

Original Research Article

Study of Hand Grip Strength in Indian Population

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ABSTRACT

Background and Purpose: Hand grip strength is a major component of hand function. Although reference values are available from western populations, it would not be appropriate to apply them for Indian population due to the variation in geographical, genetic, nutritional, social and cultural factors. The main objective of this present study was to generate reference values for grip strength in a healthy Indian population.

Methodology: Grip strength was measured using Jamar dynamometer according to the norms provided by ASHT (American society of hand therapists) in the age group of 21 to 80 years healthy Indian participants.

Results & Conclusion: This present study generated normative values of hand grip according to gender and different age groups for Indian population. The gender difference in grip strength was statistically significant with higher grip strength found in males than females. Also, it was noted that grip strength greater in dominant hand than non-dominant hand. There was an inverse relationship between age and grip strength.

Key words: Grip strength, Indian, dominance, reference values, Jamar Dynamometer.

INTRODUCTION

The hand represents the most sophisticated and differentiated musculoskeletal tool in human being. The human hand is capable of performing complex and precise functions which can be divided into grasping abilities and manual dexterity. Hand grip is an important component of human function and is a unique feature that distinguishes humans from primates.

Grip is defined as 'forceful act resulting in flexion at all the joints of the fingers along with thumb when used as a stabilizer to the object being held between the finger and the palm.'^[1] Grip strength is a referred to as a reliable and valid objective parameter to evaluate the functional integrity of the hand as the part of the

musculoskeletal system.^[2] Grip strength is also evaluated in the clinical settings as an indicator of disease activity.^[3] The evaluation of hand grip strength is of great importance in the assessment of upper limb impairment, to measure the baseline deficiency in hand muscle power, set treatment goals, to monitor progress during rehabilitation, and to document the effectiveness of various treatment strategies and to assess patient's ability to return to employment.^[4,5]

Grip strength is the integrated performance of muscles that can be produced in one single muscular contraction.^[6] Hand grip strength is quantified by measuring the amount of static force that the hand is able to squeeze around a dynamometer. Hand grip strength is

measured using Jamar Dynamometer which is reliable and valid equipment. [5] The American society of Hand Therapists (ASHT), suggested a standardized arm position for the measurement of grip strength as the position of the upper extremity might have an influence on the measurements, and recommended that the patient should be seated with his shoulder adducted and neutrally rotated, elbow flexed at 90°, the forearm in neutral position and wrist in neutral position. [7]

Normative data for hand grip strength based on age, gender and dominance are available from deferent populations using variety of measurement methods for reference. [8-12] However, these normative values can be used only for the specific populations from which the sample is derived. Although reference values are available from western populations, it would not be appropriate for use in an Indian setting, due to variations in genetic, environmental and nutritional factors which influence hand grip strength. [13]

A few studies from India have reported normative values for grip strength in an attempt to explore the association of grip strength with specific factors, namely age, relevant anthropometric factors, level of physical activity and profession. [12,14,15] Bansal reported normative data for hand grip strength in young adults, age group of 18 to 25 years, and noted higher values in males than females and overall difference of 7.2% in favor of dominant hand. [14] A recently published study provided reference values for grip, tip, palmar and key pinch strength for healthy Indian adults in the age group of 18 to 30 years. It showed that the grip and pinch strength of healthy Indian adults is less compared with age and gender-matched population from other continents. [12]

The main objective of the current study was to generate reference values for grip strength in a healthy Indian population in age groups ranging from 21-80 years using Jamar Hand Dynamometer. [7]

MATERIALS & METHODS

The study was conducted after obtaining approval from the Institutional Ethical Review Committee (IERC). 600 healthy subjects in the age group of 21-80 years were recruited. Exclusion criteria included past or present pathology or trauma to upper extremity or cervical region. Subjects were explained about the nature of the study in the language best understood by them. A written informed consent was taken from the subjects who were willing to participate in the study and the informed consent document was duly signed by the subject. Each subject will participate in single testing session.

Demographic data of the subject was noted. Hand grip strength was measured using Jamar Hand Dynamometer, a valid and reliable instrument. It is an isometric, hydraulic hand dynamometer. The Jamar dynamometer was read in kilograms (kg) with 2 kg gradation. The handle of Dynamometer was adjusted to second position for all subjects. The norms followed for standardized positioning, instructions and calculation are given by American Society of Hand Therapists. [7] The patient was made to sit on a chair without any arm rest, back straight, the shoulders adducted and neutrally rotated, the elbows flexed to 90 degrees and the forearm in neutral position, and the wrist in wrist in 0-15 degrees of extension and 0-15 degrees of ulnar deviation. The subject was instructed to squeeze the handle of the dynamometer as maximally as possible and release. No encouragement was given to the subject. Three grip strength measurements for each dominant and non-dominant hand were taken by alternating the hands with a 1-minute rest period in between each task to avoid muscle fatigue. The mean of three successive trials of strength measurements were noted.

Statistical analysis: Descriptive statistics (mean±standard deviation) were determined for all measured variables. Data were analyzed using SPSS version 16 (Statistical Package for Social Science). A 5% level of

probability was used to indicate statistical significance.

RESULTS

The present study included 600 healthy subjects (300 men and 300 women)

in the age group of 21 to 80 years. There were 520 (87%) right hand dominant and 80 (13%) left hand dominant healthy subjects.

Table 1 & 2 shows the values of grip strength based on gender and different age groups.

Table 1: Mean & SD of Grip Strength values of Dominant and Non-Dominant hand in Males

Age Groups (Years)	Dominant Hand Grip Strength				Non-Dominant Handgrip Strength			
	Mean(Kg)	SD	95% Confidence Interval for Mean		Mean(Kg)	SD	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound			Lower Bound	Upper Bound
21-30	32.08	2.39	31.40	32.76	26.88	2.40	26.20	27.56
31-40	41.56	2.24	40.92	42.20	36	1.95	35.45	36.55
41-50	36.16	1.50	35.73	36.59	31.4	4.39	30.15	32.65
51-60	30.38	1.93	29.83	30.93	25.1	1.53	24.67	25.53
61-70	24.2	2.18	23.58	24.82	17.04	2.23	16.41	17.67
71-80	19.12	1.69	18.64	19.60	11.84	2.12	11.24	12.44

Table 2: Mean & SD of Grip Strength values of Dominant and Non-Dominant hand in Females

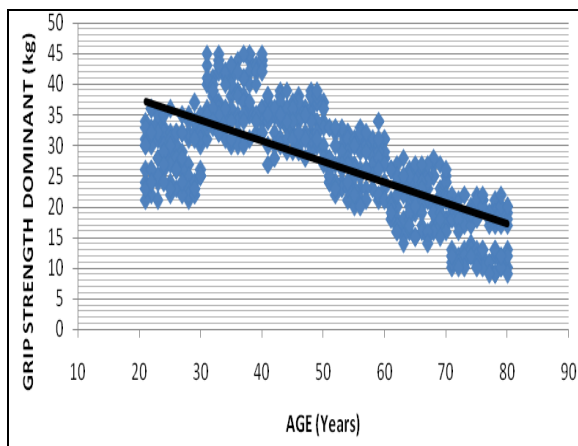
Age Groups	Dominant Handgrip Strength				Non-Dominant Handgrip Strength			
	Mean(Kg)	SD	95% Confidence Interval for Mean		Mean(Kg)	SD	95% Confidence Interval for Mean	
			Lower Bound	Upper Bound			Lower Bound	Upper Bound
21-30	24.52	2.09	23.93	25.11	20.02	2.34	19.35	20.69
31-40	33.8	1.99	33.23	34.37	29.1	2.24	28.46	29.74
41-50	30.96	2.32	30.30	31.62	25.98	2.44	25.29	26.67
51-60	23.92	1.99	23.36	24.49	19	2.17	18.38	19.62
61-70	17.96	2.31	17.30	18.62	13	1.84	12.48	13.52
71-80	11.36	1.27	11.00	11.72	6.92	1.29	6.55	7.29

Grip strength values measured in women were significantly lower than those of the men. It was found to be statistically significant using unpaired t test (P<0.0001). Also, the grip strength values of dominant hand, irrespective of sex, were higher than those of non-dominant hand using paired t test (P<0.0001).

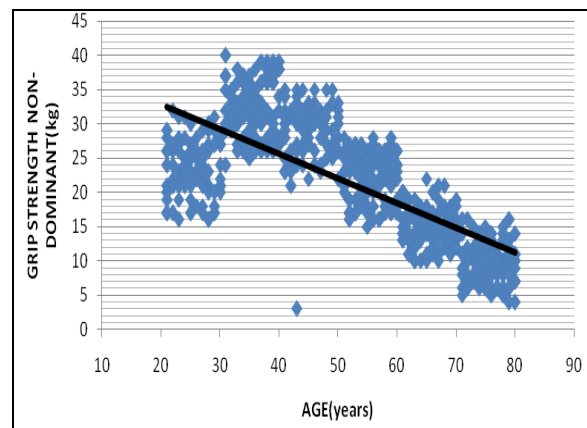
Table 3: Correlation coefficient of grip strength & age

Variable	Grip Strength	
	Dominant Hand	Non-Dominant Hand
Age	-.692**	-.720**

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



Graph 1: Correlation between age and grip strength of dominant side



Graph 2: Correlation between age and grip strength of non-dominant side.

There was an inverse and significant correlation (P<0.0001) between age and grip strength in both dominant and non-dominant hand.

DISCUSSION

This study established the reference values for grip strength for healthy Indians based on data generated from 600 healthy participants in the age range from 21 to 80 years including both men and women. Examination of grip strength is of great importance for identifying impairments, establishing goals and determining the

effectiveness of treatment strategies for patients with hand or upper extremity injuries. Grip strength testing forms a pivotal role in hand rehabilitation.

It was found that the grip strength increased gradually with age and peaked in the age group of 31 to 40 years in both males and females. It then gradually declined as the age advanced and was recorded minimum in the 71 to 80 years of age group in both males and females. Thus, it showed a curvilinear relationship between age and grip strength. This is in accordance to study done by Virgil Mathiowetz who established clinical norms for grip strength in adults aged 20 to 75+ years using Jamar dynamometer. The highest grip strength scores occurred in the 25 to 39 age group with a gradual decline seen from 60 to 79 years.^[8] Kallman et al. did a cross-sectional analysis of 847 subjects from 20 to 100 years and reported that the handgrip strength peaked in the fourth decade and then declined in a curvilinear fashion thereafter as the age increased. The reduction in strength with age may be caused by various factors, including a reduction in the number of muscle fibres and changes in their size of the muscle fibre, especially the fast twitch fibres (type 2).^[16]

The present study noted higher grip strength in males as compared to females. Felix Angst et al. showed that gender was one of the most important factors that had an impact on grip strength. He studied 978 volunteers from age group 18 to 85+ years and reported that grip strength was higher in males than females.^[17] The literature has consistently found that on average males are stronger than females.^[8] It is a known fact that males have greater muscle mass and thus larger amount of contractile tissue leading to greater grip strength as compared to females.^[18] Males have a greater height and length of forearm as compared to females who have shorter height and lesser length of forearm. Thus, greater the height of the person, longer the arms which leads to greater lever arm for force generation and mechanical advantage. Thus, it results in

generation of an efficient amount of force and higher grip strength.^[19] Also, the amount and the type of work done by males are more strenuous as compared to females who are more dextrous in nature. This leads to development of stronger muscles in males than females. Hence, all the above mentioned causes justify that males have higher grip strength as compared to females.

The present study demonstrated higher grip strength in dominant hand as compared to the non-dominant hand. Handedness is an important factor that should be taken into consideration while measuring hand grip strength. A general rule often used states that the dominant hand is approximately 10% stronger than the non-dominant hand.^[20] In our day to day life, we perform almost all the activities using dominant hand. Although, we also use non-dominant hand in our activities but the amount of contribution from dominant hand is much greater than non-dominant hand in domains of power, skill and dexterity. This leads to the differences in muscle mass and also hypertrophy of the muscle in dominant arm as compared to non-dominant. Thus it justifies that higher grip strength is seen in dominant hand as compared to non-dominant hand.

CONCLUSION

This present study generated normative values of hand grip for Indian population which can be used as reference values. The gender difference in grip strength was statistically significant with higher grip strength found in males than females. Also, it was noted that grip strength greater in dominant hand than non-dominant hand. There was an inverse relationship between age and grip strength.

Practical Implications

Although reference values are available from western populations, it would not be appropriate for use in Indian counterparts due to variation in geographical, genetic, nutritional, social and cultural factors. Hence, grip strength values

generated in this present study can be applied specifically to Indian population.

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