Evaluation of Pakistani Adult Handgrip Strength Reference Values Through Dynamometer

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ABSTRACT

Objective: To investigate the normative handgrip strength of healthy adult male and female Pakistani population and to compare it with consolidated norm.

Methodology: It was a survey-based study included 365 healthy Pakistani adult males and females ages between 18 to 54 years. A calibrated handheld Jammer Dynamometer was used to measure handgrip strength under American Society of Hand Therapists (ASHT) guidelines. Three trials were done alternately from both hands and mean were taken separately as a score.

Results: The independent T test showed significant difference among male and female handgrip strength. The strong positive correlation was found between right v/s dominant handgrip strength (r= 0.93) and left v/s non-dominant handgrip strength (r=0.93). When comparing the Pakistani norms with consolidated norms the scores were found 30.8% lesser in males and 24.1% lesser in females.

Conclusion: The study concluded that the Handgrip strength could be useful to assess and treat the hand functions. It also provides the information that the normative data of handgrip strength may vary among populations with different anthropometric traits.

Keywords: Handgrip strength, dynamometer, hand assessment, occupational therapy, normative data, Pakistani population.

INTRODUCTION

Handgrip strength is generally the most important parameter to determine hand functions because most of our daily functional task requires hand maneuvers. Hand Grip Strength measurement is an essential part of the hand rehabilitation, in the assessment of upper limb injuries, in determining the efficacy of different treatment modalities, and in evaluating work capacity of patients with local hand injuries like trauma, burn, fracture or systemic clinical pathologies such as muscular dystrophy or rheumatoid arthritis that influence hand strength [1, 9]. In addition, hand strength levels provide validated assessments of a patient's nutritional status and the general functional

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index among patients receiving nutritional interventions [4].

Normative data values of handgrip strength not only describes hand normality but is also used as an objective assessor of upper extremities damages for Occupational Therapy and Physical Therapy interventions. Published normative data of different populations are widely available and can be used as reference. It is evident from different researches that various anthropometric variables such as age, gender, ethnicity, nutritional status, shoulder circumference & Body Mass Index (BMI), type of occupation and hand dominance of any population influence the hand muscles grip strength [4, 11]. Whereas, some literature shows disparity over the correlation between hand grip strength and BMI, several researchers claiming a positive relationship between BMI and grip strength in all ages of both genders, while other indicates no relationship [3].

Handgrip strength can be measured from different types of dynamometer. In 1971, Kellor. formed the norms of grip strength to be applied in rehabilitation [5]. Among all, the Jammer Handheld Dynamometer is most widely used for measuring the grip strength because it is reliable, economic, portable,

quick and easy to administer assessment tool also known as quick bedside test [6, 7].

Different positions are used to measure the Handgrip Strength by Jammer Handheld Dynamometer and it influences on the score of grip strength [8]. Therefore the American Society for Surgery of the Hand and the American Society of Hand Therapists (ASHT) has recommended standardized instructions of measuring grip strength. According to ASHT tested individuals should be seated on chair comfortably with their shoulders adducted, elbows should be flexed at 90∘, and their forearms in neutral position [8, 9].

Many researches were conducted to develop Handgrip strength norms for different populations in all over the world [1, 2, 12]. Recently, there is no normative data of handgrip strength available for the Pakistani population. Therefore the rational of the study was to obtain age and gender specified normative data of handgrip strength based on hand dominance and Right and Left hand. Secondary purpose was to compare the values from consolidated and international norms of different populations.

METHODS

Pakistan has different ethno-linguistic groups mainly Punjabi, Sindhi, Pashtu, Balochi, Urdu speaking etc. Therefore, the Karachi city was selected to collect the data as it is composed of ethno-linguistic groups from all parts of Pakistan, in order to avoid the effect of race on the result the study subjects were enrolled from different ethnic groups.

It was a survey-based study following a convenience sampling technique, in which 365 healthy Pakistani population ages 18 to 54 years of both genders were recruited. The samples were collected randomly in different public places like University campuses, markets, parks, housing complexes and sidewalks of Karachi city. Inclusion criteria was normal healthy person having no pain feeling or known impairments in upper extremities, no history of hand surgery, fracture or any other disorders that could affect upper extremities such as peripheral nerve injury, burn on hand, contractures, carpel tunnel syndrome, arthritis, spinal disk problems, severe joint pain and having no recent hospitalization history.

Consolidated Norms and other populations published norms of Handgrip strength on Healthy population in Kilograms were searched through Google Scholars, PubMed, and Science Direct using keywords of "Hand grip strength normative data".

Measurement Procedure
Researcher interviewed and explains each participant about the nature and purpose of the study. Moreover, an unstructured questioner was given to the participants to take written informed consent and demographic data including their ethnicity (Punjabi, Sindhi etc.), age (in years), sex, dominant hand (used for writing) and occupation.

In the second stage, Handgrip strength was measured through calibrated Jammer handheld Dynamometer according to the ASHT instructions. For standardization it was set on second handle position for all the subjects. Participants were prompted by asking them to squeeze the handle as strongly as possible, three reading were taken in kilograms (Kg) from alternate hands to relax the other hand. After three trials mean was calculated for both hands separately. Data were grouped into 8 classes of 18 to 54 ages in year. Each class was sub divided into male and female. Table No. 1 shows the frequency of male and female participants within the groups.

Statistical Analysis
Mean, standard deviation, range, Pearson correlation for Right v/s Dominant, and Left v/s non-dominant hand of all ages, independent sample *T*- Test for comparison between male and female dominant Hand grip strength were tested through SPSS version 16.0.

RESULTS
The study included 285 female (78.1 %) and 80 male (21.9%), mean age were 24.18, St. Dev. 8.31 (min=17, max=54). Among 365 participants 200 (54.79%) were students, 11 (3.01%) office workers, 11 (3.01%) janitorial staff, 5 (1.36%) carpenters, 15 teachers (4.10%), 15 (4.10%) shopkeepers, 45 (12.32%) housewives and 63 (17.26%) medical professionals. Data also indicated that there were 26 (7.12%) participant with left hand dominance. The peak value in males was found in 45-49 age ranges and 25-29 age range in females.

The Independent sample T test p-values was less than 0.001 (p<0.001, t=18.58) at 95% confidence interval, concluded that there was a significant mean score difference in male and female hand grip strength. The strong positive correlation was found between right v/s dominant hand grip strength (r= 0.93) and left v/s non dominant hand grip strength (r=0.93).

The right/left and dominant/non dominant mean scores of all the age groups of male and female showed

the higher values from 19 years to 34 years of age than the values declines till 44 years of age and then again increment noticed from age 45 till 54 years of age. (Table 2)

Table 1: Number of male and female participant in the study

Age	Gender	Sample size (n)
18-19	Male	10
	Female	98
20-24	Male	34
	Female	133
25-29	Male	7
	Female	13
30-34	Male	8
	Female	10
35-39	Male	3
	Female	13
40-44	Male	10
	Female	10
45-49	Male	5
	Female	3
50-54	Male	3
	Female	5
	Total	**N = 365**

Table 2: Age and Gender specified Hand grip strength (HGS) in KGs

Age in years	Gender	Hand grip Strength Mean	St. Deviation	Min - Max
18-19	F	8.40	4.54	1.30-20.00
	M	23.56	5.20	18.30-33.30
20-24	F	8.25	4.89	1.30-36.00
	M	23.54	5.83	15.30-36.00
25-29	F	9.71	7.79	2.60-32.60
	M	22.72	7.84	12.00-33.30
30-34	F	7.50	2.81	2.00-11.30
	M	20.98	5.95	12.00-28.00
35-39	F	7.91	4.46	2.30-18.60
	M	17.86	2.97	16.00-21.30
40-44	F	8.64	3.11	4.00-12.60
	M	18.79	5.75	9.60-30.00
45-49	F	10.40	4.43	5.30-13.30
	M	24.54	5.44	18.00-32.30
50-54	F	8.50	2.62	6.00-12.60
	M	23.40	8.85	14.60-32.30

Group Statistics

	gender of all participants	N	Mean	Std. Deviation	Std. Error Mean
dominant HGS	male	80	22.4700	6.05505	.67698
	female	285	8.3731	4.74894	.28130

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
dominant HGS	Equal variances assumed	13.187	.000	22.010	363	.000	14.09691	.64047	12.83742	15.35641
	Equal variances not assumed			19.229	107.743	.000	14.09691	.73309	12.64375	15.55007

Correlations

		dominant HGS	right hand grip strength
dominant HGS	Pearson Correlation	1	.931[**]
	Sig. (2-tailed)		.000
	N	365	365
right hand grip strength	Pearson Correlation	.931[**]	1
	Sig. (2-tailed)	.000	
	N	365	365

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

Correlations

		non dominant HGS	left hand grip strength
non dominant HGS	Pearson Correlation	1	.931[**]
	Sig. (2-tailed)		.000
	N	365	365
left hand grip strength	Pearson Correlation	.931[**]	1
	Sig. (2-tailed)	.000	
	N	365	365

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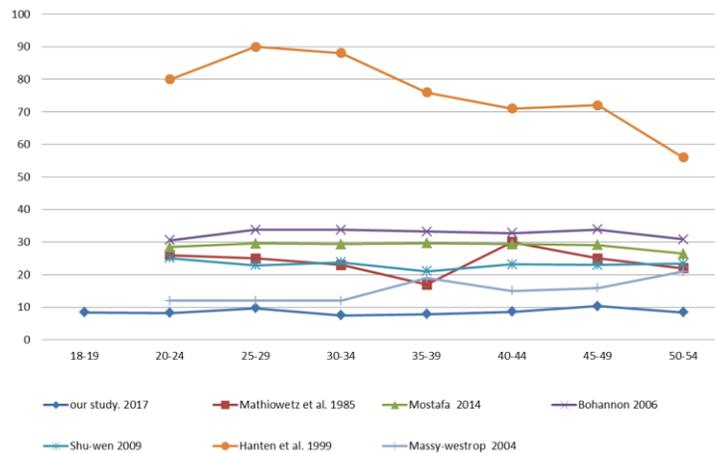

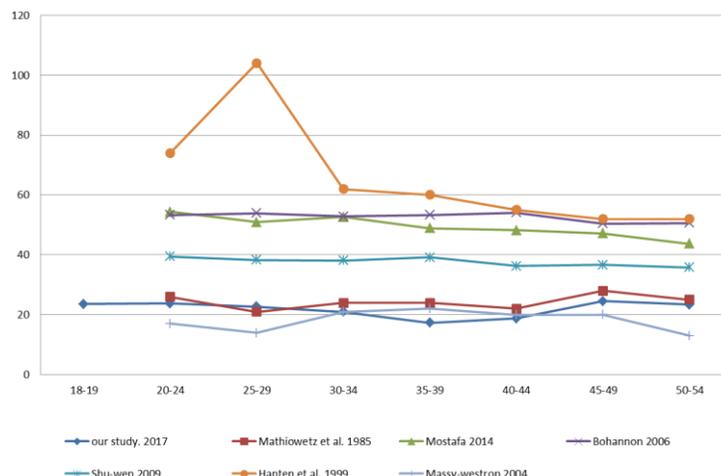**Figure 1:** Comparison of female HGS with consolidated and other norms in KGs

Figure 2: Comparison of Male HGS with consolidated and other norms in KGs

DISCUSSION

The Grip strength is a valuable parameter to assess the hand functions therefore different tools have been used to measure the handgrip strength. Jammer dynamometer was found the most efficient and widely used equipment. The Pakistani population comprises of different ethno-linguistic groups our study included 44 subjects from Punjabi, 40 Pathan, 56 Sindhi, 20 Balochi, 175 Urdu speaking and 30 others (i.e. Bohri, Memon, Kachi etc.) background. Therefore the obtained values can be used as comparative normative values for the assessment of Handgrip strength in Pakistani population.

Richard W 2006 [12] was considered as consolidated norm while Mostafa M 2014 [13], Shu-Wen Wu 2009 [14], Hanten WP. et al [15], Mathiowetz 1985 [16] & Massy-Westrop 2004 [17] was used as comparative normative data. The consolidated norm was compared with Pakistani males and females under ASHT specified conditions and our scores are 30.8% lesser than in males and 24.1% in females. Figure 1 & 2 displays the comparison of our study with the consolidated norm of Richard W 2006 [12], Mostafa 2014 [13], Shu-Wen Wu 2009 [14], Hanten WP et al. [15] and found lesser, whereas, norms of Mathiowetz 1985 [16] & Massy-Westrop 2004 [17] was close to our findings. This difference in values may be due to the calibration of the measuring device, physical strength, understanding and enthusiasm of participants. The convenience sampling method and correlation of anthropometric variables such as height, weight, palm size with grip strength would be the limitations to our study.

CONCLUSION

The study concluded that measuring the Handgrip strength under the ASHT guideline can help the medical practitioners to investigate the efficiency of individual hand functioning and treatment needs. The expected HGS measurement for an individual varies according to their age, sex, geographic region and/or ethnicity. Further research is needed to estimate possible determinants factors of muscle strength that cause the variability in muscle strength among different healthy populations.

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