A CROSS SECTIONAL STUDY OF ASSOCIATION BETWEEN SELECTED HAND ANTHROPOMETRIC VARIABLES AND HANDGRIP STRENGTH IN YOUNG ADULTS: A GENDER DIFFERENCE APPROACH

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Abstract: **Background and objectives**: Isometric hand grip strength as assessed by Maximum Voluntary Contraction (MVC) is a measure of athletic talent and morbidity outcomes. The present study investigated the possible association of the hand anthropometric variables and general body characteristics with the handgrip strength among young adults and explored the difference among male and female. **Methods:** Hand anthropometric variables and physical characteristics were studied in 32 males (age: 19.25±1.08) and 30 females (age: 18.67±0.84) using standard methods of measurements. Statistical analysis was done by parametric test and studied parameters were correlated with Handgrip strength measured as MVC. Level of significance was considered as $p<0.05$ at 95% CI. **Results:** Body weight and body surface area was significantly correlated with handgrip strength in males. None of the hand anthropometric parameters studied was significantly correlated with the handgrip strength in males and females separately. **Interpretation and Conclusion**: Young adult males have higher handgrip strength than their counter part females because they are heavier and having more body surface area. Though there are significant differences in hand dimensions and anthropometry between males and females, they are not influencing the handgrip strength.

Key Words: Adult, Anthropometry, Body Surface area, Body weight, Hand strength, Isometric Exercise.

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Introduction:

Handgrip strength is a good parameter not only in evaluation of hand as a predictor of hand function, but also to explore the status of general health.[1,2] Also, there are certain other uses of handgrip strength measurement as explained in different literatures like as a cause of mortality[3], index of nutritional status, predicting complications following surgical treatment strategies[4] and for identification of sport talent in a person.

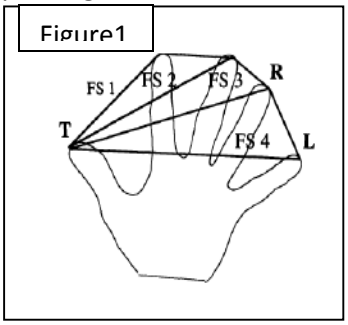
Handgrip strength as measured by Maximum Voluntary Contraction (MVC) have a positive relationship with body weight, body height, Body Mass Index (BMI) and Body Surface Area (BSA) as investigated by various researchers in varied population of athletes, children and adolescent[5]. Visnapuu and Jurimae had measured hand anthropometric variables and found their association with hand grip strength[6]. However information related to the correlation of handgrip strength and hand anthropometric variables in adult males and females is scanty. Hence this study was designed to explore the gender differences in hand anthropometric variables and physical characteristics and their possible relation with MVC.

Material and Methods:

Place: The experimental trial was carried out in the Clinical Laboratory, Department of Physiology S.B.K.M.I. & R.C. Sumandeep Vidyapeeth University. The participants reported in the morning hours from 9:30 am to 12:30 pm after having light breakfast[7]. The study was conducted in the room with normal temperature and bright light[8] after 30 minutes rest period.[9]

Ethics: This study was approved by Sumandeep Vidyapeeth Institutional Ethical Committee by approval no. SVIEC/ON/MEDI/SRP/14251 on 02/07/2014. After explaining the nature, intent and procedure of the study, informed and written consent was obtained according to SVIEC Policy from the participants.

Figure1



Study Design:

It was a cross sectional study. Purposive random sampling was done and the target population was young adults of both the sexes from urban area.

Inclusion criteria:

1. Age group: 18 to 22 years old.
2. Sex: Both Male and Female
3. Healthy and normally active i.e. participants without history of hypertension, cardiovascular, renal, musculoskeletal, neurological, psychological or chronic disorders.
4. Normotensive (BP < 140/90 mmHg)
5. Non alcoholics
6. Non tobacco chewers
7. Persons willing to sign the informed consent form and participate in the study.

Exclusion criteria:

1. Participants who were unable to perform the handgrip test either because of disability limiting the ability of the upper extremities to do so.
2. Disabled or diseased participants.
3. Participants having athletic background.
4. Participants with acute illness or on any medication.
5. Persons who were unable to co-operate.

Screening was done to ensure the normotensive blood pressure (<140/90 mmHg) of the participants.

Sample Size was 62. Participants were divided in to 2 groups based on the sex: Males (n=32) and Females (n=30). Sample size was calculated using mean differences of parameters by OpenEpi Software.

Recording of the physical characteristics: The age of the participants was recorded from registered birth date in the institution. Height (to the nearest 0.5 cm) was measured by the stadiometer during inspiration with individual standing upright, facing front to the wall, looking ahead and heels touching to one another. Body weight was measured with light clothing and without any footwear using a weight scale nearest to 0.5 kg. Body Mass Index was calculated as: BMI = [Weight in kg ÷ (Height in m)^2] Body Surface Area (BSA) was calculated as per Mosteller's Formula (1987):

BSA (m^2) = [{Height (cm) × Weight (kg)} ÷ 3600]$^{1/2}$

Recording of Hand Anthropometric Variables: Participants were instructed to seat comfortably and to spread and stretch out their dominant hand and place on the paper located on the table. The outlines of the dominant hand were drawn with maximal abduction of the fingers and thumb. The three anthropometric variables of the hand were measured with standard 300mm metal ruler as described by Visnapuu and Jurimae (2007).[6] As shown in the figure 1. 4 finger spans *FS1, FS2, FS3, and FS4* were measured. Finger span *FS5* was considered as *TIMRL* shown in figure 2. Finger length of all

Figure 2

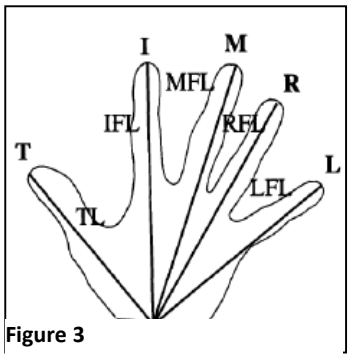
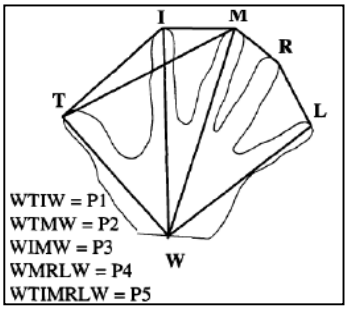


Figure 3



the five fingers was measured as shown in figure 2 i.e. *TL, IFL, MFL, RFL*, and *LFL*.

As per figure 3. 5 perimeters *P1, P2, P3, P4* and *P5* were obtained.

Recording of Maximal Voluntary Contraction (MVC): MVC for the handgrip was obtained by the Calibrated Spring-Loaded Type Dynamometer (Inco-Ambala). The participants exerted maximum effort by their dominant hand and squeezed the bar of the dynamometer maintained it for 2-3 seconds in sitting position and MVC was recorded in kg after 3 trials with brief pause of 10 sec.

Statistical Analysis:

All data were expressed as *mean ± SD. Independent t test* was used to compare mean of each variables between the groups. *Pearson correlation co-efficient* (r) was used to evaluate correlation of MVC with other variables using SPSS ver.20. Level of significance was considered as $p<0.05$ at 95% CI.

Result:

Sample Characteristics: Shapiro-Wilk's test ($p>0.05$) and a visual inspection of their Histogram, Normal Q-Q plots, Skewness and Kurtosis value showed that the data were approximately normally distributed.[10,11,12]

Table.1 Gender difference in anthropometric parameters and MVC.

	Females (n=30)		Males (n=32)	
	Mean	SD	Mean	SD
Age (years)	18.67	0.84	19.25	1.08
Height (Inch)	62.35	2.69	67.39**	2.56
Height (m)	1.58	0.07	1.71**	0.06
Weight (kg)	52.73	9.22	63.91**	10.92
height (cm)	158.37	6.84	171.17**	6.50
BSA m^2	1.52	0.14	1.74**	0.16
BMI (kg/m^2)	21.09	3.79	21.75	3.55
MVC (kg)	22.33	5.04	33.31**	8.00

**P<0.01 on comparison with females

Table.1illustrates the mean and standard deviation values of the physical characteristics and handgrip strength of the study population with the independent t test results. Body height (p<0.001), body weight (p<0.001) and body surface area (p<0.001) were significantly greater in young adult males in comparison to females. However, body mass index was identical among both the groups. There was a significant difference observed in the absolute hand grip strength measured as maximum voluntary contraction (p<0.001) between the groups.

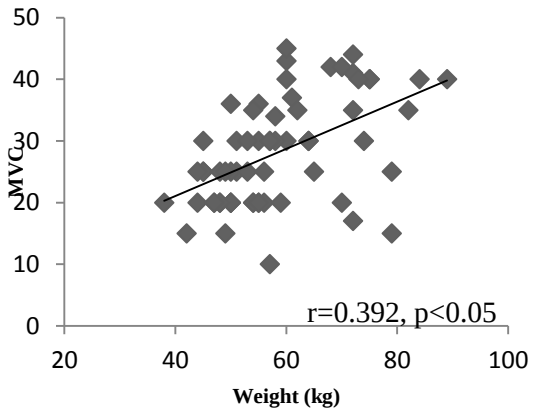
As depicted in table 2 there was highly significant (p<0.001) difference observed in all the hand anthropometric variables between the males and females.

Table.2 Gender difference in hand anthropometric parameters

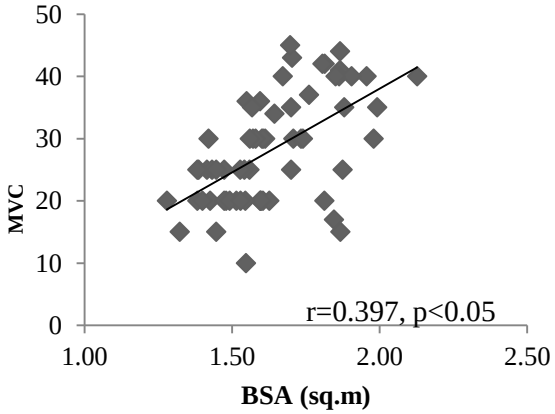
	Females (n=30)		Males (n=32)	
	Mean	SD	Mean	SD
FS1	9.97	0.89	11.20**	1.32
FS2	13.92	1.06	15.87**	1.59
FS3	16.20	1.07	18.40**	1.74
FS4	17.87	1.12	20.29**	1.52
FS5	24.77	1.54	28.19**	2.10
TL	12.18	1.08	13.07**	0.78
IFL	16.34	0.96	17.80**	0.90
MFL	17.02	0.96	18.59**	0.90
RFL	15.99	0.91	17.73**	0.86
LFL	13.91	0.74	15.31**	0.78
P1	38.21	2.69	42.06**	1.88
P2	43.02	2.16	47.53**	2.14
P3	38.13	2.32	42.31**	2.07
P4	40.71	2.07	45.03**	2.00
P5	50.92	2.46	56.62**	2.55

**P<0.01 on comparison with females

Graph- 1: Scatter plot of correlation between MVC and weight in males.



Graph- 2: Scatter plot of correlation between MVC and BSA in males.



The relationship between the handgrip strength and physical characteristics of the males and females were summarized in the table 3.

In the study population all the physical and hand anthropometric parameters studied were positively and significantly (p<0.05) correlated with the handgrip strength.

In males, only weight (r=0.392, p<o.05) and Body Surface Area (r=0.397, p<0.05) had a positive and significant correlation with the handgrip strength while in females none of the studied parameters were significantly correlated.

Table.3 Correlation of hand anthropometric parameters with MVC in study population and in males and females separately.

Pearson Correlation coefficient (r)			
Parameters	**Overall (n=62)**	**Males (n=32)**	**Females (n=30)**
FS1	**0.248**	**-0.151**	**0.074**
FS2	**0.348****	**-0.066**	**0.017**
FS3	**0.347****	**-0.077**	**-0.037**
FS4	**0.388****	**-0.043**	**-0.157**
FS5	**0.362****	**-0.105**	**-0.193**
TL	**0.260***	**-0.030**	**-0.018**
IFL	**0.414****	**0.039**	**0.005**
MFL	**0.426****	**0.043**	**-0.019**
RFL	**0.518****	**0.192**	**0.026**
LFL	**0.545****	**0.245**	**0.120**
P1	**0.374****	**-0.100**	**-0.039**
P2	**0.454****	**-0.042**	**0.015**
P3	**0.453****	**0.105**	**-0.114**
P4	**0.456****	**0.026**	**-0.106**
P5	**0.459****	**-0.026**	**-0.087**
Age	**0.135**	**-0.095**	**-0.014**
Height	**0.546****	**0.178**	**0.204**
Weight	**0.492****	**0.392***	**0.025**
BSA	**0.560****	**0.397***	**0.084**
BMI	**0.196**	**0.345**	**-0.068**

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Discussion:

The present study was undertaken among 62 young adults of both the sexes to investigate the effect of hand and general anthropometric characteristics on handgrip strength (MVC). We found that handgrip strength and general body characteristics were significantly different between young adult males and females. Male participants showed higher mean values for all the tested anthropometric variables than females, except for BMI. Based on the present study, males also showed a higher mean value of hand grip strength and this agrees with the study conducted by Shyamal and Sartinder (2011)[13], Bohannon RW et al. (2006)[14] which showed that males have higher mean values of all the anthropometric parameters than females.

Only weight and body surface area was significantly correlated with handgrip strength in males which suggests that they have positive effect on hand grip strength in this group. Chatterjee and Chowdhuri (1991)[15] agreed that hand grip strength when measured by hand dynamometer was positively correlated with weight, height and body surface area.

The handgrip strength is a physiological variable affected by age, gender and body size.[16,17] The MVC (kg) the indicator of the handgrip strength was significantly higher in males compared to females in our study. This indicates the greater muscle strength of males than females. This is due to the male sex hormone testosterone, which causes increase in muscle mass during development and protein formation. The musculature there by increasing in the males after puberty averaging about 50% than in females.[18]

We observed a significant correlation of all the hand anthropometric variables with MVC as shown by Visnapuu and Jurimae (2007)[6], indicating an association between hand measurements and handgrip strength. None of the hand anthropometric parameters was significantly correlated with the handgrip strength when males and females were separately investigated. This may question the association between hand anthropometry and MVC.

Conclusion:

We concluded from our study results that young adult males have higher handgrip strength than their counterpart females because they are heavier and having more body surface area as these variables are positively correlated with the hand grip strength. The findings suggested that though there are significant differences in hand dimensions and anthropometry between males and females, they are not influencing the handgrip strength.

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