

Normative Data of Grip and Pinch Strengths in Healthy Adults of Indian Population

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Abstract

The purpose of the study was to establish clinical norms for adults aged 20-40 year old on grip and three types of pinch strength. A dynamometer was used to measure grip strength and a pinch gauge to measure pinch strength-tip pinch, key pinch and three fingered pinch. A sample of 118 males and 112 females, aged 20-40 was tested using standard positioning and instructions. Results shows a decline in the grip strength as age increases but no such relation was established between pinch strength and age. Dominance showed no difference. Comparison between males and females ,it shows males have stronger hand strength than females.

Key words: Normative data,grip strength,pinch strength

Introduction

The hand is one of the most intricate structure and known for its complexity and utility. Hand strength is of great importance for identifying impairments, and to determine the effectiveness of interventions for patients with hand disabilities or upper extremity injuries or any sports which includes throwing, lifting and catching. Evaluation of hand strength is an important part of hand assessment as being the important parameter in deciding the success of hand rehabilitation and favourable prognosis post surgeries. Hand strength depends on patient's age, sex, and hand dominance. Grip and pinch strengths are important parameters to determine hand function Normative data is significant to develop a reference range, standards of care- As hand strength varies depending on the measuring method and a patient's position, reliable and valid evaluation of hand strength is necessary. The normative data cannot be generalized for people living in different social and economic

conditions. Therefore, due to lack of normative data of grip strength for the Indian population, the present study was undertaken to establish the normative data of grip and pinch strengths for healthy Indian adults.

Materials and Methods

This study was approved by the Institutional Review Board and informed consent was obtained. The study included 230 volunteers in the age group 20-40 years. Participants were normal individuals without any diseases or fractures. Anyone who had restriction of movement in the upper limbs, a history of inflammatory joint disease or any neurological disorder or injury involving upper extremities by self-report were excluded.

Before measuring grip and pinch strength, all 230 individuals were asked to complete a standardized questionnaire for demographic information, occupation, current medical status, histories of disease or fracture that were related to hand or upper extremity and any restriction in the range of motion of upper limb especially shoulder, elbow and wrist that interfere with the position of grip strength. Out of 230 volunteers, there were 118 males and 112 female.

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Grip strength was measured using the standard Hand Dynamometer (90.90 kgs) by Baseline® Evaluation Instruments, White Plains New York, USA. For all subjects, handle for Jamar dynamometer was set at the level II for a comfortable grip.^{4,5} Three pinch strengths were measured using the Baseline® Evaluation Instruments Pinch gauge (13.63 kgs).^{7,8,9}

The grip strength of the right and the left hand (Figure 1) were measured, subsequently the tip pinch of the right and the left hand were measured. Then key pinch and tripod pinch were measured by similar methods. Participants were given a 1 minute break between each measure. After 5 minutes of break, grip strength and three types of pinch strength were measured again in the same manner, and the average strengths were obtained respectively.

The tip pinch is thumb to the index finger, the key pinch is thumb pad to the lateral aspect of middle phalanx of an index finger, and the tripod pinch is thumb pad to pads of the index and middle fingers. The subject was tested in a seated position with the shoulder adducted, not rotated to either side, and the elbow flexed to 90 degrees with the forearm in mid prone position and wrist between 0 degree and 30 degree dorsiflexion and 0 degree and 15 degree ulnar deviation¹⁰. The unit of whole values was kilogram (Kg).

Statistical Analysis

The software used for statistical analysis was SPSS-13(Statistical Package for Social Sciences, Version 13. Percentage, mean and standard deviation were calculated for the data according to the age group, gender and hand dominance. Independent t test was applied for comparison between males and females for the variables grip and pinch strength. P-values equal to or less than 0.05 were accepted as significant.

Results

Grip strength: Both right hand 24.65 (S.D±8.88) and left hand mean grip strengths (25.16 (S.D±9.48) increased with age and then declined gradually right hand 23.42 (S.D±7.108) and left hand 23.70(S.D±7.41). It was statistically significant that men's grip strengths right hand were stronger than women's (mean 28.09 kg in men and 19.89 kg in women.) (table 1)

Pinch strength: For three types of pinch strengths, the key pinch was the strongest, followed by tripod pinch and tip pinch (table 2)

Tip pinch: Tip pinch increased with age (right hand mean in men 3.14 kg and mean 2.43 kg in women)

Key pinch: Data for both sexes demonstrate that key pinch increased with age. (right hand mean 7.05kg in men and 5.34 kg in women).

Tripod pinch: Tripod pinch increased with age. (right hand mean 5.65kg in men and 4.56kg in women).

Thus this study could not establish any relation between age and pinch strength or comparison between the right hand and the left hand.

Right hand dominant individuals: Comparisons between the left and right hands of right hand dominant individuals demonstrated that the right hand was stronger than the left hand in all measures that we performed (grip strength and 3 types of pinch strengths). Grip strength of right hand (t value=10.549), tip-tip pinch of right hand (t value 3.699) key pinch of right hand (t value 9.139) and three fingered pinch (t value 5.839). The differences were statistically significant via paired t-test ($p < 0.05$) (table 3). As subjects for right hand dominance are 226 and left hand dominance are 4, so we ignored the issue of dominance due to the small amount of sample size.

Table 1 Normative data for grip strength

AGE	HAND	MEAN±SD	SE
20-24	R	24.65±8.88	1.15
	L	25.16±9.48	1.22
25-29	R	24.08±5.92	0.77
	L	24.84±6.36	0.82
30-34	R	24.24±6.42	0.89
	L	24.65±6.24	0.86
35-39	R	23.42±7.10	0.93
	L	23.30±7.40	0.97

Table 2-Normative data for pinch strength

age	hand	tip pinch		key pinch		three fingered pinch	
		MEAN±SD	SE	MEAN±SD	SE	MEAN±SD	SE
20-24	R	2.76±0.15	1.19	6.05±1.4	0.17	5.01±1.38	0.17
	L	2.57±0.12	1.00	5.87±1.5	0.19	4.63±1.36	0.17
25-29	R	2.99±1.970	0.25	6.51±1.76	0.22	5.49±1.74	0.22
	L	2.86±1.704	0.22	6.34±1.80	0.23	5.29±1.66	0.21
30-34	R	2.49±1.06	0.15	6.00±1.69	0.23	5.09±1.34	0.18
	L	2.54±1.10	0.15	5.92±1.66	0.23	5.09±1.38	0.19
35-39	R	2.91±1.46	0.19	6.28±1.69	0.22	4.90±1.49	0.19
	L	2.75±1.27	0.16	6.13±1.35	0.20	4.80 ±1.47	0.19

Table 3: Comparison of males and females on grip and pinch strength:

	gender	mean	standard deviation	standard error	t value
grip right	M	28.09	7.139	0.657	10.549**
	F	19.89	4.185	0.395	
grip left	M	29.04	7.272	0.669	11.622**
	F	19.91	4.132	0.390	
tip pinch right	M	3.1426	1.57963	0.14542	3.699**
	F	2.4397	1.27710	0.12067	
tip pinch left	M	3.0278	1.37352	0.12644	4.212**
	F	2.3274	1.12886	0.10667	
key pinch right	M	7.054	1.6072	0.1480	9.139**
	F	5.345	1.1836	0.1118	
key pinch left	M	6.932	1.5533	0.1430	9.644**
	F	5.171	1.1793	0.1114	
three fingered pinch right	M	5.6580	1.53431	0.14125	5.839**
	F	4.5696	1.27241	0.12023	
three fingered pinch left	M	5.5155	1.52585	0.14047	6.193**
	F	4.3854	1.21527	0.11483	

**-t value significant correlation ($p < 0.05$)



Figure 1: Jamar grip strength dynamometer (Hydraulic Hand Dynamometer, and the position of measurement (A) Jamar dynamometer is set at the level II (B) The subject is in a seated position with the shoulder adducted, not rotated to either side, and the elbow flexed to 90 degrees with the forearm and wrist in neutral position.

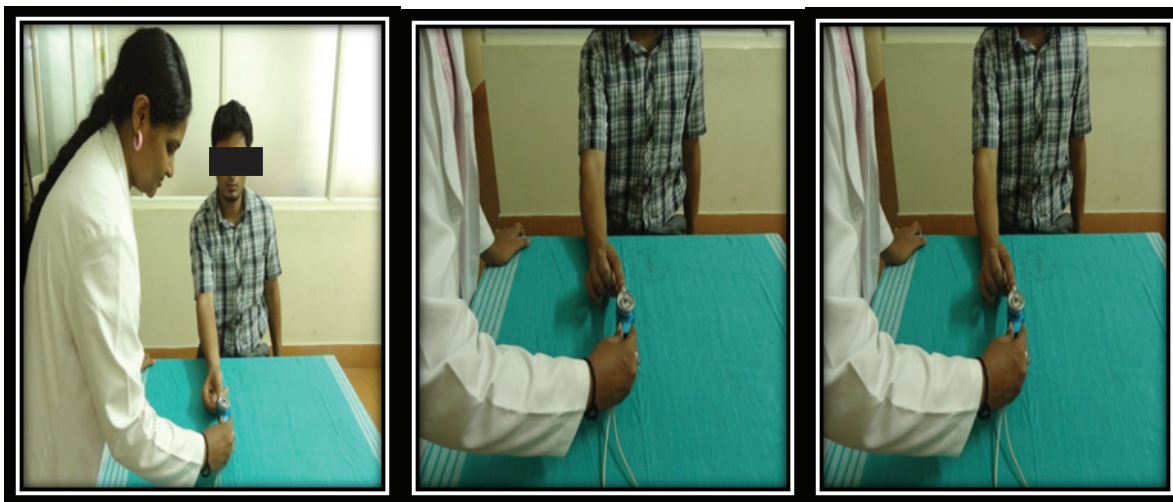


Fig 2. Jamar pinch gauge and the position of measurement (A) Key pinch is thumb pad to lateral aspect of middle phalanx of index finger (B) Tip pinch is thumb to index finger (C) Tripod pinch is thumb pad to pads of index and middle fingers.

Discussion

The study was aimed to find out the normative data of grip and pinch strength. To our knowledge, there is data available for normative data of grip and pinch strength for the age group 4-19 yr old, 20-75 yr old in the western population. 230 asymptomatic subjects in the age group of 20-40 years were recruited for the study. The subjects were divided in to 4 class intervals of 20-24, 25-29, 30-34 and 35-39 years. The study recruited 118 males and 112 females. This study puts forth a normative data for the age group of 20-40 for grip and pinches strength. Mathiowetz et al¹³ conducted a study for normative values of grip strength in the United States. The mean grip strength of the western population was found to be higher when compared to the Indians. Geographic variation and nutritional status may affect grip strength which may account of reduced strength in the Indian population. But however, this study is in agreement with similar studies performed in Indian population. Bansal² performed a similar study for the age groups 18-25 years and compared dominant hand which shows mean 29.79 ± 9.77 and non dominant hand shows mean 27.88 ± 10.01 . Koley et al^{14,15} found in the age group 18-40 years, sedentary females with right dominant individuals showed grip strength mean for right hand 22.75 ± 3.89 and left hand shows grip strength mean

21.03 ± 3.75 Pinch strength also behaves similarly with grip strength normative data of pinch strength of both right and left hand shows higher pinch strength in the western population compared to the Indian counterparts.

Young et al.⁶ reported that there was a 12-23% of individual variation in measuring hand strength. So, we measured grip and pinch strengths twice with one minute of a break between each measure and the average scores were used in this study.

Age is an important predictor of grip strength. This is inconsistent with a study by Hanten et al¹ where men in the age group 55-64 years had weaker grip strength when compared to men between the age group 20-54 years. Crosby et al¹² performed normative values for hand strength where it shows higher grip strength in the age group 20-40 years.

Age is one of the strongest predictors of pinch strength. We failed to find any relation with age and pinch strength (tip-tip pinch of right hand p value=0.307, a key pinch of right hand p value=0.323 and three-fingered pinch p value=0.167)³. This is supported by Mathiowetz et al.¹³ who established a normative data for pinch strength in 20-75+ age group and found that tip, key and three fingered pinch scores are stable in the age group 20-59 years but a gradual decrease in the age

group 60-79 years, thus a low to moderate correlation between pinch strength and age.

Gender is one of the most important factors where male subjects have strong grip strength than female subjects. Our study supports the fact suggesting higher grip and pinch strength in males better than females across the ages. Grip strength of right hand (t value=10.549), tip-tip pinch of right hand (t value 3.699), key pinch of right hand (t value 9.139), and three fingered pinch (t value 5.839). Therefore it is suggested that males have a stronger grip and pinch strength than females. To support our study in case of gender, Hanten et al.¹ also confirmed in his study that males have a stronger grip than females.

The limitation of this study is that we tried to describe grip and pinch strengths with age, sex, and hand dominance. However, they can be influenced by many factors such as hand size, the forearm circumference, height, weight, occupation, level of physical activities. Multivariate analysis for the explanation of grip and pinch strengths with these factors will be challenging.

Conclusion

Thus normative data of healthy adults of Indian population has been established in the age group 20-40 year old. Knowledge of the normative data on hand grip strength will be very helpful for the evaluation and treatment of hand or upper extremities injuries.

Conflict of Interest: Nil

Source of Funding: Self

Ethical Clearance: Taken from Ethical Committee of Father Muller Medical College.

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