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Research Article

HAND ANTHROPOMETRIC MEASUREMENT AND GRIP STRENGTH FOR BASKETBALL AND VOLLEYBALL PLAYERS IN HIGHER INSTITUTIONS IN PORT HARCOURT METROPOLIS

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Abstract

This cross-sectional study was performed to compare hand anthropometric measurements and grip strength among two different sports. The study group was composed of 41 basketball players(21 males, 20 females) and 39 volleyball players(20 males, 19 females), aged between 19-30 years. A Vernier Caliper (Shan, 200mm) with resolution of 0.01m/0.0005 inch was used for hand anthropometric measurement. During measurements values for each hand were obtained. Eight parameters were evaluated for each hand. For statistical analyses, One Way ANOVA for parametric conditions and Kruskal-Wallis Variance Analyses for subgroup which were nonparametric conditions were performed. The differences between the groups were evaluated with post hoc Bonferroni adjustments. Statistically significant differences were observed between basketball and volleyball players in right-hand and left-hand width, right and left digit index, hand length/height ratio. In females, significant differences were also observed in right- and left-hand width, third finger length, and grip strength. Male basketball players recorded higher grip strength compared to volleyball players, while female basketball players also demonstrated stronger grip than female volleyball players. These findings suggest different sports could constitute different effects on hand anthropometric measurements and grip strength.

Keywords: Hand anthropometry; Grip strength; Basketball; Volleyball.

INTRODUCTION

The human hand is a complex structure adapted for both fine motor skills and power functions. Its morphology and biomechanical capabilities enable grasping, manipulation, and performance of sports-specific tasks[1]. Grip strength is considered a reliable measure of overall musculoskeletal fitness and has been associated with athletic performance, nutritional status, and even long-term health outcomes[2]. Hand anthropometry is a systematic measurement of hand dimensions such as length, breadth, and finger span provide valuable data for ergonomics, prosthetics, and sports sciences[3]. Several studies have shown that hand dimensions influence grip strength, which in turn impacts success in sports requiring ball handling and throwing[4]. Basketball and volleyball, in particular, place high demands on hand size and grip ability[5]. Previous research demonstrated that basketball players tend to have larger hand spans, enabling better ball control and passing, whereas volleyball players rely more on explosive arm strength for spiking and serving[6]. Barut et al.[1] reported significant differences in grip strength across athletes in basketball, volleyball, and handball. Similarly, Fallahi and Jadidian[3] found correlations between hand dimensions and grip strength among grip athletes. However, most studies were conducted in non-African populations, leaving limited data on Nigerian athletes[7]. Given the increasing participation of Nigerian youths in basketball and volleyball, it is essential to understand how hand anthropometry and grip strength vary across these sports.

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MATERIALS AND METHODS

A total of 80 participants were selected: 41 basketball players (21 males, 20 females) and 39 volleyball players (20 males, 19 females), aged 19–30 years. There are two major basketball and volleyball courts in the metropolis: the University of Port Harcourt Basketball court and Ignatius Ajuru Basketball court. These courts serve as the major game center for various players involved in these games. Individuals and Players that play in these courts or are a member of the school's team during this study period was sampled.

The sample size is based on the calculation for reference population more than 10,000[8]

$$S = \frac{z^2 \times Pq}{d^2}$$

Where: S= desired sample size (population more than 10,000)
Z= standard normal deviation, usually set at 1.96 and corresponds to a confidence level of 95%.
P= the proportion of the target population estimated to have a particular characteristic, 50% is used when there is no reasonable estimate.

q= 1 – P = 0.5
d= degree of accuracy desired, usually set at 0.03

Therefore,

$$\frac{1.96^2 \times 0.5^2}{0.05^2} = 384.16$$

Adjusted sample size for a population of 10,000

= (S)
1+ [(S – 1) / population]
= 384.16
1+'[(384.16-1)/10000] = 370
1+ [(384.16-1)/100] = 79.51

A total of 80 subjects were used as sample for this study.

Method of collection

A digital Vernier Caliper was used for anthropometric measurements. Measurements were taken from the palmar side with digits fully stretched flat, and the thumb slightly extended. For each hand, 7 parameters related to hand dimensions and ratios were evaluated. Hand width, hand length, 3rd digit length and body height were measured with the method stated by Pheasent[9]. The hand length/body height ratio, the shape index which determines the hand shape, the digit index which determines grasping capability and palmar length/width ratio which determines palmar type without the digits were also assessed.

Palmar length: The palmar length defined as the distance between the midpoint of the distal wrist crease and the midpoint of the proximal digit crease, was calculated according to the formula hand length minus 3rd digit length. (hand length-3rd digit)

Fig. 1. Illustration of hand length measurement using a Vernier Caliper, taking from the distal wrist crease to the tip of the middle finger

Shape index (length-width index, hand index): This measures the overall hand shape, with small values indicating a slender hand and large values indicating a wide hand. Hand width x 100/Hand length.

Digit index (phalangeal index): This ratio measures lengths of different digits or fingers of the hand. Measurement for digit was taken from the distal tip of the 3rd digit to the mid of proximal wrist. 3rd digit length x 100/hand length.

Fig. 2. Illustration of hand span measurements using the Vernier Caliper during maximum abduction

Palmar length/width ratio: Ratio of the palmar length (from the proximal end of 3rd digit to mid of proximal wrist) and the palmar width. Palmar length/Palmar width (Palmar width = Hand width).

Hand length/height ratio: Ratio of hand length (total number of 3rd digit and palmar length) and height.Hand length/Body height.

Body weight: was measured using a standard scale with light clothing on and without any footwear.

Height: was measured with the individual in upright position in front of a wall looking ahead and heels touching one another.

Fig. 3. Measurement of Height

Grip strength

A digital hand dynamometer (Takei) was used to measure the grip strength. The participant was asked to stand upright, and arm was extended to 90 degrees with the forearm flexing at 90 degrees above. The participants were asked to squeeze the dynamometer three times with each hand. There will be a one-minute resting period between each squeeze to overcome fatigue. The mean value of three squeezes was considered.

Fig. 4. Grip strength assessment using a Digital Hand Dynamometer

Statistical analysis

Statistical analyses were performed with SPSS for windows Release 11.01. Statistical comparisons of sub-groups for parametric and non-parametric conditions were performed using Analyses of Variance (One Way ANOVA) and Kruskal-Wallis Variance Analyses respectively. The differences within the groups were evaluated with post hoc Bonferroni adjustment.

RESULTS

The Results are presented in tables 1-6

Table 1. Comparison of Left-hand and Right-hand grip strength of Male and Female for both Sport Players

Grip strength	Basketball (n=41) Mean ± SD	Volleyball (n=39) Mean ± SD
Male Left	39.64 ± 9.90	39.24 ± 9.33
Male Right	41.64 ± 11.12	39.51 ± 9.79
Female Left	32.50 ± 7.51	27.96 ± 8.05
Female Right	33.05 ± 6.69	31.84 ± 9.92
P-Value (0.0000329462)		

Analysis of variance (One way ANOVA Test), Post Hoc test (Bonferroni correction 0.008333333). α=0.05,

Table 2. Grip Strength Comparison for All Players

Gender grip strength/sports	Basketball Mean ± SD	Volleyball Mean ± SD
Male	40.64 ± 10.48	39.38 ± 9.48
Female	32.78 ± 6.93	30.00 ± 9.05
P-value (0.0000329462)		

Analysis of variance (One way ANOVA Test), Post Hoc test (Bonferroni correction 0.008333333). α=0.05,

Table 3. Comparison of Male Left- & Right-Hand Parameter

Gender/hand parameter	Male left hand		Male right hand	
	Basketball Mean ± SD	Volleyball Mean ± SD	Basketball Mean ± SD	Volleyball Mean ± SD
Hand length (mm)	207.034 ± 11.29	193.32 ± 14.52	205.71 ± 11.54	185.95 ± 37.49
Hand width (mm)	95.99 ± 4.66	87.08 ± 12.46	98.09 ± 11.48	88.63 ± 19.11
Palmar length (mm)	117.72 ± 11.51	110.91 ± 13.44	116.19 ± 11.48	109.08 ± 22.62
Digit length (mm)	92.63 ± 7.94	85.08 ± 14.10	91.08 ± 8.73	81.68 ± 19.22
Height (mm)	1847.23 ± 86.12	1786.95.74.81	1847.23 ± 86.12	1776.52 ± 322.41
Digit index (mm)	96.66 ± 8.90	97.69 ± 10.90	93.12 ± 9.78	92.11 ± 18.46
Shape index (mm)	46.41 ± 1.96	44.93 ± 4.71	47.74 ± 2.62	47.85 ± 9.62
Palmar length/width ratio (mm)	1.79 ± 0.48	1.93 ± 0.56	1.74 ± 2.62	1.85 ± 0.56
Hand length/height (mm)	0.11 ± 0.00	0.11 ± 0.01	0.11 ± 0.00	0.11 ± 0.02
Grip strength (kg)	39.64 ± 9.88	39.25 ± 9.33	41.64 ± 11.12	39.51 ± 11.81

Table 4. Comparison of Female Left and Right-Hand Parameters

Gender/hand parameter	Female left hand		Female right hand	
	Basketball Mean ± SD	Volleyball Mean ± SD	Basketball Mean ± SD	Volleyball Mean ± SD
Hand length (mm)	201.11 ±7.33	185.33 ± 16.12	201.44 ± 6.99	177.51 ± 21.86
Hand width (mm)	89.30 ± 9.42	77.9 ± 13.30	91.80 ± 9.01	83.97 ± 15.07
Palmar length (mm)	113.20 ± 10.04	105.37 ± 14.32	111.57 ± 9.10	109.98 ± 10.92
Digit length (mm)	88.23 ± 6.71	79.86 ± 1330	100.40 ± 32.07	79.56 ± 10.92
Height (mm)	1768.12 ± 88.01	1699.76 ± 127.78	1768.12 ± 88.01	1704.64 ± 122.80
Digit index (mm)	99.73 ± 12.37	102.69 ± 8.34	109.55 ± 32	96.73 ± 17.81
Shape index (mm)	44.33 ± 3.55	41.78 ± 4.38	45.52 ± 3.51	47.70 ± 9.62
Palmar length/width ratio (mm)	1.74 ± 0.58	1.96 ± 0.59	1.69 ± 0.55	1.81 ± 0.55
Hand length/height (mm)	0.11 ± 0.01	0.11 ± 0.02	0.11 ± 0.01	0.10 ± 0.01
Grip strength (kg)	32.50 ± 7.51	27.96 ± 8.05	33.05 ± 6.69	31.84 ± 9.92

Table 5. Comparison of Hand Parameters for All Players

Gender/hand parameter	Basketball left Mean ± SD	Basketball right Mean ± SD	Volleyball left Mean ± SD	Volleyball right Mean ± SD
Hand length (mm)	205.62 ± 10.71	204.69 ± 10.71	191.43 ± 15.09	183.28 ± 19.14
Hand width (mm)	94.40 ± 6.65	96.59 ± 7.16	84.91 ± 13.09	87.16 ± 13.84
Palmar length (mm)	116.65 ± 11.23	115.09 ± 11.04	109.60 ± 13.07	108.94 ± 13.20
Digit length (mm)	91.58 ± 7.82	93.29 ± 17.3	83.85 ± 14.81	81.24 ± 14.64
Height (mm)	1828.395 ± 92.04	1828.40 ± 92.04	1766.30 ± 95.80	1755.69 ± 103.07
Digit index (mm)	97.39 ± 9.76	97.03 ± 18.72	98.88 ± 10.50	93.70 ± 13.57
Shape index (mm)	45.92 ± 2.55	47.21 ± 2.10	44.18 ± 4.78	47.80 ± 7.10
Palmar length/width ratio (mm)	1.78 ± 0.50	1.73 ± 0.50	1.94 ± 0.56	1.86 ± 0.56
Hand length/height (mm)	0.11 ± 0.01	0.11 ± 0.01	0.11 ± 0.01	0.11 ± 0.01
Grip strength (kg)	37.94 ± 9.78	39.60 ± 10.82	36.57 ± 10.18	37.40 ± 10.40

Table 6. Comparison of Grip strength of other study to grip strength of current study

References	Study Location	Grip Strength Parameters (kg)	Results
Barut *et al.,* 2003	Zonguldak University, Turkey	Male Basketball (Right hand)	23.64 (10.62)
		Male Basketball (Left hand)	22.52(10.03)
		Male Volleyball (Right hand)	24.41(10.41)
		Male Volleyball (Left hand)	23.36(9.87)
		Male Handball (Right hand)	25.92(9.92)
		Male Handball (Left hand)	24.40(9.72)
		Female Basketball (Right hand)	18.23(4.34)
		Female Basketball (Left hand)	18.15(4.10)
		Female Volleyball (Right hand)	18.89(4.00)
		Female Volleyball (Left hand)	18.76(4.25)
		Female Handball (Right hand)	23.17(3.20)
		Female Handball (Left hand)	22.89(3.12)
Sandhu *et al.,* 2017	Punjab, India	Male (dominant) grip strength	32.90
		Female (dominant) grip strength	25.16
Sengupta *et al.,* 2011	Bengal, India	Male (dominant) grip strength	43.2 (8.3)
		Female (dominant) grip strength	27.0 (5.2)
Wang *et al.,* 2018	United States	Male (dominant hand)	49.7
		Female (dominant hand)	18.7
Present Study	Port Harcourt, Nigeria	Male Basketball (Right hand)	41.64 (11.12)
		Male Basketball (Left hand)	39.64 (9.88)
		Male Volleyball (Right hand)	39.51(11.81)
		Male Volleyball (Left hand)	39.25(9.33)
		Female Basketball (Right hand)	33.05(6.69)
		Female Basketball (Left hand)	32.50 (7.51)
		Female Volleyball (Right hand)	31.84(9.92)
		Female Volleyball (Left hand)	27.96 (8.05)

DISCUSSION

Physical activities and sports have an important role not only in proper growth and maturation of the child but may also delay the physical frazzle which might occur with the advance of age[10]. There are various studies concerning the effects of sports on anthropometric measurements and physical status of the human body[11]. In this study the effect of two different sports branches on the hand morphology and function was evaluated. In the study of Barut *et al.,* (2008)[1], which the study was evaluation of hand anthropometric measurement and grip strength in basketball, volleyball and handball in Zonguldak university, Turkey, where anthropometric parameters of volleyball, basketball and handball players aged 19 -18 years were investigated, it was stated that there were statistically significant differences in right and left hand shape indices, right and left hand length/ height ratio values between male basketball, volleyball and handball players and that the difference between basketball and handball groups was the reason of the significance which correlates with the present study that there was also statistically significance difference between the right and left shape indices, left and right Palmar length and left and right-Hand length/height ratio of the male for basketball and volley ball players, but the difference between the basketball and volleyball was the reason for the significance.

Barut et al (2008)[1] in their study also presented that there were no significant differences between the groups when males and the whole study group were considered for the hand grip values and that volleyball players had the greatest grip strength among males. The handball players had the greatest grip strength when the whole study group was considered. Hand grip strength of female handball players was significantly higher than the other females. In the present study, the male right hand basketball players had the highest grip strength when compared to other basketball players both for male and female basketball players. The female basketball players also had significantly higher grip strength compared to volleyball players, and this could be because of the continuous handling of the ball that the sports require and this results were obtained, there was no significant difference between the shape indices for the right hand of the males for both the basketball and volleyball but a significant difference in the shape indices for the left hand of males for both sports which may be due to the minimum usage of the left hand by both sports with the basketball players using it more than the volleyball players and this also agrees with Barut's study of significant differences for shape indices across the various sports.

Sandhu et al., (2017)[4] in his study, 'Anthropometric determinants of hand grip strength in normal healthy Punjabis', where anthropometric measurements were taken to determine handgrip strengths for both male and female in relation to their body dimensions recorded that the males had higher hand grip strength than females with measurements of 32.90kg and 25.16kg respectively which agrees with the present study that there is markedly significant difference between male and females. In another study by Sengupta et al., (2011)[12] done to measure grip strength of the Adult Bengalee population revealed that male subjects had a significantly greater ($p<0.001$) grip strength compared to that of female subjects and the highest grip strength was found in standing posture with elbow angle of 90^0 in both adult male and female which again supplements the findings of the present study although the grip strength was taking while subjects were sitting.

Wang et al., (2018)[5] recorded higher grip strength for males than females in the United States from ages of 18 -85 with the measurements presenting 49.7kg for the dominant hand of males and 18.7kg for the dominant hand of females and although it correlates with the present study, it records markedly significant difference between the established results and this could be as a result of ethnic factors influencing it as well as weather and genetic makeup. The handgrip strength shows difference probably because of the frequency, intensity, volume and mode of strength training[13], but also years of practice could be the cause of this hand variation. During play both hands are used in techniques and tactics such as left- and right-hand rebounding, lay ups, deflection, passing, fake and

faints. Handgrip strength is a basilar component in defensive and offensive maneuvers, and the repetition of these tasks is an athletic career effect. In fact, the findings showed a handgrip strength trend increase in both hands. This data underlines that constant practice may be pivotal for increasing hand strength. Findings underline that height is independent of hand length values. Although height is the most important physical characteristic in basketball players and sometimes volleyball players, it is not related to hand width dimensions. In our study hand length showed low positive correlations with both handgrip strength values as an increasing hand length showed a decreasing handgrip strength, whereas hand width increased with handgrip strength. Since handgrip strength is crucial for athletic performance improvement[14], it is important to underline that higher conditioning effects on handgrip strength are achieved more with basketball players than with volleyball players. These results confirm that athletes with specific body anthropometric values might have biomechanical advantages with respect to handgrip strength. Anatomically, gripping activities are supported by the wrist and a few muscles of the hand which include, flexor digitorium profundus (FDP), flexor pollicis longus (FPL) and the extensor digitorium communis (EDC) and major contribution from the forearm muscles. Exercises that will aid in strengthening the grip strength include tennis ball squeezing, towel wringing, reverse wrist curls, farmer's carry, pull ups, etc. Finally, in this study it could be suggested that the reason for most of the differences was the basketball group, as basketball requires more usage of hands compared to volleyball.

Conclusion

This study has shown the anthropometric and hand strength parameters for volleyball and basketball players in students of higher institutions in Port Harcourt. Particularly, this study provides evidence about the influence of hand metrics (height, weight and shape indices) on handgrip strength as well as their variations in each sport. Basketball players exhibited significantly greater hand spans and grip strength compared to volleyball players in Port Harcourt, Nigeria. Males consistently outperformed females. These results highlight the role of hand anthropometry in determining grip strength and sports performance. Grip strength measurement may serve as a useful tool for talent identification and training optimization in Nigerian athletes.

REFERENCES

1. Barut Ç, Demirel P, Kiran S. Evaluation of hand anthropometric measurements and grip strength in basketball, volleyball and handball players. *Anatomy*, 2008;2(1):55–59.
2. Ling CY, Taib MN, Rasdi H, Sapuan S, Wong SV. Handgrip strength: A reliable clinical parameter for estimating physical strength. *International Journal of Sports Med*. 2010;31(8):585–9.
3. Fallahi AA, Jadidian AA. The effect of hand dimensions, hand shape and some anthropometric characteristics on handgrip strength in male grip athletes and non-athletes. *Journal of Human Kinetics*. 2011; 29:151–159.
4. Sandhu, J.S., Gandhi, M. &Koley, S., Anthropometric determinants of hand grip strength in normal healthy Punjabis. *Journal of Exercise Science and Physiotherapy*, 2017;13(1), pp.10–16.
5. Wang, Y.C., Bohannon, R.W., Li, X. & Sindhu, B., Normative reference values for hand-grip strength in US adults aged 18–85 years. *Journal of Strength and Conditioning Research*, 2018;32(3), pp.567–573.
6. Pizzigalli L, Cremasco MM, La Torre A, Rainoldi A, Benis R. Handgrip strength and anthropometric characteristics in young female basketball players. *J Strength Cond Res.* 2016;30(8):2324–2331.
7. Balogun, J.A., Akinloye, A.A., Marzouk, D.K. & Oyeyemi, A.Y., Grip strength in Nigerian athletes: normative values and determinants. *African Journal of Medicine and Medical Sciences*, 1991;20(1), pp.17–23.
8. Isreal G.D. Determining sample size. University of Florida, IFASExtension*;* 2009; PEOD6. Available at https//www. psycholosphere.com/Determining%20sample%20size%20by%20 Glenn%20Israel.pdf
9. Pheasent S. Anthropometrics: An Introduction. United Kingdom: British Standards Institution; 1990. p. 18-9
10. Colak, T., Influence of physical activity on growth and development. *Journal of Sports Medicine and Physical Fitness*, 1995;35(1), pp.1–5.
11. Lozovina, M. &Pavičić, L., Anthropometric changes in elite male water polo players: longitudinal study. *Collegium Antropologicum*, 2004;28(1), pp.335–343.
12. Sengupta, P., Sahoo, S., Sahoo, S. & Pal, A.K., Anthropometric determinants of hand grip strength in adult Bengalee population. *Asian Journal of Sports Medicine*, 2011; 2(3), pp.146–150.
13. Kılınç, F. The effect of different strength training methods on handgrip strength. *Journal of Physical Education and Sport Sciences*, 2008;10(3), pp.45–52.
14. Mohamed, O., Zidan, N. & El-Sayed, R., The relationship between handgrip strength and physical performance in athletes. *Journal of Sports Science and Medicine*, 2009;8(4), pp.567–572.

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