MB	58.86ab	28.43a	36.00a	92.00a	52.00a	47.00a
OpH	57.82abc	28.09a	35.00ab	91.82a	49.36a	47.09a
OtH	59.18a	28.64a	35.73ab	94.82a	51.82a	48.55a
S	55.00bc	26.20a	32.80b	85.40b	48.00a	43.60b
L	54.00c	27.38a	33.25ab	85.00b	48.25a	43.13b
p	***	NS	**	***	NS	***

** = significant at $p < 0.01$; *** = significant at $p < 0.001$; NS = none significant $p > 0.05$; PPs = playing positions of players, AL= arm length, FAL= forearm length, UAL= upper arm length, LL = leg length, ULL= upper leg length, LLL= lower leg length, MB = middle blockers, OpH = opposite hitters, OtH = outside hitters, S = setters, L= liberos.

Analysis of variance showed highly significant differences in AL, FAL, UAL, LL and LLL for players in different playing positions while no significant difference was observed in ULL (Table 3). The highest AL, FAL, LL and LLL were measured for OtH followed by MB whereas the lowest AL, FAL, UAL, LL and LLL was measured for L playing position (Table 3). However, the difference in length measurements was at par for MB, OpH and OtH playing positions. The highest UAL was measured from between MB followed by OtH and OpH while the lowest was measured for S playing position.

Table 4. Circumference measurements in different playing positions (Analysis of variance)

PPs	UAC	FAC	ChC	WC	HC	CC
MB	28.29a	24.00a	89.57a	84.14a	99.00a	35.43a
OpH	27.18a	23.45a	87.18a	76.55a	97.91a	34.91a
OtH	26.82a	23.45a	86.55a	77.55a	97.73a	35.73a
S	27.70a	23.20a	91.40a	83.40a	98.80a	35.60a
L	27.75a	24.00a	86.88a	78.13a	95.63a	35.25a
p	NS	NS	NS	NS	NS	NS

NS = None significant difference $p > 0.05$; PPs = playing positions of players; UAC = upper arm circumference; FAC = forearm circumference; ChC = chest circumference; WC = waist circumference; HC = hip circumference; CC = calf circumference; MB = middle blockers; OpH = opposite hitters; OtH = outside hitters; S = setters, L = liberos.

No significant difference was observed in circumference and skin fold measurements between players in different playing positions (Table 4 and 5).

Table 5. Skin fold measurements in different playing positions (Analysis of variance)

PPs	Tr	Bi	Sub	Sup	Me	∑5SF
MB	22.57a	18.57a	18.00a	21.29a	18.43a	98.86a
OpH	20.45a	17.27a	18.82a	16.91a	20.36a	93.82a
OtH	20.09a	17.73a	14.64a	15.64a	20.55a	88.64a
S	21.00a	21.20a	21.00a	22.20a	20.80a	106.20a
L	21.00a	16.88a	16.50a	19.00a	21.75a	95.13a
p	NS	NS	NS	NS	NS	NS

NS = None significant difference $p > 0.05$; PPs = playing positions of players, Tr = triceps, Bi = biceps, Sub = sub scapular, Sup = supra spinal, Me = medial calf, ∑5SF = sum of s skin folds, MB = middle blockers, OpH = opposite hitters, OtH = outside hitters, S = setters, L = liberos.

Discussion

Female volleyball players’ anthropometric characteristics are influenced by role specialization. Considering the specialized and different roles of each position, it is likely that differences exist and are desired in anthropometric profiles among the playing positions to optimize performance (Mielgo-Ayuso, Calleja-González, Clemente-Suárez, Zourdos, 2015) and provide important prerequisites for outstanding performance (Stamm Veldre, Stamm, Thomson, Kaarma, Loko, Koskel, 2003). Thus, this study aimed to investigate the anthropometric characteristics of female premier league volleyball players in relation to playing positions. The information obtained provides a general picture of the players’ characteristics in relation to their position.

Female volleyball players in various playing positions differed significantly in standing height, sitting height, and standing reach height, whereas no significant differences were found in body mass and body mass index between players in different positions. Middle blockers, outside-hitters, and opposites are taller and have higher standing reaches than setters and liberos. These results confirm previous investigations in relation to female volleyball players’ position (Gualdi-Russo Zaccagni, 2001; Malousaris Bergeles, Barzouka, Bayios, Nassis, Koskolou, 2008; Zhang, 2010; Carvajal et al., 2012; Martin-Matillas et al., 2014; Palao, Manzanares, Valadés, 2014; Milić et al., 2017).

As stated by Vujmilović and Karalić (2014), from the point of modern volleyball, very tall females have an objectively greater prospective for successful engagement in volleyball, which every year becomes more of a “privilege” for tall male and female players. But Ethiopian volleyball players are lower than Italian, Greek, Chinese, Cuban, and Spanish female volleyball team players (Palao, Manzanares, Valadés, 2014), Spanish Super-League female volleyball players (Mielgo-Ayuso et al., 2015), and African, American, Asian, Chinese, and European female volleyball players (Zhang, 2010) by their height and weight of all playing position players.

Concerning body length measurements, in the current investigation, significant differences were observed between volleyball players by their positional differences. Thus, setters and liberos showed relatively lower arm and leg lengths, while middle blockers, outside hitters, and opposite hitters showed relatively higher arm and leg lengths. This is related to that of height measurements.

With regard to body circumferences, no significant difference was observed among Ethiopian volleyball players by their playing position. These results contradict those of Mielgo-Ayuso et al. (2015). In this study, players

at all positions showed relatively higher body circumferences than Spanish Super-League female volleyball players (Mielgo-Ayuso et al., 2015).

In the current study, no significant differences were observed among volleyball players by their playing positions in five skinfold measurements. Like body circumference measurement results; this also contrasts with the results of the findings of Zhang (2010) and Mielgo-Ayuso et al. (2015). Their finding indicates significant differences between volleyball players in skinfold measurement.

Conclusion

Appropriate anthropometric characteristics are one criterion to determine the playing position of players at the time of the game. Regarding this, Katic et al., (2007), mentioned that volleyball players required enhancing their motor, technical, and tactical abilities and skills in individual, group, and collective aspects. Besides that, it requires players with appropriate anthropometric characteristics, which largely determine the position of the player on the team. In the current research, significant differences were observed in standing height, sitting height, standing reach height, and arm and leg lengths among female volleyball players in different playing positions. But, significant differences were not shown by weight, BMI, body circumferences, and skinfold measurement between players in different playing positions.

Although Ethiopian female volleyball players in five playing positions are lower than other world female volleyball players by their anthropometric characteristic measurements, this may be considered one factor which affects their success in a game. Considering players' anthropometry seems to be crucial at the time of selection and assigning of players to playing positions.

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