Original Research Paper



DETERMINING THE CORRELATION BETWEEN HAND GRIP STRENGTH AND HAND LENGTH, FOREARM CIRCUMFERENCE AND BMI AMONG HEALTHY FEMALE ADULTS: AN OBSERVATIONAL STUDY

Dr. Mansi H. Pavasiya *

BPT, Surat, Gujarat, India. *Corresponding Author

ABSTRACT Background: Hand grip strength (HGS) studies among healthy adult females have shown correlation between anthropometric variables and hand grip strength. The objective of this study is to obtain normative data and to evaluate the correlation among hand grip strength and other anthropometric variables especially hand length, forearm circumference with regard to dominant hand and BMI among healthy females in Surat, India using hand held dynamometer.

Aim: the aim of the study is to know the correlation between hand grip strength and hand length forearm circumference with regards to dominant hand and BMI amongst healthy female adults.

Method: A sample of 160 female adults from the Government physiotherapy college, Surat, India, aged 18 to 25 years were tested for hand grip strength using hand held dynamometer using standardized position and instructions. Hand grip strength was measured using hand held dynamometer in kilograms, hand length, forearm circumference and height was measured in centimeter using a measure tape and weight was measured using weighing machine in kilograms.

Result: A significant positive correlation was found between hand grip strength and hand length, forearm circumference, and BMI being predicted by Pearson's correlation analysis.

Conclusion: Normative value hand grip strength among female physiotherapy students has been established through this study. The study also concludes that hand grip strength is influenced by hand length, forearm circumference as well as BMI of the subjects and these variables can be better predictors while clinically rehabilitating hand patients.

KEYWORDS : Hand Grip Strength, Hand Length, Forearm Girth Circumference, Hand Held Dynamometer.

INTRODUCTION

The human hand is a complex structure and is very dutiful to the functions of manipulation. It serves the purpose of conveying sensory information about temperature, shape and texture of any object to brain (1). The ability to perform firm grip, together with highly elaborated nervous control and sensitivity of fingers helps to deal with daily demands of life (2, 3). Grip strength is the strength of several muscles in the hand and its power is the forceful flexion of all finger joints with the maximal voluntary force. The force has most commonly been measured in kilograms and pounds, some studies have also used millimeters of mercury and also newton. Anakwe et al., has observed that associations with forearm and hand circumference have also been proposed to be better indicators of grip strength (4).

Saki et al., has also shown that hand grip strength is positively correlated not only to height and weight but also to BMI and anthropometric hand measurements (5). Researchers have proved that hand grip strength is influenced by posture and other anthropometric traits like fat percentage and hand perimeters (6).A thorough literature survey by Kelley et al., elucidates the disparity that exists in the literature over relationship between hand grip strength and hand length, forearm circumference and BMI in both genders and all ages, while other researchers found no relationships(7). The hand is an organ specialized for grip and sensation. This makes the hand to be an irreplaceable and subtlest improvement of work as well as a sensory organ of humans. The hand muscles play a vital role in the performance of day to day activities of normal life such as using tools or transferring objects from one place to another (8). The hand grip is an act of taking by hand and keeping a firm hold of any object, tool or instrument. It is widely accepted that hand grip strength measurements provide an objective index of the functional integrity of the upper extremity. Hand grip strength is a physiological variable that is affected by a number of factors including age, gender and body size among others. The estimation of hand grip strength is of immense importance in determining the efficacy of different strategies of hand an also in hand rehabilitation (9).

The power of grip is the forceful flexion of all, finger joints with a maximum voluntary force that the subject is able to exert under normal bio kinetic conditions, as it is directly affected by muscular, skeletal and neural systems (10). Measurement of hand grip was mean to evaluate forearm and hand functions. In addition, grip strength has been used as a predictor of etiological factors of mortality and disability in many patients. Hand grip strength can be used in many patients with a large range of pathologies that impair the upper extremities (11).

Physiotherapy

Grip strength also has an important role in determining treatment efficacy, such as in the evaluation of different wrist orthotics, the effect of hand exercises in rheumatoid arthritis and recovery after trauma also; it is used in evaluation after many different surgical procedures (12).

Grip strength can be measured quantitatively using a hand held dynamometer. Hand grip strength measurement becomes more reliable only when standardize methods and calibrated equipments are used even when there are different assessors or different brands of dynamometers (13). Although numerous dynamometers have been developed, researchers have turned towards the use of models with adjustable handle settings allowing for adjustment of instrument to size of human hand or for assessing strength at various spans of grip (14). Balogun et al has used prediction regression models for analyzing grip strength with independent variables like gen-der, age, weight and/or height either in children, in adults or in aging people (16).

Objective Of The Study:

1)The study will be helpful during the rehabilitation of the patients with hand injuries considering hand length, forearm circumference, age, BMI to be the important predictors.

2)The study will also be helpful in obtaining normative data on hand length, forearm circumference and hand grip strength. 3)The study will also be helpful in determining the treatment strategy for patient with hand injuries.

Hypothesis

Null Hypothesis:

There is no significant correlation between hand grip strength and hand length, forearm circumference and BMI in healthy female adults.

AlternateHypothesis:

There is a significant correlation between hand grip strength and hand length, forearm circumference and BMI in healthy female adults.

Limitation Of Study:

Limited age group
 Only female students
 Small sample size

METHODOLOGY AND MATERIALS

Study Design: Observational study

Study setting: Government Physiotherapy College, Surat

Sampling technique: Random sampling

Study population:

Healthy female adult students of Government Physiotherapy College, Surat aged 18 to 25 years.

Study sample size: 160 healthy female adult students

Study duration: total duration - one month

Inclusion Criteria: Normal healthy adult female students Age group 18 to 25 years Asymptomatic individuals

EXCLUSION CRITERIA:

·Subjects with recent hand injuries or surgery

·Subject having any hand deformity

·Subject with hand swelling or oedema

·Subject having any vascular or neurological problem

·Subject having any restricted movement of hand or upper limb

·Subject having any musculoskeletal disorder

 $\ensuremath{\mathsf{Subject}}$ with history of any inflammatory joint disease of upper limb

Subject with hypo mobility or hyper mobility of hand Subject having pain or inflammatory condition of hand

Subjects unwilling to participate in study

Subjects who are unable to understand the procedure or instructions

·Subjects who are unable to achieve standardized position

Materials used in study:

Pen Hand held dynamometer Inch tape Weighing machine Consent form

METHOD:

1)160 female healthy adult students who fulfilled the inclusion criteria were allowed to participate in the study.

2)Written informed consent was taken from subject prior to data collection and whole procedure was thoroughly explained to the subject.

3)Height, weight and thus BMI, hand length, forearm

circumference and hand grip strength were measured.

Forearm Circumference: It was measured using a measure tape from the elbow joint 3 centimeter down from the cubital fossa.

Hand Length: It was measured from the wrist crease to the tip of the middle finger using a measuring tape.

Hand Grip Strength:

·It was measured using a hand held dynamometer.

The participants were seated in a chair without an arm rest with the elbow flexed to 90 degrees and wrist slightly extended and slight ulnar deviation. Then participants were asked to maximally grip the dynamometer. Participants were given specific commands to obtain maximum reading of grip strength during trials. While performing, three trials were given for the dominant hand with regular interval of 2 minutes rest period between trials.

BMI:

•The height and weight of the subject were measured using a measuring tape and weighing machine respectively. •BMI was calculated using the formula: weight (in kg) /

Statistical Analysis

height²(in m²).

Statistical analysis is performed using the software EpiInfo. Demographic data is analyzed using descriptive statistics. Average of three successive trials of hand grip strength is used for study. Pearson's correlation analysis provides a better understanding about relation between hand grip strength and hand length, forearm circumference and BMI of the subjects. Variables tested were height, weight, BMI, age, hand length and forearm girth circumference with hand grip strength being dependent variable.

Statistics was performed using Pearson's correlation analysis while keeping confidence interval 95% and level of significance at p <= 0.05.

RESULT

The study included 160 healthy female adult students in the age group of 18-25 years (Table1)

Table -1:Mean and Standard Deviation of Constructs in the study (n=160)

Constructs	Mean(SD)
Age	21.08(0.973)
Height	157.92(10.70)
Weight	51.55(9.72)
BMI	20.62(3.75)
Forearmcircumference	20.46(2.45)
Handlength	16.94(1.22)
Handaripstrenath	20.05(5.18)

Pearson's correlation analysis shown in following table shows the correlation between age, height, weight, hand length, forearm girth circumference and hand grip strength (Table-2).

Though the correlation is low to medium all the variables are shown to be statistically significant correlation with hand grip strength.

 Table 2: Correlation Between Anthropometric Variables And

 Hand Grip Strength

Variables	r(correlationco- efficient)	pvalue
Age	0.0287	0.178
Weight	0.2413	0.002

VOLUME-9, ISSUE-6, JUNE-2020 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Height	0.0263	0.741
BMI	0.173	0.286
Handlength	0.1604	0.427
Forearmgirth circumference	0.2734	0.0004

BMI								
Table 3	8: Cor	relation	between	hand g	grip	strength	(HGS)	and



Line chart 1: HGS VS BMI

Interpretation:

There is a significant positive correlation between Hand grip strength and BMI.

 Table 4:Correlation between hand grip strength(HGS) and hand length (HL)



Line chart 2: HGS VS HL

Interpretation: There is a significant positive correlation between Hand grip strength and Hand length.

 Table 5:Correlation Between Hand Grip Strength (hgs) And

 Forearm Circumference (FC)

		1	
	HGS	FC	pvalue
Mean	20.05	20.46	0.0004
SD	5.182	2.454	
Pearsonr	0.2734		
value			



Line chart 3: HGS VS FC

Interpretation: There is a significant positive correlation between Hand grip strength and Forearm circumference.

DISCUSSION

The result of the study shows that there is a significant positive correlation between hand grip strength and hand length, forearm circumference and BMI. This result is in concurrence with the other studies which has showed that lever arm for force generation is affected by the length of the arm resulting in an efficient amount of force. Gandhi et al., 2010 and Kauley and Kaur (2011) also showed that hand grip strength has strong relation with various anthropometric characteristics like height, weight and BMI. This result goes hand in hand with Everret and Sills, 1952 has reported that hand length along with hand breadth and forearm girth has positive correlation with hand grip strength. However they have concluded that none of these factors could be singled out as predictive of hand grip strength. Hand length is the most predictive factor of hand grip strength according to this study. The result of this study is in congruence with Hagerross and schiebe (2000) who have confirmed in their study that hand length is an important variable for hand grip strength. Hand span affects grip strength, grip force, and exertion level as reported by Ruitz et al., 2006.Earlier studies have shown that grip strength changes in accordance with the size of the hand, and researchers have shown that children's hand size is smaller, therefore a lower grip strength in teenagers. Forearm girth circumference is found to be a better predictor for normal hand grip strength and therefore is a good indicator of measuring hand grip strength. Hand circumference is studied to be a very good indicator of body stature, hence a good estimate of physical capacities as held by Hogrel, 2015. Therefore, it can be concluded that the higher the circumference the higher the HGS would be.

CONCLUSION

The study concludes that there is a significant positive correlation between hand grip strength and hand length, forearm circumference and BMI. Thus, these variables play an important role in predicting the recovery of the patients while rehabilitating hand patients. This will also be helpful in planning treatment for patients after any hand injury or any surgery. The study also provides with the normative data for all this variable among healthy female adult students aged from 18 to 25 years.

REFERENCES

- Norman K, Stobäus N, Gonzalez MC, Schulzke J-D, Pirlich M. Hand grip strength: outcome predictor and marker of nutritional status. Clinical Nutrition. 2011; 30(2):135-142.
- [2] Rahimi R, Behpur N. The effects of plyometric, weight and plyometricweight training on anaerobic power and muscular strength. Physical Education and Sport. 2005; 3(1):81-91.
- [3] Shah UN, Sirajudeen MS, Kumar P, Somasekaran NM, Shantaram M. The association between hand grip strength and hand dimensions in healthy Indian females. 2012.
- [4] Anakwe R, Huntley J, McEachan J. Grip strength and forearm

circumference in a healthy population. Journal of Hand Surgery (European Volume). 2007; 32(2):203-209.

- Sasaki H, Kasagi F, Yamada M, Fujita S. Grip strength predicts cause-specific mortality in middle-aged and elderly persons. The American journal of medicine. 2007; 120(4):337-342. [5]
- Amelican Journal of Infections. Loop, Jose Spectra Con-Benefice E, Malina R. Body size, body composition and performances of mild-to-moderately undernourished S children. Annals of human biology. 1996; 23(4):307-321. [6] motor Senegalese
- Ali NA, O'Brien Jr JM, Hoffmann SP, et al. Acquired weakness, [7] handarip mortality in critically ill patients. American strength, and Journal of Respiratory and Critical Care Medicine. 2008; 178(3):261-268.
- [8] Visnapuu M, Jürimäe T. Handgrip strength and hand dimensions in young handball and basketball players. The Journal of Strength & Conditioning Research. 2007; 21(3):923-929.
- Koley S, Kaur N, Sandhu J. Å study on hand grip strength in female labourers of Jalandhar, Punjab, India. J. Life Sci. 2009; 1(1):57-[9] 62
- [10] Massy-Westropp NM, Gill TK, Taylor AW, Bohannon RW, Hill CL. Hand Grip Strength: age and gender stratified normative data in a populationbased study. BMC research notes. 2011; 4(1):127.
- [11] Charles LE, Burchfiel CM. Occupational and other risk factors for hand grip strength. Environ Med. 2006; 63: 820-827.
- [12] Bagis S, Sahin G, Yapici Y, Cimen OB, Erdogan C. The effect of hand osteoarthritis on grip and pinch strength and hand function in postmenopausal women. ClinRheumatol. 2003; 22: 420-424.
- [13] Sjoblom S, Suuronen J, Rikkonen T, Honkanen R, Kroger H, Sirola J. Relationship between postmenopausal osteoporosis and the components of clinical sarcopenia. Maturitas.2013; 75: 175-180.
- [14] Goodson A, McGregor AH, Douglas J, Taylor P. Direct, quantitative clinical assessment of hand functions: usefulness and reproducibility. Man Ther. 2007; 12: 144-152.
- [15] https://www.ijphy.org
 [16] Alahmari, K. A., Paul Silvian .S., Reddy, R. S., Kakaraparthi, V. N., Ahmad, I., & Alam, M. M. (2016). Determining the strength of hand grip for healthy adults in relation with hand length, forearm circumference, BMI and hand dominance. International Journal of Physiotherapy, 3(5), 562-568.