

## Correlation of various anthropometric parameters and dominant hand grip strength in cricket and football players

Dr. Charushila Atul Rukadikar<sup>1</sup>, Dr. Mundewadi S.A<sup>2</sup>, Dr. Snehalata Mali<sup>3</sup> Dr. Atul R Rukadikar<sup>4</sup>

<sup>1</sup>MBBS, MD Physiology, Assistant Professor, Department of Physiology  
Zydus Medical College & Hospital, Dahod, Gujarat

<sup>2</sup>MBBS, MD Physiology, Associate Professor, Department of Physiology, Dr.VM GMC,  
Solapur, Maharashtra.

<sup>3</sup>MBBS, MD Physiology, Assistant Professor, Department of Physiology  
MIMSR Medical College & Hospital, Latur, Maharashtra.

<sup>4</sup>MBBS, MD Microbiology, Professor and Head, Department of Microbiology, Zydus  
Medical College & Hospital, Dahod, Gujarat

Corresponding Author: Dr. Charushila Atul Rukadikar

### Abstract

**Background:** Handgrip strength is a physiological variable affecting a number of variables including age, sex and size, weight, height, strength of muscle, exhaustion, daytime, age and diet, movement constraints and pain. Clear relation between the strength of the handgrip of different anthropometric traits.

**Aims and Objectives:** To Correlation of various anthropometric parameters and dominant handgrip in cricket and football players.

**Material and Methods:** The present research was performed in the Sports Physiology Laboratory of the Department of Physiology. The duration of the study was from December 2012 to November 2014. A test research is conducted to conduct a comparative study of anthropometric parameters and dominant handgrip strength in cricket and football players.

**Results:** There is a positive correlation between weight, height, MUAC, BMI, percent body fat, percent lean body weight, mid-upper arm diameter, mid-upper arm area, corrected mid-upper arm muscle area, mid-upper arm fat area with dominant handgrip strength for Cricket and Football players. There is a negative correlation between arm fat index, tricep skin thickness, and dominant handgrip strength in cricket and football players.

**Conclusion:** It can be concluded that handgrip strength showed a strong correlation with anthropometric measurements (height, weight, percent of lean body mass, mid-upper arm circumference, mid-upper arm area, corrected mid-upper arm muscle area). The dominant force of the handgrip can be predicted using these anthropometric parameters.

**Keywords:** Handgrip strength; muscular strength; hand functioning; anthropometric variables

### Introduction

Handgrip intensity is an inevitable consideration in determining the functional potential of rheumatoid arthritis, neuromuscular, preoperative, postoperative and community-based elderly patients [1]. Measurement of handgrip strength is of the utmost importance in evaluating the efficacy of various hand care strategies and also in hand recovery. Grip intensity determines the handiness of the individual, an important field of population variance research. It is also used as an indicator of the efficacy of the general physical strength of the

forearm and forearm muscles and as a functional nutritional status and physical performance index [2,3]. Handgrip strength is a physiological variable defined by a number of variables, including age, gender, body size, weight, height, muscle strength, fatigue, time of day, age, nutritional status, reduced mobility, and pain. Different anthropometric characteristics (weight, height, hand length, etc.) have been reported to have clear associations between handgrip strength [4].

We decided to find a correlation between the strength of the handgrip and anthropometric parameters and concentrated on the impact of dominance on the strength of the handgrip.

## **Materials and Methods**

### **Study design:**

The present study was carried out in the sports physiology laboratory of the department of physiology. Duration of the study from December 2012 to November 2014 and it is not a follow-up type of study. The present study was approved by the Institution Ethical Committee of the college.

### **Source of data:**

The data was collected from the players of Football and Cricket Academy of district level. A test study with 60 subjects (30 cricket players and 30 football players) is undertaken to do a comparative study of handgrip strength and anthropometric parameters in crickets and football players.

### **Selection criteria:**

The selection criteria of the subjects were based on the inclusion and exclusion criteria:

#### **Inclusion criteria:**

- Normal healthy cricket players and football players must have to play cricket and football for the last 3 years.
- Subjects who were selected for the university team and still playing at the university level, state level, or national level.
- Subjects with age group between 15-25 years.
- Subjects practicing daily for 2-3 hrs for 6 days a week.

#### **Exclusion criteria:**

- The subject age group below 15 years and above 25 years.
- Subjects who were not regularly practicing.

### **Method of Collection of Data**

Subjects were verbally and visually screened to rule out any history of past and current injury to the right hand or medical condition which might affect handgrip strength and anthropometric parameters. Readings were documented in the data collection form which included demographic data from all the participants including name, age, gender, hand dominance, ht, and wt before the start of the test.

### **Anthropometric Measurements:**

Anthropometric variables, i.e. height, weight, BMI, Mid Upper Arm Circumference, % Of Body Fat, Bicep Skinfold Thickness, % Of Lean Body Mass, Mid Upper Arm Area, Corrected Mid upper Arm muscle area, Mid Upper Arm Fat Area, Arm Fat Index, and dominant handgrip strength were measured.

### Statistical Analysis:

Data were summarized using descriptive statistics such as percent, mean, S.D. Descriptive statistics provide information on the distribution, variability and central tendency of the variable. Descriptive statistical analysis has been carried out in this report. Important measures applied in this analysis were that the unpaired test was used to equate cricketers and football players with BMI variables, precise anthropometry, handgrip power. All statistical measurements were made using Windows SPSS (Statistics Package for Social Sciences) version 19.0.

### Results

**Table 1: Correlation of various anthropometric parameters and dominant hand grip strength in cricket and football players**

Variables	Cricket players				Football players			
	N	Correlation coefficient (r)	t test	p value	N	Correlation coefficient (r)	t test	p value
Height	30	0.10	0.51	(p > 0.05)	30	0.27	0.27	
weight	30	0.36	2.03	(p > 0.05)	30	0.29	1.59	
BMI	30	0.28	1.54	(p > 0.05)	30	0.17	0.89	
% of body fat	30	-0.16	-0.88	(p > 0.05)	30	-0.03	-0.16	
% of Lean body mass	30	0.16	0.88	(p > 0.05)	30	0.03	0.16	
MUAC	30	0.48	2.92	p < 0.01	30	0.33	1.84	p > 0.05
MUAA	30	0.09	0.48	p < 0.01	30	0.29	1.58	p > 0.05
CMUAMA	30	0.56	3.61	P < 0.01	30	0.07	0.34	P > 0.05
MUAFA	30	0.01	0.07	(p > 0.05)	30	0.32	1.81	
Arm fat index	30	-0.49	-2.95	p < 0.01	30	-0.02	-0.10	p > 0.05
Tricep skin fold thickness (Ts)	30	-0.31	-1.73	p > 0.05	30	-0.14	-0.75	p > 0.05

There is low positive correlation observed between height, weight, BMI, % of body fat, % of Lean body mass and dominant hand grip strength in Cricket players and Football players which is statistically non significant (p > 0.05).

There is highly significant positive correlation observed between MUAC, CMUAMA and dominant handgrip strength in Cricket players (p < 0.01). There is low positive correlation observed between MUAC, CMUAMA and dominant handgrip strength in Football players which is statistically non significant (p > 0.05). There is low positive correlation observed between MUAA, MUAFA and dominant handgrip strength in cricket and football players which is statistically non significant (p > 0.05).

There is highly significant negative correlation observed between AFI and dominant handgrip strength in Cricket players (P < 0.01). There is low negative correlation observed between AFI and dominant handgrip strength in Football players which is statistically non significant (p > 0.05). There is low negative correlation observed between Ts and dominant handgrip strength in Cricket and Football players which is statistically non-significant (P > 0.05).

### Discussion

#### Height

Our findings show that with increased height in both cricketers and football players, dominant handgrip strength continued to be increased. For dominant hands, r= 0.10, t= 0.51 for cricketers, r= 0.27 for football players, t= 149 (Table 1). Similar result with our finding i.e. positive correlation between height and hand grip strength is shown by

other authors like Fallahi AA (2011,  $r= 0.603$ ) [5], Koley S and Pal AS (2009,  $r= 0.872$ ) in Indian population [6], Koley S and Gandhi M (2008) [7], Moy F (2011,  $r=0.346$ ) [8] in Malaysia population, Sampoli S (2007) [9], Neimpoog S (2007) [10], Pietrese S (2002) [11], Kamarul T (2006) [12]. The dissimilar result with our finding is shown by Jurimae T (2009) [13]. His study shows that there is a low negative correlation between height and handgrip strength. More height will lead to more muscle fiber quantity and length. When examined for grip, it can contribute to more strength in the hands. This may be the explanation for the positive association of height and handgrip power, because more heightened players may have more grip strength.

### **Weight**

Our findings show that with a rise in weight in both cricketers and football players, the dominant handgrip strength continued to increase. For dominant handgrip strength,  $r= 0.36$ ,  $t= 2.03$  for cricketers,  $r= 0.29$  for football players,  $t= 1.599$  for football players (Table 1). Similar result with our finding i.e. positive correlation between weight and hand grip strength is shown by other authors like Fallahi AA (2011,  $r=0.516$ ) [5] in Indian population, Moy F (2011,  $r= 0.298$ ) in Malaysia population [8]. Koley S and M Gandhi (2008) [7], Sampoli S (2007) [9], Neimpoog S (2007) [10], Pietrese S (2002) [11], Kamarul T (2006) [12], Günther CM (2008) [14]. More weight may lead to more weight of hands. It may exert more force of contraction on the dynamometer when testing for handgrip strength. This may be the reason for the positive correlation between weight and handgrip strength.

### **BMI**

Our findings show that, with an increase in BMI in both cricketers and football players, dominant handgrip strength continued to increase. In DM hands,  $r= 0.28$ ,  $t= 1.54$  in cricketers and  $r= 0.17$  in football players,  $t= 0.89$  (Table 1). Similar result with our finding i.e. HGS is positively correlated with BMI is shown by other authors like Fallahi AA (2011,  $r= 0.061$ ) [5], Moy F (2011,  $r= 0.150$ ) [8] in Malaysia population, Koyle S, Pal AS (2009) [6], Koley S and M Gandhi (2008) [7], Sampoli S (2007) [8], Pietrese S (2002) [11], Günther CM (2008) [14]. A dissimilar result with our finding i.e. HGS is negatively correlated with BMI is shown by Westrop M (2011) [15]. Kamarul T (2006) [12] shows that there is no correlation between BMI and HGS. BMI should be maintained within the usual range to be useful for HGS improvement. It would lead to better results for players in cricket and football.

### **% of body fat**

Our findings show that dominant handgrip strength in both cricketers and football players continued to decrease with a rise in body fat percentage. In DM hands,  $r= -0.16$  for cricketers,  $t= -2.95$  for football players,  $r= -0.03$  for football players,  $t= -0.16$  (Table 1). The dissimilar result with our finding i.e. handgrip strength is positively correlated with % of body fat is shown by other authors like Fallahi AA (2011,  $r= 0.079$ ) [5]. Neimpoog S (2007) [10] states that no correlation between handgrip strength and body fat %. The percentage of body fat increased and the percentage of muscle mass decreased. More fat can result in less muscle mass, which can lead to less strength in the handgrip. This may cause the percentage of body fat and handgrip strength to be negative.

### **% of lean body mass**

Our findings show that the dominant strength of handgrip continued to increase with an increase in lean body mass percentage in both cricketers and football players. For

dominant hands,  $r = 0.16$ ,  $t = 0.88$  for cricketers,  $r = 0.03$  for football players,  $t = 0.16$  (Table 1). A similar result with our finding i.e. handgrip strength is positively correlated with % of lean body mass is shown by author Fallahi AA (2011,  $r = 0.536$ ) [5]. The dissimilar result with our finding i.e. handgrip strength is negatively correlated with % of lean body mass is shown by author Koley S (2009, for rt hand  $r = -0.400$  and lt hand  $r = -0.372$ ) [16].

This may lead to a positive correlation of % of lean body mass and handgrip strength.

### **MUAC**

Our findings show that, with an increase in MUAC in both cricketers and football players, dominant handgrip strength continued to increase. For DM hands, in cricketers  $r = 0.48$ ,  $t = 2.92$ , in football players  $r = 0.33$ ,  $t = 1.84$  (Table 1). Similar result with our finding i.e. HGS is positively correlated with MUAC is shown by Koley S (2009, for rt hand  $r = 0.513$  and for lt hand  $r = 0.547$ ) in Indian cricket players [16]. The MUAC should be increased with special training and specific exercises. Diet patterns should take into account the duration of exercise. As MUAC increases, the strength of the handgrip will improve. Greater handgrip ability will have better outcomes for both cricket and football players.

### **MUAA**

Our findings show that with increased mid-upper arm area (MUAA) in both cricketers and football players, dominant handgrip strength continued to increase. For dominant hand, in cricketers  $r = 0.09$ ,  $t = 0.48$ , in football players  $r = 0.29$ ,  $t = 1$  (Table 1). Similar result with our finding i.e. mid-upper arm area is positively correlated with handgrip strength, in Indian cricket players shown by an author like Koley S (2009, for rt hand  $r = -0.493$  and for lt hand  $r = -0.481$ ) [16]. This may lead to a positive co-relation of mid-upper arm area and handgrip strength in our cricket and football player.

### **CMUAMA**

Our findings show that, with an increase in the corrected mid-upper arm muscle area (CMUAMA) in both cricketers and football players, dominant handgrip strength (DM and NDM HGS) continued to increase. For dominant hands, in cricketers  $r = 0.56$ ,  $t = 3.61$ , in football players  $r = 0.07$ ,  $t = 0.34$  (Table 1). Similar result with our finding i.e. arm muscle area is positively correlated with handgrip strength in Indian cricket players is shown by other authors like Koley S (2009, for rt hand  $r = 0.506$  and lt hand  $r = 0.539$ ) [16], Pieterse S (2002) [11]. This reason may lead to a positive co-relation of CMUAMA and handgrip strength in our cricket and football player.

### **MUAFA**

Our findings show that with the rise in the corrected mid-upper arm fat area (MUAFA) in both cricketers and football players, dominant handgrip strength continued to increase. For DM hands, in cricketers  $r = 0.01$ ,  $t = 0.07$  and in football players  $r = 0.32$ ,  $t = 1.81$  (Table 1). A similar result with our finding i.e. arm fat area is positively correlated with HGS in Indian cricket players is shown by Koley S (2009, for rt hand  $r = 0.326$  and lt hand  $r = 0.292$ ) [16]. MUAFA and MUAA are positively associated with handgrip strength in our studies. These may be the reasons for the positive correlation between handgrip strength and mid-upper arm fat area (MUAFA).

### **Arm fat index (AFI)**

Our findings show that, with a rise in the arm fat index (AFI) in both cricketers and football players, dominant handgrip strength continued to decrease. For DM hands,

cricketers  $r = -0.49$ ,  $t = -2.95$  and for football players  $r = -0.02$ ,  $t = -0.109$  (Table 1). The dissimilar result with our findings i.e. arm fat index is positively correlated with HGS in Indian cricket players is shown by author Koley S (2009, for rt hand  $r = 0.083$  and lt hand  $r = 0.014$ ) [16]. Our results suggest the dominant strength of the handgrip, which may be the explanation for a positive correlation between the strength of the handgrip and the index of the arm fat. In order to obtain sufficient grip strength, the fat index of the arm should be kept within the normal range. Better handgrip ability leads to better outcomes for cricket and football players.

### Triceps skin fold thickness

Our findings show that, with an increase in tricep skinfold thickness in both cricketers and football players, dominant handgrip strength continued to decrease. For DM hands, in cricketers  $r = -0.31$ ,  $t = -1.73$ , in football players  $r = -0.14$ ,  $t = -0.75$  (Table 1). The dissimilar result with our finding i.e. tricep skinfold thickness is positively correlated with handgrip strength in Indian cricket players, is observed by other authors like Koley S (2009, for rt hand  $r = 0.278$  and for lt hand  $r = 0.210$ ) [16]. Tricep skinfold thickness should be maintained within the normal range to get proper handgrip strength. Better handgrip strength leads to better performance of cricket and football players.

### Conclusion

Coaches should periodically assess all anthropometric parameters of height, weight, percentage of lean body weight, mid-upper arm diameter, mid-upper arm area, corrected mid-upper arm muscle area. Physical health requirements need to be modified in order to improve the productivity of players. Handgrip training programs at various levels, such as school, college, university, state, should be planned. In this way, when choosing a sport, we can give the player a specific sport prescription.

### References

1. Chandrasekaran B, Ghosh A, Prasad C, Krishnan K, Chandrashaarma B. Age and anthropometric traits predict handgrip strength in healthy normals. *J Hand Microsurg.* 2010 Dec;2(2):58–61. [PubMed]
2. Foo LH, Zhang Q, Zhu K, Ma G, Greenfield H, Fraser DR. Influence of body composition, muscle strength, diet and physical activity on total body and forearm bone mass in Chinese adolescent girls. *Br J Nutr.* 2007 Dec;98(6):1281–7. [PubMed]
3. Massy-Westropp N, Rankin W, Ahern M, Krishnan J, Hearn TC. Measuring grip strength in normal adults: reference ranges and a comparison of electronic and hydraulic instruments. *J Hand Surg Am.* 2004 May;29(3):514–9. [PubMed]
4. Häger-Ross C, Rösblad B. Norms for grip strength in children aged 4-16 years. *Acta Paediatr.* 2002;91(6):617–25. [PubMed]
5. 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. *J Hum Kinet.* 2011 Sep;29:151–9. [PubMed]
6. Koley S, Singh AP. An association of dominant handgrip strength with some anthropometric variables in the Indian collegiate population. *Anthropol Anz.* 2009 Mar;67(1):21–8. [PubMed]
7. Koley S, Gandhi M. An Association of Hand Grip Strength with Height, Weight, and BMI in Boys and Girls aged 6–25 years of Amritsar. *The internal journal of biological anthropology* 2008;2(1):1–12.[PubMed]
8. Moy F, Chang E, Kee K. Predictors of Handgrip Strength among the Free-Living Elderly in Rural Pahang, Malaysia. *Iran J Public Health.* 2011 Dec;40(4):44–53. [PubMed]

9. Semproli S, Brasili P, Toselli S, Ventrella AR, Jürimäe J, Jürimäe T. The influence of anthropometric characteristics to the handgrip and pinch strength in 6-10-year old children. *Anthropol Anz.* 2007 Sep;65(3):293–302. [PubMed]
10. Niempoog S, Siripakarn Y, Suntharapa T. An estimation of grip strength during puberty. *J Med Assoc Thai.* 2007 Apr;90(4):699–705. [PubMed]
11. Pieterse S, Manandhar M, Ismail S. The association between nutritional status and handgrip strength in older Rwandan refugees. *Eur J Clin Nutr.* 2002 Oct;56(10):933–9. [PubMed]
12. Kamarul T, Ahmad TS, Loh WY. Handgrip strength in the adult Malaysian population. *Journal of Orthopedic Surgery* 2006;14(2):172–7. [PubMed]
13. Jürimäe T, Hurbo T, Jürimäe J. Relationship of handgrip strength with anthropometric and body composition variables in prepubertal children. *Homo.* 2009;60(3):225–38. [PubMed]
14. Günther CM, Bürger A, Rickert M, Crispin A, Schulz CU. Grip strength in healthy caucasian adults: reference values. *J Hand Surg Am.* 2008 Apr;33(4):558–65. [PubMed]
15. Massy-Westropp NM, Gill TK, Taylor AW, Bohannon RW, Hill CL. Hand Grip Strength: age and gender stratified normative data in a population-based study. *BMC Res Notes.* 2011 Apr 14;4:127. [PubMed]
16. Koley S, Yadav MK. An Association of handgrip strength with some anthropometric variables in Indian cricket players, *Physical Education and Sport* 2009;7(2):113–23.