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Original Research Article

Correlation between Handgrip Strength and Selected Anthropometric Parameters in Athletes and Nonathletes

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Abstract

Handgrip strength is a reliable predictor of muscular strength and proper hand functioning. The aim of this study was to compare and correlate between handgrip strength and selected anthropometric variables in Nigerian athletes and non-athletes of both sexes. A cross-sectional, descriptive study was carried out on 62 athletes and 80 non-athletes in the age range of 18-30 years among the students of the University of Port Harcourt. Handgrip strength was measured using an electronic hand dynamometer. Anthropometric variables used were mid-arm circumference, arm length, forearm length, hand length and hand width. An independent samples t-test was used to compare between both sexes in each subject category in both dominant and non-dominant handgrip strength. Also, an independent samples t-test was used to compare differences in anthropometric variables between both sexes in each subject category. A Pearson's correlation was used to determine the relationship between handgrip strength and anthropometric variables in both athletes and non-athletes. The findings from this study showed that athletes had a significantly higher handgrip strength mean values compared to non-athletes. Strong positive correlations were shown handgrip strength and most anthropometric variables used in the study. It was concluded that handgrip strength was higher in people engaged in sports and it showed significant relationship with anthropometric variables.
Keywords: Handgrip strength; muscular strength; hand functioning; anthropometric variables.

INTRODUCTION

Handgrip strength is known to be the maximal power of forceful flexing of the fingers occurring under bio-kinetic conditions [1]. It is a reliable assessment tool in determining the muscular strength of an individual [2, 3]. Because of the manipulative ability of the hand in various physical or sporting activities, it is highly susceptible to musculoskeletal problems such as upper limb disorders or injuries [4]. Various researchers have conducted studies to show the relationship between handgrip strength and human anthropometric dimensions such as height, weight, limb lengths, etc [5, 6]. There is no doubting the fact that the relevance of these anthropometric dimensions with respect to sporting activities is critical in sports ergonomics and numerous works have been done across various populations to examine the effect of these anthropometric dimensions on handgrip strength [7-9]. There is however need for such study to be carried upon in a Nigerian population given the fact that Nigeria is one of the leading sporting countries in the world. The aim of this study was to compare and correlate between handgrip strength and selected anthropometric variables in Nigerian athletes and non-athletes.

MATERIALS AND METHODS

This cross-sectional study was conducted after it was approved by the Ethics Committee of the University of Port-Harcourt. It was carried out on 62 athletes and 80 non-athletes in the age range of 18-30 years. All participants were students of the University of Port-Harcourt and athletes that partook in this study were involved in sporting activities such as weightlifting, basketball, handball and tennis. Exclusion criteria were subjects with a history of upper limb injuries, disorders or have had surgical operations in the hand. An informed consent was obtained.

Handgrip Strength

Handgrip strength was measured using an electronic hand dynamometer. Participants were asked to sit properly with their elbow flexed at 90 degrees and the forearm in mid-prone on an armrest [10]. Participants were later told to squeeze the dynamometer

tightly and an average of three (3) readings was recorded.

Hand Length and Width

Hand length was measured as the distance from the tip of the middle finger to the distal wrist crease. Hand width was taken from the radial side of the index finger to the ulnar end of the small finger. Both measurements were taken using a metre rule.

Arm Length and Forearm length

Arm length was measured in 90 degrees bended elbow from the acromial end of the clavicle to the tip of the olecranon process [11]. Forearm length was measured from the tip of the olecranon process to the point between the radial and ulnar tuberosity [12]. A non-flexible measuring tape was used to take these measurements.

Statistical Analysis

Data analysis was presented in tables. An independent samples t-test was used to compare between both sexes in each subject category in both dominant and non-dominant handgrip strength. Also, an independent samples t-test was used to compare differences in anthropometric variables between both sexes in each subject category. Finally, a Pearson's correlation was used to determine the relationship between handgrip strength and anthropometric variables in both athletes and non-athletes. A 0.05 level of probability was used to indicate statistical significance. All these were carried out with the aid of the Statistical Package for the Social Sciences (SPSS) version 23.0.

RESULTS

In Table-1, the means and standard deviations for dominant and non-dominant handgrip strength in the male category were 43.46±5.45 and 38.72±5.24 respectively while that of the female category were 36.50±3.90 and 32.19±4.01, respectively.

Table-1: Descriptive statistics of Handgrip Strength (HGS) in athletes

HGS (kgf)	Sex	*N*	Mean	S.D	*p*-value
Dominant HGS	M	38	43.46	5.45	Significant
	F	24	36.50	3.90	
Non-dominant HGS	M	38	38.72	5.24	Significant
	F	24	32.19	4.01	

Significant at p ≤ 0.05

In Table-2, the means and standard deviations for dominant and non-dominant handgrip strength in the male category were 38.48±3.39 and 33.83±3.36 respectively while that of the female category were 28.82±2.84 and 23.31±3.13, respectively.

Table-2: Descriptive Statistics of Handgrip Strength (HGS) in non-athletes

HGS (kgf)	Sex	*N*	Mean	S.D	*p*-value
Dominant HGS	M	46	38.48	3.39	Significant
	F	34	28.82	2.84	
Non-dominant HGS	M	46	33.83	3.36	Significant
	F	34	23.31	3.13	

Significant at p ≤ 0.05

In Table-3, the male category had mean and standard deviation values such as mid-arm circumference (24.11±2.58), arm length (31.78±1.47), forearm length (28.82±1.48), hand length (19.45±1.50) and hand width (9.05±0.81). With exception to mid-arm circumference, these values were significantly higher in males compared to females at p ≤ 0.05.

Table-3: Descriptive Statistics of Anthropometric Parameters in athletes

ANTHROPOMETRIC PARAMETERS	Sex	*N*	Mean	S.D	*p*-value
Mid-arm Circumference (cm)	M	38	24.11	2.58	Not significant
	F	24	22.79	2.63	
Arm Length (cm)	M	38	31.78	1.47	Significant
	F	24	29.59	1.90	
Forearm Length (cm)	M	38	28.82	1.48	Significant
	F	24	26.23	1.59	
Hand Length (cm)	M	38	19.45	1.50	Significant
	F	24	18.23	1.10	
Hand Width (cm)	M	38	9.05	0.81	Significant
	F	24	8.21	0.62	

Significant at p ≤ 0.05

In Table-4, the male category had mean and standard deviation values such as mid-arm circumference (23.25±1.27), arm length (31.53±1.62), forearm length (26.97±1.42), hand length (18.78±0.97) and hand width (8.56±0.56). They all were significantly higher in males compared to females at p ≤ 0.05.

Table-4: Descriptive Statistics of Anthropometric parameters in non-athletes

ANTHROPOMETRIC PARAMETERS	Sex	*N*	Mean	S.D	*p*-value
Mid-arm Circumference (cm)	M	46	23.25	1.27	Significant
	F	34	20.95	1.28	
Arm Length (cm)	M	46	31.53	1.62	Significant
	F	34	29.32	1.49	
Forearm Length (cm)	M	46	26.97	1.42	Significant
	F	34	25.33	1.30	
Hand Length (cm)	M	46	18.78	0.97	Significant
	F	34	17.52	0.80	
Hand Width (cm)	M	46	8.56	0.56	Significant
	F	34	7.76	0.60	

Significant at p ≤ 0.05

In Table-5, in the male athlete category, there was a positive correlation between handgrip strength and mid-arm circumference (r = 0.54, p = 0.00), arm length (r = 0.48, p = 0.00), forearm length (r = 0.34, p = 0.04) and hand width (r = 0.45, p = 0.00). Whereas, in the female athlete category, positive correlations only showed in arm length (r = 0.60, p = 0.00), forearm length (r = 0.49, p = 0.02) and hand width (r = 0.41, p = 0.04). In the male non-athlete category, there was a positive correlation between handgrip strength and mid-arm circumference (r = 0.42, p = 0.00), arm length (r = 0.30, p = 0.04), hand length (r = 0.35, p = 0.02) and hand width (r = 0.54, p = 0.00). Whereas, in the female athlete category, positive correlations only showed in hand length (r = 0.46, p = 0.01) and hand width (r = 0.39, p = 0.02).

Table-5: Correlation between Handgrip Strength and Anthropometric Parameters in subjects

Category	Sex	Statistic	MAC	AL	FAL	HAL	HAW
ATHLETES	M	r	0.54**	0.48**	0.34*	0.16	0.45**
		p-value	0.00	0.00	0.04	0.35	0.00
	F	r	0.35	0.60**	0.49*	0.38	0.41**
		p-value	0.09	0.00	0.02	0.07	0.04
NON-ATHLETES	M	r	0.42**	0.30*	0.21	0.35*	0.54**
		p-value	0.00	0.04	0.17	0.02	0.00
	F	r	-0.10	0.13	0.02	0.46**	0.39*
		p-value	0.57	0.45	0.90	0.01	0.02

MAC = Mid Arm Circumference, **AL** = Arm Length, **FAL** = Forearm Length, **HAL** = Hand Length, **HaW** = Hand Width, * = Correlation is significant at the 0.05 level; ** = Correlation is significant at the 0.01 level.

DISCUSSIONS

The hand is regularly used for carrying out daily actions including writing, squeezing and manipulating objects. The ability of the hand to grasp objects is built on the biomechanics of the fingers [13].

From this current study, the results showed that both dominant and non-dominant handgrip strength (HGS) in males were significantly higher compared to females in both athletes and non-athletes which could be attributed to higher muscle masses in males as a result of a greater concentration of ATP (Adenosine triphosphate) in their muscle fibre composition [14]. Also, athletes possessed higher values of dominant and non-dominant HGS compared to non-athletes in both genders. The greater involvement of athletes in hand or gripping sporting activities which leads to an increase in muscle length could be the contributing factor to this difference [15].

With regards to mid-arm circumference, a positive correlation with handgrip strength was observed only in males of both athletes and non-athletes which are in agreement with various studies [16-18]. Females tend to have different variations in their percentage of fat deposits in their upper arm [19].

Apart from the female category of non-athletes, arm length showed a positive correlation with handgrip strength which is in concordance with Koley and Kaur [20]. A positive correlation between handgrip strength and forearm length was also noticed in both

genders of the athlete group. These statements can be backed by some studies [21, 22], who both suggested that anthropometric measurements such as forearm length, as well as their morphology contribute towards an athlete's performance.

Finally, handgrip strength positively correlated with hand length in non-athletes for both sexes. While handgrip strength showed a positive correlation with hand width in all categories although the correlation was stronger in athletes compared to non-athletes. This could be attributed to the role of the greater involvement of the metacarpophalangeal joint during sporting activities by athletes who in turn tend to have greater handgrip strength [23].

CONCLUSION

From this study, it may be concluded that handgrip strength values are greater in people who are involved in hand sports. It also had some strong correlations with most of the anthropometric variables studied especially among athletes and with the data in this current study, there is need for a proper application of anthropometrics in the selection of athletes to enhance sports performance among Nigerian athletes in the future.

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CONFLICT OF INTEREST

The authors declare that there is no Conflict of interest

AUTHOR'S CONTRIBUTION

We write to state that both authors have contributed significantly, and that all authors are in agreement with the contents of the manuscript. 'Author A' (Adheke, M.O.) designed the study and protocol, reviewed the design, protocol and examined the intellectual content and 'Author B' (Oyakhire, M.O.) wrote the first draft of the manuscript, 'Author C' (Paul, J.N.) managed the literature search and managed the analyses of the study. All authors read and approved the final manuscript.

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