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## Correlation between Grip Strength and Physical Factors in Men

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**Background:** Grip strength is widely accepted indicator of nutritional status, bone mineral content, muscular strength and functional integrity of upper extremity. The assessment of grip strength plays a vital role in determining the efficacy of different treatment strategies of hand.

**Objective:** This cross-sectional study was performed to study the correlation between hand grip strength and physical factors (height, weight, body mass index, and hand and forearm anthropometric measurements) in healthy Indian male population.

**Materials and Methods :** A total of 50 healthy male subjects, satisfying the selection criteria were recruited in the study. Subjects were then assessed for height, weight, body mass index (BMI) and hand and forearm anthropometric measurements. The grip strength of both dominant and non-dominant hands was measured using Jamar dynamometer.

**Statistical analysis:** The data was analyzed by Pearson's correlation coefficients and 5% level of probability was used to indicate statistical significance.

**Results:** In males, dominant and non-dominant grip strength have significant ( $p < 0.05 - 0.001$ ) positive correlation with height ( $r = 0.518, 0.579$ ), weight ( $r = 0.512, 0.527$ ), BMI ( $r = 0.337, 0.328$ ), hand breadth ( $r = 0.39, 0.42$ ), hand length ( $r = 0.60, 0.60$ ), hand span ( $r = 0.64, 0.62$ ), wrist circumference ( $r = 0.46, 0.38$ ) and forearm girth ( $r = 0.65, 0.68$ ).

**Conclusion:** The results show that physical factors such as height, weight, body mass index, hand and forearm anthropometric measurements positively correlate with hand grip strength in healthy Indian males.

**Keywords:** Hand grip strength, Jamar dynamometer, Anthropometric measurements



### INTRODUCTION

Grip strength is widely accepted indicator of nutritional status, bone mineral content, muscular strength and functional integrity of upper extremity<sup>1, 2</sup>. The assessment of grip strength plays a vital role in determining the efficacy of different treatment strategies of hand<sup>3</sup>. Hand grip strength can be quantified by measuring the amount of static force that the hand can squeeze around a dynamometer. The force has most commonly been measured in kilograms and pounds<sup>4</sup>. The Jamar dynamometer has been found to give the most accurate and acceptable measures of grip strength<sup>5</sup>.

Anthropometric data is very useful in designing functions concerning with human. Without such data, the designs cannot fit the people who are going to use them. Therefore the information regarding the human sizes is essential to be implemented in the design of various facilities. Hand anthropometry is very important and used in designing objects dealing with human hands<sup>6</sup>.

The information regarding hand grip strength and anthropometric measurements of healthy men is scanty from India. Since men are the most important source of work force in India, their hand grip strength and anthropometric data are essential in the implements from ergonomic considerations. Keeping these factors in view, a study has been undertaken to generate hand grip strength and physical factors (height, weight, body mass index, and hand and forearm anthropometric measurements) of normal adult Indian men and to determine whether these parameters are correlated.

### MATERIALS AND METHODS

This was a cross-sectional descriptive study and was conducted in post graduate research laboratory at Yenepoya University, Mangalore, Karnataka. Approval was taken from Yenepoya University Ethical Committee prior to the commencement of the study. The data was collected from 50 healthy adult males of age group 20-80 years. Informed consent was obtained from all subjects prior to data collection.

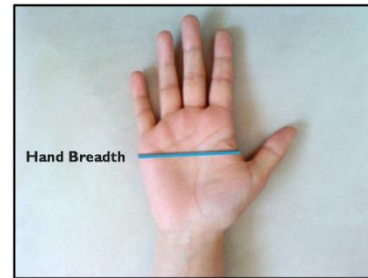


Figure 1: Hand breadth

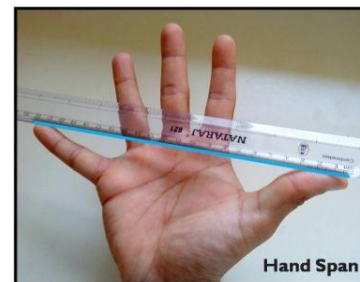


Figure 2: Hand span

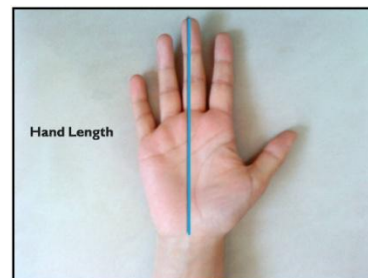


Figure 3: Hand length



Figure 4: Grip strength

## Grip Strength and Physical Factors in Men

**Table 1: Descriptive statistics of Age, Height, Weight, BMI**

Age group (yrs)	Number (n)	Age* (yrs)	Height*(cm)	Weight* (kg)	BMI*(kg/m <sup>2</sup> )
20 – 40	20	28.50 ± 4.67	169.79 ± 8.00	75.05 ± 14.30	25.86 ± 3.78
40 – 60	20	48.15 ± 5.40	163.98 ± 7.44	64.95 ± 14.75	23.84 ± 4.13
60 – 80	10	68.10 ± 6.42	162.20 ± 7.54	68.00 ± 14.41	25.96 ± 4.61

\* Values are mean ± S.D

**Table 2: Descriptive statistics of Hand and Forearm Anthropometric variables**

Anthropometric Variables	Side	
	Dominant	Non dominant
Hand length*(cm)	19.28 ± 0.89	19.27 ± 0.89
Hand breadth*(cm)	8.97 ± 0.66	8.95 ± 0.65
Hand span *(cm)	21.48 ± 1.66	21.48 ± 1.66
Wrist circumference *(cm)	17.55 ± 1.04	17.19 ± 0.98
Forearm girth*(cm)	27.22 ± 2.38	26.66 ± 2.40
Grip strength *(kg)	35.56 ± 8.68	32.85 ± 8.82

\* Values are mean ± S.D

The inclusion criteria in the study was that subjects should be healthy. Subjects were excluded if they reported any neurological or musculoskeletal impairment of upper-limbs, cardiovascular or systemic illness.

### Procedure

Healthy males were assessed for the - height (cm), weight (kg), body mass index (BMI) as recommended by World Health Organization (WHO).

*Hand and Forearm anthropometric measurements:* The precision of the measures was 0.5 cm. The hand span, length, breadth, wrist circumference, forearm girth measurements were therefore rounded to the nearest whole centimeter.

*Hand breadth Measurement:* Measurements of the hand breadth was taken in both hands from the radial side of metacarpal D2 (index finger) and ulnar side of metacarpal D5 (small finger)<sup>7,8</sup> as shown in **Figure 1**.

*Measurement of Hand span:* Hand span was measured in both hands from the tip of the thumb to the tip of the small finger with the hand opened as wide as possible<sup>12</sup> (**Figure 2**).

*Measurement of Hand length:* Measurements of the hand length was taken in both hands (perpendicular distance) from the tip of the middle finger to the distal wrist crease<sup>7,8</sup> (**Figure 3**)

*Wrist circumference:* Measurement of the wrist circumference was taken for both sides around distal wrist flexion crease<sup>9</sup>.

*Forearm girth:* Measurement of the forearm girth for both sides was taken around the maximum girth immediately distal to the elbow with arm extended in front of the body and palm up<sup>10</sup>.

Handgrip strength was measured using a Jamar dynamometer (**Figure 4**). Grip strength is tested by placing the subject in seated position with his arm side, elbow flexed 90°, forearm in mid-prone position, wrist extended between 0°-30° & ulnarly deviated 15°. The subject alternatively grips the dynamometer with his dominant and non-dominant hands, performing 3 trials, using different grip spans in random order, allowing a 1-minute rest between the measurements<sup>11-13</sup>. The reported precision of the device was 0.1 kg. For each measure, the hand to be tested first was chosen randomly. For Jamar dynamometer the grip span equivalence

**Table 3: Correlation coefficient (r) of Dominant and Non-dominant Hand grip strength with Height, Weight and BMI**

Anthropometric Variables	Grip Strength	
	Dominant	Non dominant
Height	0.518**	0.579**
Weight	0.512**	0.527**
BMI	0.337*	0.328*

\* P<0.05, \*\* P<0.001

**Table 4: Correlation coefficient (r) of Dominant and Non-dominant Hand grip strength with various Anthropometric variables**

Anthropometric Variables	Grip Strength	
	Dominant	Non dominant
Hand breadth	0.39*	0.42*
Hand length	0.60**	0.60**
Hand span	0.64**	0.62**
Wrist circumference	0.46**	0.38*
Forearm girth	0.65**	0.68**

\* P<0.05, \*\* P<0.001

for the different positions are as follows: position 1 - 3.5 cm; position 2 - 4.8 cm; position 3 - 6.0 cm; position 4 - 7.3 cm; and position 5 - 8.6 cm.

**Statistical analysis**

Pearson’s correlation coefficients were applied to establish the correlations of dominant and non-dominant hand grip strength with height, weight BMI, hand and forearm anthropometric measurements.. A 5% level of probability was used to indicate statistical significance.

**RESULTS**

In **Table 1**, descriptive statistics of age, height, weight and BMI of the subjects is depicted. Anthropometric variables of hand and forearm and grip strength are given in **Table 2**.

The dominant and non-dominant grip strength have significant positive correlation (p<0.05 - 0.001) with height (r = 0.518, 0.579),

weight (r = 0.512, 0.527) and BMI (r = 0.337, 0.328) as shown in **Table 3**.

The dominant and non-dominant grip strength have significant positive correlation (p<0.05 - 0.001) with hand breadth(r = 0.39, 0.42), hand length(r = 0.60, 0.60), hand span(r = 0.64, 0.62), wrist circumference(r=0.46, 0.38) and forearm girth(r = 0.65, 0.68) as illustrated in **Table 4**.

**DISCUSSION**

The assessment of grip strength plays a cardinal role in hand rehabilitation. It evaluates the patient’s initial limitation and renders a rapid reassessment of patient’s improvement throughout the rehabilitation. In our study 50 healthy Indian adult males were evaluated for grip strength using Jamar dynamometer. The mean dominant and nondominant grip strength was observed to be 35.56kg and 32.85kg respectively. The dominant grip strength is stronger than that of the nondominant side and this finding agree with results of Bansal<sup>14</sup> and Fraser etal<sup>15</sup>. Grip strength is influenced by factors like age, synergistic muscle action, and state of nutrition, cooperation of patient, restricted range of motion, pain and sensory loss<sup>16</sup>.

This study investigated the correlation between grip strength and physical factors like height, weight, BMI, and hand anthropometric measurements (hand length, hand breadth, hand span, wrist circumference and forearm girth) in both dominant and non dominant sides.

The findings of this study indicate that both dominant and nondominant grip strength positively correlates with height, weight and BMI. This finding partially supports and partially contrasts with the findings of Kamrul etal<sup>17</sup>, Where in significant correlations were noted between hand grip strength and height and weight but not BMI in 18-65 years aged healthy Malaysian population. The results of this study indicate that both dominant and nondominant grip strength positively correlates with hand length, hand breadth and hand span of respective sides. This finding is in agreement with the findings of MacDermid etal<sup>18</sup>, where in significant correlations were noted between hand grip strength and hand length, hand breadth and hand span of respective sides in healthy

population. In our study, Hand grip strength was positively correlated with wrist circumference. This finding is in agreement with that of Ramakrishnan et al<sup>19</sup>, where in wrist circumference has a reasonably good correlation with hand grip strength in both males and females. The findings of this study demonstrate a correlation between grip strength and forearm girth. This finding tends to be in agreement with the findings of Fraser et al<sup>15</sup>.

### Limitations and Future Scope

Due to small sample size and the type of population used, these results cannot be reflected to the entire population of India. The electronic dynamometers can be used for the assessment of hand grip strength in future. Various studies which have been reported showed significant differences between rural and industrial communities regarding handgrip strength. Our subjects in this study were from rural setting, so future research should also take urban population into consideration.

### CONCLUSION

The correlation between hand grip strength and physical factors such as height, weight, body mass index, and hand and forearm anthropometric measurements in healthy males were studied. In our study hand grip strength was positively correlated with physical factors such as height, weight, body mass index, and hand and forearm anthropometric measurements. Based on the results of our study and previous researches on hand grip strength, an attempt should be made globally to establish coefficients for grip strength evaluation. These coefficients should incorporate physical factors such as, weight, height, BMI, hand and forearm anthropometric measurements during the assessment of optimal normal grip strength for the postoperative or the post-traumatic hand depending on hand dominance and grip strength of the other side.

### CONFLICTS OF INTEREST

None declared

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