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## Original Article

# Study of Correlation between Dominant Hand's Grip Strength and Some Physical Factors in Adult Males and Females

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### ABSTRACT

**Background:** Muscular strength of the adult population is the key factor for their potency. Dominant hand plays an important role in most of the daily muscular activities and sport activities. There are many factors which may affect the handgrip strength and very few studies especially in India have shown their correlation with handgrip strength. **Aims and Objectives:** The cross-sectional study was carried out to find the correlation of age, body height, body weight, body mass index (BMI), waist circumference (WC), waist to hip ratio (WHR) and hand span of dominant hand with dominant handgrip strength in adult males and females. **Material and Methods:** The study included 121 healthy adults, 76 males and 45 females. All the parameters to be studied were measured using the standard methods and dominant handgrip strength was measured using the standard adjustable digital hand grip dynamometer in both males and females. **Statistical Analysis:** The data was analysed by Pearson's correlation coefficients and 5% level of probability was used to indicate the statistical significance. **Results:** The dominant hand's grip strength in males (M) and females (F) have significant positive correlation ( $P < 0.05 - 0.001$ ) with body height ( $r = 0.245$  (M),  $0.379$  (F)), body weight ( $r = 0.497$  (M),  $0.484$  (F)), BMI ( $r = 0.428$  (M),  $0.350$  (F)) and hand span of dominant hand ( $r = 0.761$  (M),  $0.418$  (F)). Whereas handgrip strength in subjects have non-significant weak positive correlation ship ( $P > 0.05$ ) with WC ( $r = 0.180$  (M),  $0.102$  (F)) and WHR ( $r = 0.058$  (M),  $0.101$  (F)). **Conclusion:** Our study showed the significant positive correlation of dominant hand's grip strength with age, body height, body weight, BMI and hand span of dominant hand. Weak positive but not significant, correlation of handgrip strength was also observed with WC and WHR. More research work is needed to obtain the precise correlation of these variables with handgrip strength of dominant hand

**Key Words** – Handgrip strength, Body mass index, Waist circumference, Waist to hip ratio, Handgrip dynamometer.

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## 1. INTRODUCTION

Wellbeing and proper fitness of musculoskeletal system is one of the important factors to carryout daily activities, gripping and pulling strength is part of it.

Along with daily activity the gripping and pulling strength of the hands is essential to many sports such as rock climbing, wrestling, handball, and swimming, and is regarded as a factor in maximizing performance and control.<sup>1</sup> Grip strength has long been thought of as a possible predictor of overall body strength. Direct correlation in grip strength and overall body strength was found in very old and oldest females.<sup>2</sup> There are several factors which influences the grip strength. Study showed a significant age related increase in absolute and relative handgrip strength irrespective of hand preference.<sup>3</sup> Greater height and lower functional disability were found for both men and women to be significantly associated with grip strength, among men being underweight was associated with lower hand grip strength and among women better cognitive functions was associated with higher hand grip strength.<sup>4</sup> The study results indicate that the handgrip strength was mostly dependent on the basic (body height) and hand-specific anthropometric parameters in judo performers.<sup>5</sup> When measuring handgrip strength in women, hand size must be taken into consideration.<sup>6</sup> Optimal grip span to determine the maximum handgrip strength and hand span correlated in both the genders in teenagers.<sup>7</sup> Hand span and optimal grip span showed a significant linear association in the children.<sup>8</sup> Significant correlation was observed between the dominant hand strength and the ratios of first finger over fifth finger.<sup>9</sup> The hand circumference had the strongest correlation with maximum grip strength in both males and females for right hand.<sup>10</sup>

While searching on internet we found very few studies especially in India which have attempted to establish the relation between handgrip strength and anthropometric data. The objective of this study was to establish the correlations between anthropometric data like Age, Height, Weight, BMI, Waist circumference (WC), Waist to hip ratio (WHR) and Hand span of

dominant hand with handgrip strength of dominant hand in adult males and females in order to establish a simple model to predict maximal grip strength in dominant hand. Findings may also be useful in the process of sports talent identification in grip sports such as handball, basketball, volleyball and baseball, as well as in other sports.<sup>11</sup>

## 2. MATERIAL AND METHODS

The present study was cross-sectional descriptive study conducted in the Department of Physiology, Dr. Ulhas Patil Medical College Jalgaon. Study was approved by the institutional ethics committee. Data was collected from total 121 (76 males and 45 females) first year students of different courses studying in the college. Before conducting the study informed consent was taken from all the participants. Preliminary clinical examination of subjects was carried out to exclude any neurological or musculoskeletal impairment in upper limbs or systemic cardiovascular / respiratory disorder affecting musculoskeletal functioning. Anthropometrical measurements Age, Height, Weight, Waist circumference (WC) and Hip circumference (HC) were recorded along with Hand span of dominant hand and dominant hand's grip strength test was carried out after the clinical examination.

### *Anthropometry*

*Age:* The age of the individuals was determined from their reported date of birth.

*Weight:* A digital weighing machine was used to measure the body weight with an accuracy of  $\pm 100$  grams. Subjects were weighed without their shoes and with light summer clothing.

*Height:* Standing body height was measured without shoes to the nearest 0.5 cm with the use of height stand with shoulders in relaxed position and arms hanging freely.

**Body Mass Index (BMI):** BMI was calculated as body weight measured in kilograms divided by square of body height measured in meters.

**Waist and Hip Circumferences:** The circumferences in waist and hip were obtained using a retractable measuring tape to the nearest 0.1 cm while maintaining close contact with skin and without compressing the underlying tissues. Waist was measured horizontally between the lower costal rib and the upper border of the iliac crest. Subjects were in standing position and the measurement was made at the normal minimal respiration. With light summer clothing hip was measured at the maximum circumference of the buttocks.

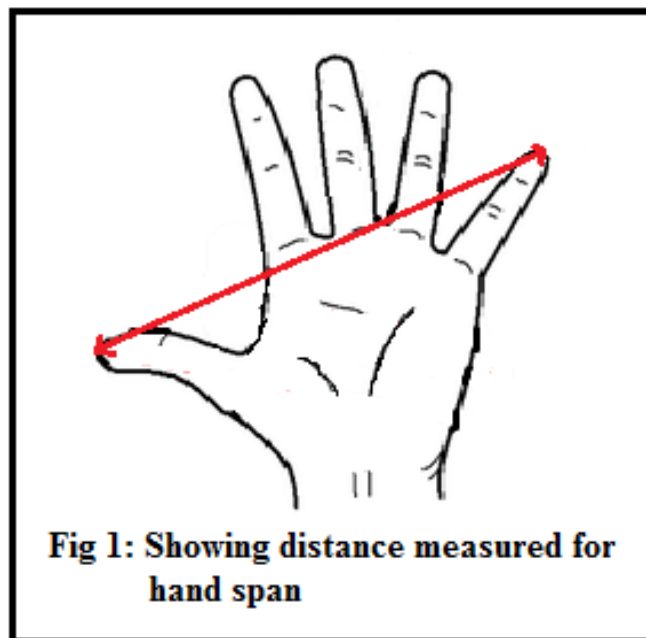
**Waist-to-Hip Ratio (WHR):** It was calculated from the above measurements by using the formula,  $WHR = \text{waist circumference (cm)} / \text{hip circumference (cm)}$ .

**Hand span:** Hand span was measured in dominant hand from the tip of the thumb to the tip of the small finger with the hand opened as wide as possible (Fig.1). The accuracy of the measurement was 0.5 cm.

**Handgrip Strength:** The grip strength of dominant hand was measured using a standard adjustable digital hand grip dynamometer (Takei Scientific Instruments Co. Ltd., Japan) at standing position with shoulder adducted and neutrally rotated and elbow in full extension. The subject grips the dynamometer, freely without support and without touching the trunk, with maximum force with his dominant hand at least for 6 seconds.<sup>12</sup> After performing 3 trials using comfortable grip span for the subject, allowing a 1 minute rest between the measurements,<sup>13</sup> best measurement out of 3 was recorded. Results were recorded in kilograms and the reported precision of the device was 0.1 kg. In females all the measurements were taken by female author.

**Statistical analysis**

Pearson’s correlation coefficients were applied to establish the correlations of dominant handgrip strength with height, weight, BMI, WC, WHR and hand span. A 5% level of probability was used to indicate the statistical significance.



**Fig 1: Showing distance measured for hand span**

**3. RESULTS AND OBSERVATIONS**

Table No 1 depicts the descriptive statistical analysis for age, height, weight, BMI, WC, WHR, hand span and grip strength of dominant hand. All the values in the table are expressed as Mean and SD for male and female students.

**Table 1: Summary of descriptive statistics for Age, Height, Weight, BMI, WC, WHR, Hand span of dominant hand and Grip strength of dominant hand in male and female subjects**

	Age (Years)	Height (cm)	Weight (Kg)	BMI (Kg/m <sup>2</sup> )	WC (cm)	WHR	Hand* span (cm)	Hand* Grip strength (Kg)
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
<b>Males</b> (n=76)	19.78 (1.21)	172.67 (5.66)	62.22 (9.32)	20.86 (2.86)	76.35 (9.24)	0.82 (0.06)	22.21 (1.42)	41.62 (4.95)
<b>Females</b> (n=45)	19.28 (1.05)	157.66 (6.36)	49.41 (8.17)	19.85 (2.91)	72.67 (9.72)	0.80 (0.06)	19.58 (1.83)	28.91 (3.15)

\* Values of dominant hand

**Table 2: Correlation coefficient (r) of Dominant Hand grip strength with Height, Weight, BMI, WC, WHR and Hand span in males and females**

Variables	*Grip Strength			
	Males		Females	
	'r' value	'p' value	'r' value	'p' value
<b>Height</b>	0.245	< 0.05	0.379	< 0.05
<b>Weight</b>	0.497	< 0.001	0.484	< 0.001
<b>BMI</b>	0.428	< 0.001	0.350	< 0.05
<b>WC</b>	0.180	> 0.05	0.102	> 0.05
<b>WHR</b>	0.058	> 0.05	0.101	> 0.05
<b>*Hand span</b>	0.761	< 0.001	0.418	< 0.05

\* Values of dominant hand

Table No 2 depicts the values of correlation coefficient (r) of dominant hand grip strength with height, weight, BMI, WC, WHR and hand span of dominant hand. Results of the table suggested that grip strength of dominant hand in males (M) and females (F) have significant positive correlation (P < 0.05 – 0.001) with height (r = 0.245 (M), 0.379 (F)), weight (r = 0.497 (M), 0.484 (F)), BMI(r = 0.428 (M), 0.350 (F)) and hand span of dominant hand (r = 0.761 (M), 0.418 (F)). As shown in table this correlation is strongly positive with hand span in males.

Whereas the grip strength of dominant hand in males and females have non- significant weak positive correlation (P > 0.05) with WC (r = 0.180 (M), 0.102 (F)) and WHR (r = 0.058 (M), 0.101 (F)).

#### 4. DISCUSSION

Adult population is back bone of nation only due to the fact that they have more muscle strength and in turn working capacity. In human's daily life, the major proportion of usage of hand is the dominant hand. Many daily functions and sporting events require high activity levels of the flexor musculature of the forearms and hands. These are the muscles involved in gripping strength. The characteristic structure of the hand is related to its function as a grasping tool. Grasping ability is made possible by the fact that the thumb can be opposed to the fingers. The fingers and the thumb act as a versatile pair of pliers. They need the palm of

the hand as a flat base, on which the object grasped can be held.<sup>14</sup> In present study we have shown that in adults' dominant hand's grip strength has significant positive correlation with age, body height, body weight, body mass index (BMI) and hand span of dominant hand. Study also shows that in adults, grip strength of dominant hand has weak positive but not significant correlation with waist circumference (WC) and waist to hip ratio (WHR).

The handgrip strength test is a simple and economic test that gives practical information about muscle, nerve, bone, or joint disorders.<sup>15, 16</sup> Even though there are various methods and devices for measuring hand strength, this is usually done using a dynamometer which is economical and easy to use.<sup>17, 18</sup> Hand held dynamometer is considered to be a reliable instrument in evaluating grip strength and is used widely in rehabilitation.<sup>19</sup> All these studies had shown that hand held dynamometer is simple and reliable instrument to measure hand grip strength. Majority of our subjects were right handed and dominant right hand posses 10% greater strength.<sup>20</sup> Grip strength correlates with overall body strength,<sup>2</sup> and several factors influences the grip strength.<sup>3</sup> So we had tried to find out correlation between various parameters and dominant hand's grip strength measured by hand held dynamometer in adults.

Key finding of the study was dominant hand's grip strength has significant positive correlation with age, body height, body weight, BMI and hand span of dominant hand. Our study results were consistent with the study which concluded 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.<sup>21</sup> Dominant right handgrip strength had strong positive correlation with anthropometric variables in elite Indian volleyball players.<sup>22</sup> Several other studies had also showed the

positive correlation of these factors with hand grip strength. In cricketers, right and left hand grip strength have significantly positive correlations with height, weight and BMI,<sup>23</sup> there was an excellent strong positive correlation when age, body height and body weight were compared with handgrip strength.<sup>24, 25</sup>

Reasons for this positive correlation are difficult to explain. Age dependent increase of hand grip strength in males and females were strongly associated with changes of muscle mass during their childhood.<sup>26</sup> In case of height, a positive correlation with the hand grip strength could be the result of various factors such as with greater heights that would lead to longer arms, with greater lever arm for force generation, resulting in an efficient amount of force.<sup>26</sup> When body weight and BMI was considered the reason can be explained only for underweight that they have very less fat.<sup>27</sup> Confirming the trends shown in previous publications, research had concluded that there are age groups handgrip strength differences for both males and females.<sup>28</sup> Relation between muscle strength and anthropometric, body composition parameters found that height and lean body mass were closely correlated with grip and leg strength, especially in men.<sup>29</sup>

Our study also showed that grip strength of dominant hand has weak positive but not significant correlation with WC and WHR. Surprisingly while searching on internet we didn't find any study on correlation between WC/WHR and handgrip strength. WC/WHR is the measures of visceral or abdominal fat mass. This measurement is independent of height and muscle mass, has emerged as important predictors of risk of obesity related diseases and is thus very useful indicators of excess body fat and increased health risk.<sup>30</sup> It was suggested that overall muscle function was impaired in obese females compared to their non-obese counterparts and not only the lack of physical activity but obesity and its metabolic consequences also might

be responsible for this finding.<sup>31</sup> At whole muscle and fascicular levels, adiposity of obesity was associated significantly with lower skeletal muscle contractile capacity in young adults.<sup>32</sup> Therefore may be correlation of WC and WHR with dominant hand's grip strength was not significant.

The limitation of the present study was in its design. This was a small group cross-sectional study carried out in the single institute. Though our study was not vast, it does provide hint of the correlation of handgrip strength and anthropometric parameters. A larger sample size and a longitudinal study will definitely be of a great value in predicting the correlation between hand grip strength and various physical parameters. Further, the correlation needs to be studied in non dominant hand. We are planning to expand the study in larger population by including more anthropometric parameters of hand/body composition and their correlation with grip strength of both the hands, in different age groups so as to obtain more precise correlation ship in between them.

## 5. CONCLUSION

Present study is based on the premise that the anthropometric parameters have correlation with dominant hand's grip strength. More specifically the purpose of this study is to establish the correlations between anthropometric data like Age, Height, Weight, BMI, WC, WHR and Hand span with dominant hand's grip strength in adult males and females. Based on the results of this study, significant positive correlation is observed between age, body height, body weight, BMI, dominant hand's span and dominant hand's grip strength. Weak positive but not significant, correlation is also observed with WC and WHR. Causes for these results are difficult to explain but as far as WC and WHR are concern obesity, its metabolic consequences might be responsible for non significant correlation. Our study establishes a simple model to predict

maximal grip strength in dominant hand. Findings may also be useful in the process of sports talent identification in grip sports.

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