ORIGINAL RESEARCH

Anthropometric Determinants of Hand Grip Strength in Normal Healthy Punjabis

[1]Ravneet Sandhu, [2]Parminder K Sandhu, [3]Dimple Bajaj, [4]Joginder P Singh

ABSTRACT

Aim: To determine whether height, body mass index (BMI), hand length, and hand breadth were predictive of hand grip strength in healthy Punjabi adult males and females.

Materials and methods: This cross-sectional study recruited 100 healthy adult males (50) and females (50) in the age group of 50 to 60 years randomly. Their anthropometric characteristics including height, weight, BMI, hand length, and hand breadth were measured using standard techniques. Hand grip strength was measured using Jamar dynamometer. Data were analyzed using Student's t-test and analysis of variance (ANOVA).

Results: The present study generated the normative data for hand grip strength and its association with gender, height, weight, BMI, hand length, and hand breadth in study subjects. The gender difference in grip strength was statistically significant with higher grip strength found in males than females. Also, it was found that grip strength was more in the dominant hand as compared with the nondominant hand. Subjects with longer and broader hands had stronger grip.

Conclusion: The knowledge of determinants of hand grip strength in a normal population is essential as in clinical settings it is used as an indicator of overall physical strength and health. Hand length and hand breadth should be well thought out for hand grip strength measurements in the older age group since these anthropometric measures could affect the results of treatment and control of hand function.

Keywords: Body mass index, Hand breadth, Hand grip strength, Hand length, Jamar dynamometer.

[1]PhD Scholar, [2,3]Professor, [4]Wellness Consultant

[1]Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar, Punjab, India

[2,3]Department of Physiology, Sri Guru Ram Das Institute of Medical Sciences & Research, Amritsar, Punjab, India

[4]SRL Ranbaxy Lab, Amritsar, Punjab, India

Corresponding Author: Parminder K Sandhu, Professor Department of Physiology, Sri Guru Ram Das Institute of Medical Sciences & Research, Amritsar, Punjab, India, e-mail: sandhugillp@rediffmail.com

INTRODUCTION

Estimation of hand grip strength is crucial in deciding the effectiveness of treatment strategies and hand rehabilitation. The hand grip strength is the result of greatest voluntary forceful flexion of the fingers by an individual under normal conditions.[1] Hand grip strength is important for performing day-to-day activities.[2] The hand grip measurement may be used in research, as follow-up of patients with neuromuscular disease,[3] as the functional index of nutritional status, for predicting the extent of complications following surgical intervention,[4] and also in sport talent identification.[5] Research suggests that there are strong correlations between grip strength and various anthropometric traits, such as age,[6] hand length,[7] and BMI.[8] Handheld dynamometers have been used to measure muscle strength, especially muscles that are strong enough to exert force against gravity and tolerate resistance.[9] There have been varied results in the understanding of the relationship between BMI and hand grip strength,[10] with BMI being shown to be insignificant in some studies of hand grip strength.[11,12]

This present study aimed to determine whether height, weight, gender, BMI, hand length, and hand breadth were predictive of hand grip strength of healthy adult Punjabi males and females in the age group of 50 to 60 years.

MATERIALS AND METHODS

The study was approved by the research and Ethical Committee of the Institute. This cross-sectional study was carried out on 50 males and 50 females, who were apparently healthy volunteers selected randomly from the city of Amritsar in the age group of 50 to 60 years. About 90% of the participants were right-handed. The nature and underlying principle of the study were explained to the subjects followed by obtaining written informed consent in vernacular language.

The included subjects had no glucose intolerance, no history of pain and musculoskeletal problems in the shoulder, arm or hand, and no documented history of trauma or brachial plexus injury, peripheral nerve injury, or cervical radiculopathy in the previous 6 months. None of the participants was involved in an occupation that requires manual handling that can influence the hand grip.

Participants with a history of cervical spondylosis, carpal tunnel syndrome, peripheral nerve injury, and cervical radiculopathy during the previous 6 months were excluded from the study. Demographic information in the form of questionnaire was taken from each subject. Weight and height were recorded to calculate BMI. Age was calculated in years to the nearest half year. Height to the nearest centimeter was recorded in subjects standing barefoot on the floor against the wall with their heels slightly separated and their buttocks in contact with the wall. Their weights were measured in kilograms on a portable weighing machine without wearing shoes.

The BMI was calculated using formula:

$$BMI\ (kg/m^2) = Wt\ (kg)/Ht^2\ (m).$$

The hand length was measured from the distal crease of the wrist to the tip of the middle finger using a flexible measuring tape (cm) for both hands. Hand breadth measurement was taken in both hands from the radial side of the metacarpal D2 (index finger) to ulnar side of metacarpal D5 (small finger).[3,13]

Hand grip strength was measured on the dominant hand and nondominant hand using Jamar handheld dynamometer. The subject was seated in a straight back chair with their feet flat on floor. The shoulder was adducted and neutrally rotated, elbow flexed at 90°, and forearm was in neutral position with the wrist between 0 and 30° extension and between 0 and 15° ulnar deviation. The period of the effort did not exceed 5 seconds. A period of 30 seconds rest was given between three trials for the dominant hand to be tested. The Average of the three trials was calculated.

Means and standard deviations were used to describe the participants' demographic data.

Statistical measures of the mean scores and standard deviation were calculated for the baseline measurement for each participant. Paired t-test was used for comparing data of the subjects.

RESULTS

Table 1 shows descriptive statistics of hand grip strength in the dominant hand with selected anthropometric variables in healthy males and females. Females had lower mean variables in height (159.62 cm), weight (67.22 kg), BMI (26.43 kg/m²), hand length (17.69 cm), hand breadth (7.92 cm), and hand grip strength (25.16 kg) than male counterparts (173.46 cm, 71.10 kg, 23.59 kg/m², 18.79 cm, 8.47 cm and 32.90 kg respectively). Statistically significant (p ≤ 0.001) difference was noted in height (t = 11.77), BMI (t = 4.03), hand length (t = 5.12), and hand grip strength (t = 6.55).

Table 2 shows descriptive statistics of grip strength in nondominant hand with selected anthropometric variables in males and females. In nondominant hand, the females have lower mean values in height (160 cm), weight (67.22 kg), hand length (17.79 cm), and hand grip strength (21.64 kg) than males (173 cm, 71.10 kg, 18.83 cm, 28.62 kg respectively). There was observed higher mean value in BMI 26.43 kg/m² and hand breadth (9.27 cm) in females than males (23.59 kg/m², 8.43 cm respectively). Highly significant differences (p ≤ 0.001) were noted in height (t = 11.77), hand length (t = 5.55), hand grip strength (t = 6.42), and BMI (t = 4.03).

Table 1: Descriptive statistics of grip strength in dominant hand with selected anthropometric variables in males and females

	Males		Females			Significance
Parameters	*Mean*	*SD*	*Mean*	*SD*	*t-value*	*p-value*
Age (years)	55.28	2.83	54.62	2.5	1.2	NS
Height (cm)	173.46	5.74	159.62	6.01	11.77	0.001
Weight (kg)	71.10	9.47	67.22	10.05	1.24	NS
BMI (kg/m²)	23.59	2.74	26.43	4.15	4.03	0.001
Hand length (cm)	18.79	0.92	17.69	0.88	6.12	0.001
Hand breadth (cm)	8.47	0.41	7.92	0.30	7.70	0.001
Total hand grip strength (kg)	32.90	7.60	25.16	3.45	6.55	0.001

SD: Standard deviation; NS: Not significant

Table 2: Descriptive statistics of grip strength in nondominant hand with selected anthropometric variables in males and females

	Males		Females			Significance
Parameters	*Mean*	*SD*	*Mean*	*SD*	*t-value*	*p-value*
Age (years)	55.28	2.83	54.62	2.55	1.22	NS
Height (cm)	173.46	5.74	159.62	6.01	11.77	0.001
Weight (kg)	71.10	9.47	67.22	10.05	1.24	NS
BMI (kg/m²)	23.59	2.74	26.43	4.15	4.03	0.001
Hand length (cm)	18.83	0.95	17.79	0.92	5.55	0.001
Hand breadth (cm)	8.43	0.39	9.27	10.21	0.59	NS
Total hand grip strength (kg)	28.62	6.76	21.64	3.67	6.42	0.001

SD: Standard deviation; NS: Not significant

Table 3: Descriptive statistics of grip strength in dominant hand with selected anthropometric variables and f-value (ANOVA) in males and females

	Males		Females			Significance
Parameters	*Mean*	*SD*	*Mean*	*SD*	*f-value*	*p-value*
Age (years)	55.28	2.83	54.62	2.5	0.56	NS
Height (cm)	173.46	5.74	159.62	6.01	111.42	0.001
Weight (kg)	71.10	9.47	67.22	10.05	1.72	NS
BMI (kg/m^2)	23.59	2.74	26.43	4.15	10.61	0.001
Hand length (cm)	18.79	0.92	17.69	0.88	20.13	0.001
Hand breadth (cm)	8.47	0.41	7.92	0.30	20.76	0.001
Total hand grip strength (kg)	32.90	7.60	25.16	3.45	86.29	0.001

SD: Standard deviation; NS: Not significant

Table 4: Descriptive statistics of grip strength in nondominant hand with selected anthropometric variables and f-value (ANOVA) in males and females

	Males		Females			Significance
Parameters	*Mean*	*SD*	*Mean*	*SD*	*f-value*	*p-value*
Age (years)	55.28	2.83	54.62	2.55	0.56	NS
Height (cm)	173.46	5.74	159.62	6.01	111.42	0.001
Weight (kg)	71.10	9.47	67.22	10.05	1.72	NS
BMI (kg/m^2)	23.59	2.74	26.43	4.15	10.61	0.001
Hand length (cm)	18.83	0.95	17.79	0.92	19.15	0.001
Hand breadth (cm)	8.43	0.39	9.27	10.21	0.82	NS
Total hand grip strength (kg)	28.62	6.76	21.64	3.67	85.35	0.001

SD: Standard deviation; NS: Not significant

Table 3 shows mean, standard deviation, and one-way analysis of grip strength and selected anthropometric variables in dominant hand of males and females. Statistically highly significant (p ≤ 0.001) group differences were noted in height (F = 111.42), BMI (F = 10.61), hand length (F = 20.13), hand breadth (F = 20.76), and hand grip strength (F = 86.29).

Table 4 shows mean, standard deviation, and one-way analysis of grip strength and selected anthropometric variables in dominant hand of males and females. Statistically highly significant (p < 0.001) group differences were noted in height (F = 111.42), BMI (F = 10.61), hand length (F = 19.15), and hand grip strength (F = 85.35).

DISCUSSION

The estimation of hand grip strength is of great importance as it is an important indicator of overall physical strength and health. It assesses the patient's initial limitation and provides a quick reassessment of patient progress throughout the treatment. In our study, 50 healthy Punjabi adult males and 50 healthy Punjabi adult females were evaluated for grip strength using Jamar dynamometer.

The dominant hand grip strength is stronger than that of nondominant hand in both groups, and this finding was similar to the result of other studies. Hand grip strength is a physiological variable that is affected by a number of factors including age, gender, and body size among others.[14,15]

Hand grip strength was more in males as compared with females in both dominant and nondominant hands, and this could be due to physiological differences between them.[16,17]

The study also investigated the correlation between hand grip strength and anthropometric variables like height, weight, BMI, and hand dimensions (hand length and hand breadth) in both groups (males and females) in both dominant and nondominant sides.

In the dominant hand in both males and females, hand grip strength positively correlated with height, BMI, hand length, and hand breadth. Other researchers[18] had also found similar results with some parameters, wherein dominant hand grip strength was found to be positively correlating with hand length and hand breadth, but a nonsignificant association was found with height and BMI.

On the nondominant side, in both study groups, hand grip strength positively correlated with height, BMI, hand length, while nonsignificant correlation was found with hand breadth. This finding partially supports and partially contrasts with the findings of study,[19] which states that on the nondominant side, hand grip strength positively correlates with height, weight, and hand length, but not with BMI and hand breadth.

Limitations

The major limitation of this study is sample size. Also, cross-sectional studies like this cannot determine the longitudinal course of individual grip strengths.

CONCLUSION

The present study provides a sample of healthy adult male and female data on hand grip strength for clinical use and hand rehabilitation. It explored the relationship between grip strength, hand length, and hand breadth. Hand length and hand breadth should be well thought-out for hand grip strength measurements in the older age group, since these anthropometric measures could affect the results of treatment and control hand function training. The present study provides therapists with valuable information about the treatment in a clinical setting while devising a program that involves grip activities for the aged.

ACKNOWLEDGMENTS

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