



## STUDY ON INFLUENCE OF VARIOUS ANTHROPOMETRIC PARAMETERS ON HANDGRIP STRENGTH IN YOUNG MALES AND FEMALES

### Physiology

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### ABSTRACT

Handgrip strength is an important test to evaluate physical fitness and nutritional status. It varies with age, gender, body size etc. This study was carried out in a Medical College of South Bengal to assess gender differences in handgrip strength and to correlate between various anthropometric parameters and handgrip strength in young males & females. The study included 100 apparently healthy medical students (50 male & 50 female) in the age group 17-20 years. Anthropometric parameters like BMI, forearm circumference and hand circumference were measured. Handgrip strength of both hands was measured using a handgrip dynamometer. Results revealed males have significantly greater handgrip strength than females. A positive correlation was found between all anthropometric data with maximum grip strength (MGS) in both sexes except forearm circumference of left hand in females. Strongest correlation of Maximum Grip Strength was observed with hand circumference in both sexes. Thus MGS can be predicted using hand circumference alone.

### KEYWORDS

Forearm circumference, Hand circumference, Maximum grip strength (MGS)

### INTRODUCTION

Handgrip strength (HSG) is one of the most important test to evaluate physical fitness and nutritional status of the individual. It is said to be the most reliable clinical measure of human strength [1]. The power of handgrip is forceful flexion of all finger joints with maximum voluntary force that the subject can exert [2]. Strength varies with age and sex of the individual. Usually girls have lower handgrip strength than boys. After puberty this difference increases and by the age of 18 years girls have mean handgrip strength 60% lower than boys. Men possess greater strength than women for all muscle groups tested [3]. Different studies suggested that poor grip strength is predictive of increased mortality from cardiovascular disease [4, 5].

There exists a great variation in the literature over the relationship between Body Mass Index (BMI) and Maximal Grip Strength (MGS). Earlier studies have revealed a positive relationship between BMI and MGS in both genders, at all ages, while a few studies have not been able to establish any such relationship [6-8]. Many studies have shown that anthropometric variables such as height, weight, body mass index, hand length and hand width are positively correlated with grip strength [8, 9]. Dominant hand had approximately 10% stronger grip strength than non dominant hand [10].

HGS strongly indicates the health status based on the disability, morbidity and mortality in adult populations [11]. Hand grip strength can be measured by the amount of static force that the hand can exert on a handheld dynamometer. This is called biomechanical measurement. It is a reliable measurement when standardized methods and calibrated equipment are used and this eliminates the bias of different assessors or with different brands of dynamometers [12, 13].

There are a few studies in India which have attempted to establish the relation between gender and various anthropometric parameters like weight, height, BMI and particularly hand circumference & forearm circumference on handgrip strength in young males and females.

On this background the present study was performed to assess the gender differences in handgrip strength in young males & females and to assess the correlation (if any) between various anthropometric parameters and handgrip strength in young males & females.

### MATERIALS & METHODS

The study included 100 apparently healthy 1<sup>st</sup> year MBBS students (50 male & 50 female) with age (mean±SD) 18.46 ± 0.09 yrs and 18.42 ± 0.09 yrs respectively as subjects. This was a cross sectional observational study. The study was conducted in the Department of Physiology, IPGME&R, Kolkata during the period of January 2018 to

July 2018. The study protocol was approved by the Institute's Ethical Committee and the subjects signed an informed consent statement prior to participation. Subjects having joint problems of hand, wrist and elbow, history of fracture, neurological disorder, and deformities of upper limb were excluded from the study.

Handgrip strength of both the hands was measured using a handgrip dynamometer (INCO-AMBALA INDIA) as the maximal voluntary contraction sustained for at least 3 seconds. Each subject was given verbal instructions & demonstration before being tested and further instructions were provided at the time of the test. Subject stood upright & was instructed to hold the dynamometer in the hand with the shoulder abducted and elbow in full extension and they were encouraged to exert the maximal strength. Three attempts with a pause of 10-20 seconds were allowed and best result was taken.

BMI, forearm circumference and hand circumference were measured by standard procedure.

**BMI:** The height was recorded using a stadiometer (INDOSURGICALS) and weight was measured by digital standing scales with the subjects wearing light clothes and without shoes. BMI was then calculated by Quetelet's index,  $BMI = \text{weight (in kg)} / \text{height (m)}^2$

**Forearm circumference:** Forearm circumference was measured by a flexible measuring tape at the midpoint between olecranon process of ulna and styloid process of radius [1].

**Hand circumference:** Hand circumference was measured by flexible measuring tape at maximum hand width [1].

The data was analysed using Graph Pad Prism version 5. Gender wise difference was analyzed by unpaired "t" test. Pearson's correlation coefficient was used to correlate between handgrip strength and various anthropometric parameters. Descriptive data are presented as mean±SD. Results were considered to be significant if their associated p values were less than 0.05.

### RESULTS

There was a statistically significant difference in mean BMI, forearm circumference and hand circumference in both upper limbs between males and females ( $P < 0.05$ ). There was a significant difference in hand grip strength between males and females with males having higher values than females ( $p < 0.05$ ) (Table 1). Analysis revealed a positive correlation between all anthropometric data with MGS in both males and females except forearm circumference of left hand in females. Strongest correlation of MGS was observed with the hand

circumference in both males and females for both hands (Table 2 & 3, Figure 1, 2, 3&4).

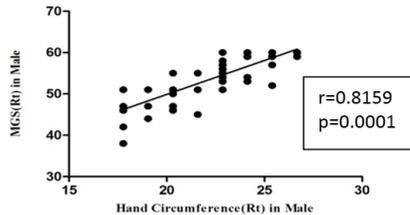
**TABLE – 1: Maximal Grip Strength (MGS) & Anthropometric parameters in Males and Females**

Parameters	Males (Mean± SD) n=50	Females (Mean± SD) n=50	p value
BMI (Kg/m2)	23.25 ± 0.17	22.35 ± 0.20	0.0008
Right mid-forearm circumference(cm)	25.52 ± 0.29	23.48 ± 0.33	<0.001
Right hand circumference(cm)	22.07 ± 0.39	19.96± 0.29	<0.001
Right hand MGS(kg)	53.28 ± 0.78	31.98 ± 1.14	<0.001
Left mid-forearm circumference(cm)	25.38 ± 0.28	22.96 ± 0.31	<0.001
Left hand circumference (cm)	21.54 ± 0.31	19.48 ± 0.26	<0.001
Left hand MGS (kg)	52.86 ± 0.86	30.08 ± 1.28	<0.001

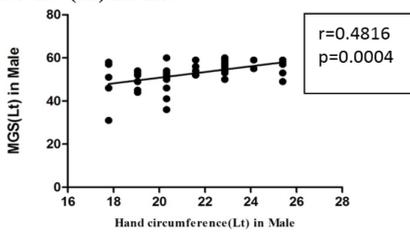
**TABLE – 2: Correlation between hand MGS and Anthropometric parameters in Males**

Parameters	Right Hand		Left Hand	
	r	p	r	p
BMI	0.5028	0.0002	0.4169	0.0026
Hand Circumference	0.8159	0.0001	0.4816	0.0004
Forearm Circumference	0.3190	0.0239	0.3250	0.0213

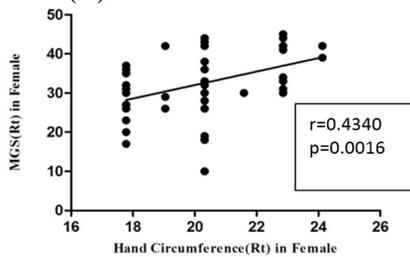
r=Pearson's correlation coefficient



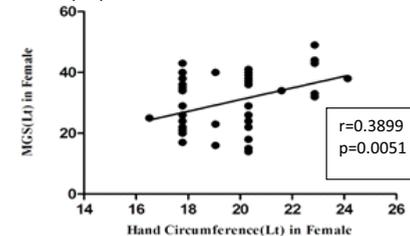
**Figure 1: Scatterplot showing correlation of MGS (Rt) with hand circumference (Rt) in Male**



**Figure 2: Scatterplot showing correlation of MGS (Lt) with hand circumference (Lt) in Male**



**Figure 3: Scatterplot showing correlation of MGS (Rt) with hand circumference (Rt) in Female**



**Figure 4: Scatterplot showing correlation of MGS (Lt) with hand circumference (Lt) in Female**

**TABLE – 3: Correlation between hand MGS and Anthropometric parameters in Females**

Parameters	Right Hand		Left Hand	
	r	p	r	p
BMI	0.3240	0.0217	0.2888	0.0420
Hand Circumference	0.4340	0.0016	0.3899	0.0051
Forearm Circumference	0.3226	0.0223	0.2184	0.1277

r=Pearson's correlation coefficient

**DISCUSSION:**

Our study shows significant difference in handgrip strength between males and females. Males have higher grip strength than females. This is similar with earlier studies [14, 15]. Muscle girth mainly determines muscle strength. More force can be generated by a muscle with large cross sectional area & thus the muscle can lift more weight. Increased bone mineral density and muscle mass in males contributes to greater muscle strength in male [16]. Testosterone increases type 2 fibres [17] which are the fast fibres with high activity of glycolytic enzymes. Thus higher proportion of type 2 fibres in males explains greater muscle strength in them. Flexor musculature of the forearms and hands are responsible for a number of daily functions of the hand. These hand muscles are involved in gripping strength. The coordinated actions of flexor and extensor muscles and their interplay is an important factor in the grip strength. Similar findings were reported by previous studies [14, 15, 18]. The factors influencing the grip strength are hand dominance, fatigue, time of the day, age, gender, nutritional status, pain and muscle strength. Handgrip strength is well correlated with nutritional status of the individual. Guo et al and Kenjile et al found grip strength to be a strong predictor of an individual's nutritional status [19, 20]. In our study in both males & females there was a positive correlation between all anthropometric data and MGS except forearm circumference of left hand in females. Hand circumference had the strongest correlation with MGS. This finding was similar to the study which showed strong correlation between hand circumference and MGS [21]. Further studies on larger population in this field are needed to generate more data which can be used clinically in hand and upper limb rehabilitation, and possible screening for other health related issues.

**CONCLUSION**

Our study clearly shows the influence of gender difference and various anthropometric parameters on handgrip strength in young males and females. According to our study, hand circumference is a good predictor of maximum grip strength (MGS) than BMI and forearm circumference.

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