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A study of correlation between hand anthropometry and hand grip strength in young adult male population of North India

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ABSTRACT

Dimensions of human hand have been measured by various authors across study groups. This anthropometric data has frequently been used to solve medicolegal cases. However, these details differ across various population groups and races, hence the present study was specifically undertaken to make an anthropometric record of young male population of North India. Young males between the 18 to 25 years were selected and their hand length, hand breadth and Hand Index were measured. Sliding Vernier's callipers and Dynamometer were used to measure the dimensions of hand and strength of hand grip, respectively. An anthropometric index (Hand Index) was calculated after measuring hand length and hand breadth. The results of the study indicated that hand grip strength was more in the right hand than the left hand and that all the hand variables were positively correlated to the hand grip strength.

1. Introduction

Human hand is a structurally unique part of the upper extremity with a number of bones, joints and muscles acting in a unison. Digits of the hand permit tight grasp which is under control of an elaborate nervous plexus.[1] Appropriate positioning of hand in space allows hand to complete a particular task.[2] Hand grip is grasping of objects and hand grip strength is the forceful flexion of the finger joints with a maximal voluntary force that the subject is able to exert under normal biokinetic conditions.[3] Hand grip strength is an important component of precise and fine motor activities, an indicator and measure of strength of several forearm muscles.[4] Estimation of hand grip strength is of immense importance as it determines the efficacy of different treatment strategies and rehabilitation.[5] A number of factors like age, sex and body size influence the hand grip strength. Additionally, hand grip predicts the muscular strength by determining the bone mineral density and bone area at the hand and forearm site.[6] Earlier studies on the hand grip have indicated the difference between grip strength of right and left handed subjects.[7] Hand grip strength influences optimal grip span in women.[8]

The current study aims to correlate the hand anthropometric indices with the hand grip strength in young adult male subjects.

2. Materials and Methods

The present study was conducted in the Department of Anatomy, Maharishi Markandeshwar Institute of Medical Sciences and Research, Mullana, (Ambala) on 200 young male subjects. The subjects were from different parts of north India. Prior informed written consent for the study was obtained from subjects in English and Vernacular. Apparently healthy males in the age group 18-25 years were selected. Subjects with apparent anomalies, inflammation, trauma, deformities and history of surgery of hand were not selected. Subjects with chronic medical illness were also excluded from the study.

1. Sliding calipers
2. Dynamometer

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In the present study hand length and breadth were measured on both the hands of all the subjects. Hand grip strength of both hands was also measured. All the measurements were taken on the clean and dry hands of the subjects in the following manner:-

The subjects were asked to place the hand in supine position on a table with fingers extended.

The hand dimensions were taken by sliding Vernier 's Caliper.

The following were the dimensions measured on the subjects:-

Hand Breath (HB): Distance between the most lateral parts on the head of 2^{nd} metacarpal to the most medial point of the head of 5^{th} metacarpal.

Hand length (HL): Distance between midpoints of the distal transverse crease of the wrist to the most anterior projection of the skin of the middle finger.

Hand index (HI): Hand breadth / Hand length $\times$ 100.

2.1. Method for measuring hand grip strength

Hand dynamometer made by fabrication enterprises, NY 10533 U.S.A., was used to measure the grip strength of all the subjects. Each subject was made to sit on a chair with elbow flexed at 90 degrees and the forearm in semi-pronation lying on an arm rest. The subjects were asked to squeeze the dynamometer with their hand and grip strength was recorded (kg).

Anthrppometric index:

$Hand\ index\ (HI) : \frac{Hand\ breadth}{Hand\ length} X\ 100$

2.2. Statistical analysis

1. All the data was compiled and entered in Microsoft Excel worksheet as master chart.
2. The data was statistically analyzed (arithmetic mean and standard deviation will be calculated) and tabulated.

3. Result

The mean age of males in the present study was 20.31$\pm$ 2.03 years. Hand dimensions of the subjects like hand length & breadth were measured and hand index was calculated for both sides; minimum and maximum readings were noted and mean calculated along with standard deviation (Table 1).

Index and ring finger length were measured for both sides; minimum and maximum readings were recorded and mean calculated (Table 2).

Table 3 shows left hand anthropometric parameters like hand length, hand breath and hand index among the subjects. The minimum and maximum values for hand length, hand breadth and hand index are given in the table; their respective mean and standard deviation.

Table 4 shows Right hand anthropometric indices like hand length, hand breadth and hand index along with their respective means and standard deviations; all measurements were in cm.

Table 5 shows the comparison of various anthropometric parameters of both hands of the subjects. Mean value of hand breadth, hand index and ring finger length was seen higher in right hand of male students while hand length and index finger length was found higher in left hand of male students.

Table 6 shows the comparison of hand grip strength among right and left hand of male students. The mean value of right hand grip strength was higher as compared to left hand grip strength in male students. The difference was statistically significant (p value=0.006).

The Table 7 shows the correlation of hand grip strength with the anthropometric parameters of both the hands in males. A positive correlation was found between the hand grip strength and all the hand parameters of both the hands in males ($p \leq 0.05$) except for the left ring finger length.

Table 8 shows the regression equation for calculation of hand grip strength in males from the values of different hand parameters. In the Table 8 y stands for the hand grip strength and x stands for the particular hand measurement.

Table 9 shows the regression equation for the calculation of age of males from the various hand anthropometric measurements of male students. In the Table 9 y stands of the age of the individual and x stands for the particular hand measurement.

Table 1: Range of Hand dimensions(length & breadth) and Hand Index of right and left side

Variables		Minimum	Maximum	Mean $\pm$ SD
Hand length (cm)	Right	16.45	22.46	19.28$\pm$1.06
	Left	16.94	23.71	19.29$\pm$1.09
Hand breadth (cm)	Right	6.22	10.07	8.50$\pm$0.57
	Left	6.94	10.45	8.47$\pm$0.64
Hand index	Right	34.92	55.13	44.23$\pm$3.10
	Left	36.30	52.45	43.97$\pm$2.97

Table 2: Digital anthropometric indices of subjects

Variables		Minimum	Maximum	Mean $\pm$ SD
Index finger length (cm)	Right	6.36	8.91	7.52 $\pm$ 0.43
	Left	6.09	9.33	7.55 $\pm$ 0.50
Ring finger length (cm)	Right	5.43	8.93	7.74 $\pm$ 0.61
	Left	6.32	9.12	7.65 $\pm$ 0.62

Table 3: 3 Left hand anthropometric parameters Hand length, hand breadth and hand index (in cm) along with respective standard deviation (in cm)

Left Hand Variable	Minimum (in cm)	Maximum (in cm)	Mean ± SD (incm)
Hand Length	16.94	23.71	19.29 ± 1.09
Hand breadth	6.94	10.45	8.47 ± 0.64
Hand Index	36.30	52.45	43.97 ± 2.97

Table 4: Right hand anthropometric parameters such as hand length, hand breadth and hand index along with respective standard deviation (in cm)

Right Hand Variable	Minimum (in cm)	Maximum (in cm)	Mean ± SD (in cm)
Hand Length	16.45	22.46	19.28 ± 1.06
Hand breadth	6.22	10.07	8.50 ± 0.57
Hand Index	34.92	55.13	44.23 ± 3.10

Table 5: Comparison of hand anthropometric parameters among right and left hand of the subjects

Variables		Minimum	Maximum	Mean ± SD	p-Value
Hand length (cm)	Right	16.45	22.46	19.28 ± 1.06	0.905
	Left	16.94	23.71	19.29 ± 1.09	
Hand breadth (cm)	Right	6.22	10.07	8.50 ± 0.57	0.558
	Left	6.94	10.45	8.47 ± 0.64	
Hand index (cm)	Right	34.92	55.13	44.23 ± 3.10	0.394
	Left	36.30	52.45	43.97 ± 2.97	
Index finger length (cm)	Right	6.36	8.91	7.52 ± 0.43	0.529
	Left	6.09	9.33	7.55 ± 0.50	
Ring finger length (cm)	Right	5.43	8.93	7.74 ± 0.61	0.144
	Left	6.32	9.12	7.65 ± 0.62	

Table 6: A comparison of hand grip strength among right and left hand of subjects

Variable		Minimum Handgrip Strength	Maximum Handgrip Strength	Mean ± SD	p-Value
Male (N=200)	Right hand	18.00	54.00	39.23±7.43	0.006*
	Left hand	18.66	56.00	37.21±7.29	

*p-Value $\leq$ 0.05 statistically significant

Table 7: Correlation of right and left hand anthropometric parameters with handgrip strengthin male students

Variables		r-Value	p-Value
Hand length	Right	0.308	0.001*
	Left	0.319	0.001*
Hand breadth	Right	0.429	0.001*
	Left	0.381	0.001*
Hand index	Right	0.169	0.017*
	Left	0.138	0.051

*p-Value $\leq$ 0.05 statistically significant

Table 8: Regression equation for hand grip strength and hand anthropometric measurements of male students

Variables	Right hand	Left Hand
Hand Lengths	y = 2.1534x - 2.2785	y = 2.1311x - 3.8916
Hand Breadth	y = 5.5757x - 8.184	y = 4.356x + 0.3272
Hand Index	y = 0.4048x + 21.329	y = 0.3383x + 22.342

Table 9: Regression equation for age and hand anthropometric measurements of male students

Variables	Right hand	Left Hand
Hand Lengths	y = 0.0159x + 20.009	y = 0.1726x + 16.986
Hand Breadth	y = 0.5160x + 15.927	y = 0.7405x + 14.045
Hand Index	y = 0.0836x + 16.619	y = 0.1151x + 15.255
Index Finger Length	y = 0.4706x + 16.777	y = 0.5389x + 16.247
Ring Finger Length	y = 0.6315x + 15.425	y = 0.5352x + 16.219
Hand Grip Strength	y = 0.0453x + 18.539	y = 0.0287x + 19.246
2D:4D Ratio	y = -0.138x+20.45	y = -0.055x+20.37
y is the age of individual and x is the particular hand measurement		

Table 10: Comparison of hand length of males subjects of present study group with some accessible previous studies

Authors	Population & Region	Age	Sex (No. of subjects)	Mean hand length	
				RHL	LHL
Present study (2017)	Students, North Indian	18-25 years	Male (200)	19.28	19.29
Dhawan V et al (2016) [9]	Haryana, India	21-25	Male (200)	19.36	19.42
Kumar T et al (2015)	Kashmiri Pandits	18+	Male (150)	18.17	18.26
Aboul-Hagag KE et al (2011) [10]	Egyptian	18	Male (250)	19.47	19.49
Ibeachu PC et al (2011) [11]	Port Harcourt Nigeria	18-30	M (150)	19.02	19.09
Danborno B et al (2008)	Nigerian	18+	M(250)	19.85	19.93

Table 11: Comparison of hand breadth of males of present study group with some accessible previous studies

Authors	Population & Region	Age	Sex & No. of subject	Mean hand breadth	
				RHB	LHB
Present study (2017)	Students, North Indian	18-25 years	M (200)	8.50	8.47
Dhawan V et al (2016) [9]	Haryanvi, India	21-25	M (200)	8.77	8.81
Aboul-Hagag KE et al (2011) [10]	Egyptian	18	M (250)	8.13	8.14
Ibeachu PC et al (2011) [11]	Port Harcourt	18-30	M(150)	8.58	8.43
Danborno B et al(2008)	Nigerian	18+	M (250)	8.90	8.68

Table 12: Comparison of length of index fingers of both hands of subjects present study group with some accessible previous studies

Authors	Population & Region	Age (years)	Sex & No. of subject	Mean index finger length	
				RH(cm)	LH(cm)
Present study	Students North Indian	18-25	M (200)	7 .52	7.55
Sen. J et al (2015) [12]	Rajbansi (East India)	18-60	M(250)	6.84	6.86
Ibegbu AO et al (2012) [1]	Nigerian students	18years	M(300)	7.43	7.43
Hagag KEA et al (2011) [10]	Egyptian	18	M (250)	7.80	7.85

Table 13: Comparison of ring finger dimensions of subjects of present study group with some accessible previous studies

Authors	Population & Region	Age	Sex & No. of subject	Mean hand ring finger length	
				RH	LH
Present study	Students North Indian	18-25	M (200)	7.74	7.65
Sen. J et al(2015) [12]	Rajbansi population	18-60	M (250)	7.05	7.13
Ibegbu AO et al (2012) [1]	Nigerian students	18 years	M(300)	8.03	8.03
Hagag KEA et al (2011) [10]	Egyptians	18 years	M (250)	8.07	8.11

Table 14: Comparison of hand grip strength of present study group with some accessible previous studies

Authors	Population & Region	Age	Sex & No. of subject	Mean of the hand grip strength	
				Right	Left
Present study (2017)	Students North Indian	18-25	M (200)	39.23	37.21
Koley S et al. (2006) [13]	Punjab India	18-25	M	–	–
Bansode DG et al. (2004) [14]	Students Turkey	18+	M (76)		41.62
Barut C et al. (2008) [2]	Players Turkey	9-18	M (236)		23.46

4. Discussion

The present study was undertaken to obtain the baseline data for the various anthropometric parameters of the hand, in young male population of north India. This can serve as a baseline data for the population indicating the nutritional status and their physical activity.[2]

The results of this study were observed to be similar to the various studies done by Dhawan V et al, Kumar T et al, Aboul - Hagag, KE et al, Ibeachu PC et al, Danborno B et al.

Hand breadth measurements for both right and left hand were compared with the measurements of the earlier studies done inside and outside India (Table 11). The results of the studies done by Aboul-Hagag KE et al, Ibeachu PC et al, Danborno B et al were similar to the present study. All these studies were done on male subjects and the number of subjects varied from 100 to 250.

Index finger lengths of both the hands were compared with some of the previous studies done in India and abroad. Similar results were observed in the studies done by Sen. J et al, Ibegbu AO et al and Hagag KEA et al.

Dimensions of ring finger of the subjects in the preset study were compared with the similar dimensions of some of the previous studies (Table 13). Similar result were observed in the studies done by Sen J et al, Ibegbu AO et al, Hagag- KEA et al.

Table 14 compares the hand grip strength of the subjects in the present study with some of the earlier studies. The hand grip strength was found more for the right hand as compared to the left hand. The results were statistically significant. The similar results were observed in the studies done by Koley et al, Bansode DG et al, Barut C et al.

5. Conclusion

The present study gives a baseline data for the anthropometric parameters of the hand like hand length, hand breadth and hand index in young male population of north India. It was observed in the present study that all the hand variables were positively correlated to the hand grip strength. The findings and measurements of the present study were compared with some of the findings of the earlier studies on hand anthropometry and it was concluded that findings of the current study were very much on line with earlier studies.

6. Source of Funding

None.

7. Conflict of Interest

None.

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