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"A study to find out correlation between hand dominance, BMI & isometric grip strength in young adults"

Mishra Neeti*, Mishra Anil[1], Chaklasiya kinjal and Panchal Nisha[3]

Associate Professor, SPB Physiotherapy College, Surat, india,
dr.neetimishra@gmail.com, 9879697384
Professor,Shrimad Rajchandra College of Physiotherapy,Bardoli,Surat,India,anilmpt@gmail.com,9558767651
BPT,SPB Physiotherapy College, Surat,India,
kinjal.chasatiya@yahoo.com,
BPT,SPB Physiotherapy College, Surat, India, panchalnisha1234@gmail.com

ABSTRACT:

Background & Purpose: The present study was carried out with the aim to measure and compares maximal isometric handgrip strength in dominant and non-dominant hand in right and left handed individuals. The study was done at SPB Physiotherapy college, Surat after approval from the ethics committee**. Method:** Subjects selected for study comprised of 50 normal, healthy individuals (10 males and 40 females) of age 18-26 years, free of any lesion or impairment in upper limbs. The anthropometric measurements recorded in the above selected subjects were body weight and height and the body mass index (BMI). After taking the measurements, subjects were made to sit comfortably on the chair and hand grip strength was measured by hand held dynamometer. The maximal isometric handgrip strength was measured in the standard arm position in both the dominant and non-dominant hand in right and left handed individuals using a hand grip dynamometer in all the subjects. **Results:** Negative correlation between age(r=1) and BMI (-1.42). Positive correlation between BMI and dominant hand grip strength (.198). Positive correlation between BMI and non dominant hand grip strength (.118). **Conclusion:** it can be concluded that hand grip strength , is influenced by Age, BMI and hand dominance.

KEY WORDS: Dominant hand, Non dominant hand, Hand grip strength (HGS), body mass index (BMI), hand held dynamometer

*Corresponding author

Mishra Neeti

Associate Professor,

SPB Physiotherapy College, Surat, India,

Email:dr.neetimishra@gmail.com,

Mob. 9879697384

INTRODUCTION

A young adult is generally a person ranging in age from their late teens or early twenties to their thirties. [1] The human hand is one of the very important structures which is able to perform wide range of movements, be it gross or skilled. The function of hand intricately involves the motion, strength dexterity and motivation. Most of the daily activity involves interaction with objects that are to be grasped in the hand. The manipulative ability of the human hand requires effect force dexterity. [2, 3] The hand is an organ specialized for grip and sensation. This makes the hand to be an irreplaceable and subtlest instrument of work as well as a sensory organ of humans.[4]

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 the brain.[5] The ability to perform firm grip, together with highly elaborated nervous control and sensitivity of fingers, helps to deal with daily demands of life.[6,7]

The body mass index (BMI) is a widely used tool to evaluate overweight and obesity based on two anthropometric parameters, height and weight: where weight is measured in kilograms, and height in meters. The World Health Organization (WHO) has emitted recommendations on the reference values (cut-off points), to classify the weight condition of a person (underweight, normal, and overweight). Although some differences in the values of normal ranges for different populations has been recognized by WHO, however arguing compatibility .[8] Strength is related to age and sex. [9,32-36.] At all ages girls have lower average values then boys and after puberty this difference increases, until by the age of 18years, boys have a mean hand grip 60% higher than girls.[10] Males possess considerably greater strength then females for all the muscle groups tested[11,12]Hand grip strength is an important tool to evaluate physical fitness and nutritional status. It has come to be regarded as the most reliable clinical measure of human strength. This sedentary lifestyle in turn could lead to low physical fitness and low muscle strength also the excess fat globules get deposited over the muscle fibers and leads to reduced muscle strength.[13]

Hand grip strength in form of isometric test is reliable clinical measure to assess the physical fitness and nutritional status of an individual. It is the most common assessment method to measure the upper extremity muscle strength.[14] Hand grip strength is a good indicator of a health status based on the incidence of disability, morbidity and mortality in the adult population.[15] The power of hand grip is the result of forceful flexion of all finger joints with the maximum voluntary force that the subject is able to exert under normal bio kinetic condition[16].The grip strength has been reported to be higher in dominant hand with right handed subject, but there were no such significant differences between sides that could be documented for left handed people.[17]Many hand grip strength in young

healthy adults have revealed that anthropometric variables like height, weight, BMI, hand length, hand width, grip span, are positively associated with handgrip strength.[18]

The Jamar dynamometer is the most widely reported device used to measure grip strength.[19-20]The Jamar dynamometer presents good inter-ratter reliability and test-retest reliability.[20]he American Society of Hand Therapists (ASHT) has recommended the Jamar dynamometer as the gold standard, leading to its widespread use in clinical practice and research.[21]

The estimation of hand grip strength is of immense importance in determining the efficacy of different treatment strategies of the hand therefore, need of the study arises, to find out the correlation of handgrip strength with hand dominance, age and BMI.

AIMS AND OBJECTIVE-

1. To measure maximal isometric hand grip strength in dominant and non-dominant hand in right & left handed individuals using a hand grip dynamometer in a normal young adult of age 18-26 years.
2. To find relationship between BMI and maximal isometric hand grip strength.
3. To find relationship between hand dominance and isometric hand grip strength .

METHODOLOGY-

***Study design*:** Correlational study

Sampling design: purposive sampling

Population: the study population comprised of 50 normal, healthy individuals of either sex of 18-26 years of age .***Sample size*** was calculated with the help of G power software version 3.19.2. with effect size .40,α =0.05 and power 0.85.The **Study duration** was of 6months and **Study setting** was in SPB physiotherapy college, Surat.

***Inclusion criteria*: was** Age between 18-26 years, Healthy individual of either sex, No restriction of movement in upper limbs, No history of Rheumatoid arthritis, No history of inflammatory joint disease, neurological disorder, injury to upper extremity by self report.

***Exclusion criteria*: included** Smokers, Alcoholic, Pregnant females, Pain and aching in the shoulder, arm / hand at rest/ when moving – on most of the days of month, Joint stiffness.

***Materials and tools*:** include Stethoscope, Sphygmomanometer ,Wooden Stadiometer Handheld dynamometer , Weighing machine, Edinburg handedness questionnaire sheets, Self administered questionnaire sheets

Outcome measures:

- Handgrip strength in a dominant and non dominant hand.

- BMI

PROCEDURE

Complete preliminary examinations were done for the subjects using self administered questionnaire. The subjects were screened on basis of inclusion and exclusion criteria. The procedure was fully explained to the subjects in simple language which he/she could understand and written informed consent for the same was taken. Anthropometric measurement height and weight were recorded in the study subjects. Hand dominance was checked via Edinburg Handedness questionnaire during preliminary examination.

Body weight **(**kg**)**: was measured by portable human weighing machine. The machine was placed on the plane surface and the subjects were asked to remove heavy outer garments and shoes. Subjects were asked to stand erect on the centre of the machine with hands at sides and looking straight ahead. Calibration was checked before measurement.

Height **(**m**):** was measured with the help of anthropometric rod. The subject were asked to remove shoes and stand erect with head straight, feet together on the floor and the vertical distance from the ground to the vertex of the subject was measured.

Calculation of Body mass index (BMI)**:** It was calculated from recorded weight (kg) and height (m).The following formula was used to measure BMI.

BMI = weight (kg) / height (m2)

This was followed by measurement of **hand grip strength** which was measured with the help of a hand held dynamometer. Handgrip strength was measured in both the hands, dominant and non-dominant in every subject. The grip strength of both right and left hands was measured using a standard adjustable digital hand grip dynamometer. Three readings were taken and the mean was recorded.

Before taking the measurements, subjects were requested to sit comfortably on the chair with straight back, without armrest with the feet flat on the floor, shoulder adducted and neutrally rotated, elbow flexed at 90^0, forearm in neutral position, wrist between 0-30^0 of extension and between 0-15^0 of ulnar deviation.

Subjects were asked to hold the dynamometer in above said position and were instructed to squeeze the dynamometer as hard as possible without moving the body. Thus final grip strength was measured from the dynamometer scale when the pointer no longer moved. Three attempts for each subject were conducted, alternating right and left hands with 1minute rest between two attempts to overcome the fatigue. Mean of these three trials were taken as the reading .The participants were not provided with any visual or verbal feedback regarding their work intensity.

STATISTICAL ANALYSIS

The statistical analysis was performed using SPSS version 16.Descritive statistics were carried out for the age, sex and outcome measures. Normality of the data was done by shapro-wilk test. Pearson correlation test was performed to identify the relationship between age, BMI, hand dominance and handgrip strength. The level of significance was kept at $p \leq 0.05$.

RESULT

The study population comprised of 50 , healthy individuals of either sex of 18-26 years of age. The distribution of males (20%) and females (80%) in the study illustrates in Table No. 1. The descriptive statistical analysis for Age, BMI, Dominant hand grip strength, Non dominant hand grip strength is depicts in Table No. 2. It also illustrates the handgrip strength in the dominant and non dominant hand in the study population. The mean ± SD in the dominant hand in the study population was 1.352±1.283 and that in the non dominant hand was 1.711±1.202. The difference in the handgrip strength in the dominant and non dominant hand was found to be statistically significant. Positive correlation between BMI and dominant hand grip strength (.198) illustrate in Table No. 4. Positive correlation between BMI and non dominant hand grip strength (.118) illustrate in Table No.5.

Table.no.1.illustrates mean and standard deviation of age(n=50)

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Age	50	18	23	20.40	1.512

Table No.2: illustrates Summary of descriptive statistical analysis for age, BMI, Dominant& Non-dominant HGS

	N	**MEAN**	**Std. Deviation**
Age	50	20.40	1.512
BMI	50	21.43	4.58
Grip	50	25.33	5.20
Grip2	50	23.96	5.015

. **Table3.shows BMI distribution among subjects**

	BMI	N
underweight	<18.5	9
normal	18.5-24.9	33
overweight	25.0-29.9	6
Obesityclass1	30.0-34.9	2
Class2	35.0-39.9	0
Class3	≥40	0

Table No. 4: illustrates positive correlation between BMI and dominant hand grip strength

	Pearson corelation	Sig.(2-tailed)	N
BMI	1	.167	50
DomHGS	.198		

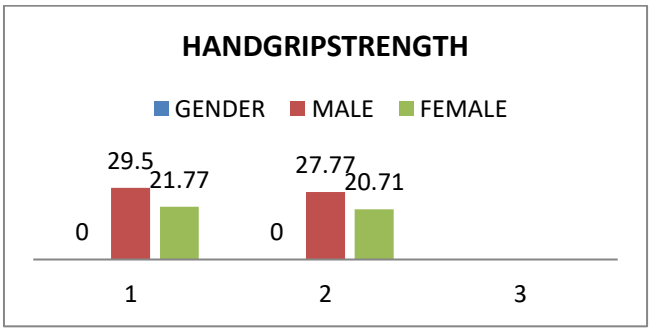
Table No. 5: illustrates positive correlation between BMI and non dominant hand grip strength

	Pearson corelation	Sig.(2-tailed)	N
BMI	1	.414	50
NONDomHGS	.118		

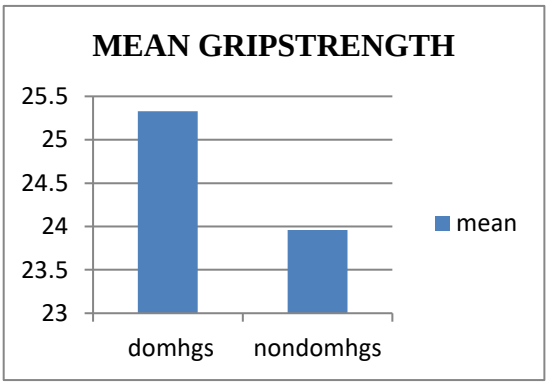
Table 6. Shows negative correlation between age and grip strength.

	Pearson correlation	Sig.(2-tailed)	N
AGE	1	.310	50
GRIPSTRENGTH	-.148		

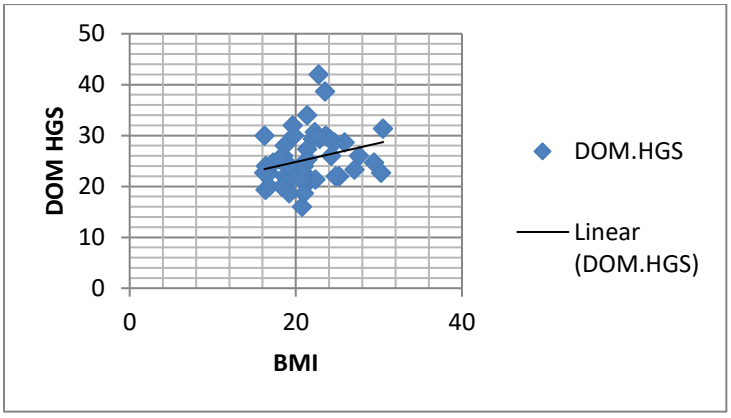
Graph 1.shows comparison of DOMHGS and NONDOMHGS between males and female



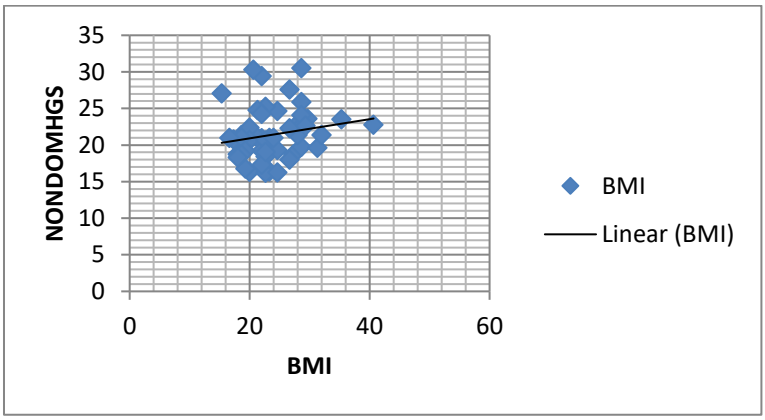
Graph 2.shows mean comparision of dom and nondom hand grip strength



Graph no. 3: illustrates relationship between BMI and dominant hand grip strength



Graph no. 4: illustrates relationship between bmi and no dominant hand grip strength



DISCUSSION

The aim of this study was to find out the relationship between age, BMI, hand dominance with handgrip strength in normal young adults**.** Grip strength has long been thought of as a possible predictor of overall body strength.[22] Smith et al. (2005) found a direct correlation in grip strength and overall body strength in very old and oldest females.[23] Fry et al. (2006) also found a correlation between grip strength and performance in American junior male weightlifters.[24] So, an increase in hand grip strength determines the physical strength of an individual. These studies support the present study, as there was significant correlation between age, BMI, hand dominance and hand grip strength. Handedness inherits genetically, but hand grip strength is affected greatly by nutritional status of an individual. That's why hand grip strength has been considered as a functional index of nutritional status.24-26 Incel et al. (2002) reported that percentage of stronger non dominant hand grip was 10.93%. and 33.33% for right and left handed groups respectively[27]Instead of segregating data into two sexes, they plotted all the data into left and right hand groups. A general rule often used suggests that the dominant hand is approximately 10% stronger than the non dominant hand. This rule has also been confirmed in study (difference of grip strength in dominant and non dominant

hands ranged from 8.88% to 13.86%)[28, 29] This rule has also been confirmed in present study (mean of dom.hgs is (25.33) more than nondom.hgs(23.36) ,both in males and females.

Gandhi et al., 2010 and Kauley and Kaur (2011) also showed that handgrip strength had strong correlations with various anthropometric characteristics, like height, weight and BMI.[27] Ages shows a low negative correlation with hand grip strength in the above study. Similar result is found in present study also, there is negative correlation between grip strength and age (-.148).The negative correlation between Age and HGS can be explained by the decline in musculoskeletal strength and mass associated with aging as suggested by Marmon et al., 2011 [28.,27] Age is a significant predictor of HGS and shows a negative t- value. Some researchers reported that age is associated with diminished hand grip strength, and found association between moderate hand strength and general muscle mass reduction due to age as observed by Vianna et al., 2007.[27, 28]. Past research exploring the relationship between BMI and hand grip strength has provided incongruent findings. The study results of Westroppet al., who have found that BMI is not correlated to hand grip strength does not match with our study.[29] In present study, weak positive correlation was found between BMI and dominant HGS (.198) Also there was weak positive correlation between BMI and non dominant HGS (.118). The results from the present study are consistent with previous researches[12] demonstrating stronger grip for men than women within the same age strata, both in dominant and non dominant hand. males also showed a higher mean value for Hand grip strength and this agrees with the study conducted by Shyamal and Sartinder (2011), which showed that males have a higher mean values of all the anthropometric parameters than females. In a study of hand grip strength among Korean population, Lee et al, 2012, has pointed out that only height and BMI to be significant contributors to handgrip strength while weight of the subject was not a significant predictor.[30] In the case of height, a positive correlation with the hand grip strength could be as a result of different factors such as higher heights that would lead to longer arms, with greater lever of arm for higher force generation thus, resulting in an efficient amount of force. In present study, we found correlation of BMI with HGS; we did not look for individual relationship of height and weight with dominant and non dominant HGS. The reason could be the age related changes in body composition particularly increased fat, central fat deposition and decreased lean mass., [31]

CONCLUSION

The present study concludes that there was weak negative correlation between grip strength and Age. But weak positive correlation was found between BMI and dominant and non dominant hand grip strength. Therefore it can be concluded that hand grip strength , is influenced by Age, BMI and hand dominance.

Limitation of study-This was a small group cross-sectional study carried out in single institute. This study does not provide correlation of handgrip strength and other anthropometric parameters.. The study was conducted in a particular age group, so the correlation could not be established for different age groups.

Scope of future study- large sample size and longitudinal study will definitely be of great value in predicting the correlation between hand grip strength and various physically parameter. The study can further be perused in larger population by including more anthropometric parameters of hand/body composition and their correlation with grip strength of both the hands, in different age groups ,so as to obtain more precise correlation between them.

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