



## HAND GRIP STRENGTH AN IMPORTANT DETERMINANT IN ERGONOMICS: AN ANTHROPOMETRIC STUDY IN THE RURAL TERTIARY MEDICAL COLLEGE OF DARJEELING DISTRICT, WEST BENGAL, INDIA

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**ABSTRACT** Hand grip strength measurement by hand dynamometer is a very effective yet very easy tool for the assessment of many health related issues. In case of rehabilitation after hand surgery or hand injury, choice of sports category, job placement etc. Even the morbidity status can be assessed with this simple instrument. In our study we included this instrument to assess the relationship of hand grip strength and different hand dimensions and body mass index. An institute based cross sectional study was designed with all the 47 first year nursing students. Their anthropometric measurements like, height, weight, body mass index, hand dimensions of both upper extremities were done. Statistical calculation was done using SPSS version 20. Pearson correlation coefficient was calculated for 2-tailed test. Some of the parameters were correlated significantly at the 0.01 level; some were at the 0.05 level. Like, Hand Grip Strength (HGS) of dominant hand with age ( $p=0.009$ ), height and weight with hand grip strength ( $p=0.009$  and  $0.003$  respectively), forearm length of dominant and non-dominant hands are significantly related HGS ( $p=0.011$  and  $0.022$  respectively). BMI is significantly related to dominant hand grip strength ( $p=0.46$ ). Total hand lengths are also significantly related with HGS ( $0.014$ ,  $0.031$  respectively). Several studies on hand grip strength correlate higher hand grip strength with higher sports and job performances. So achieving the goal of ergonomics the proper placement of people to increase efficiency in their workplaces, this study seems to be the first step.

**KEYWORDS :** Hand grip strength, hand dynamometer, anthropometric measurements

**INTRODUCTION:** Hand grip involves the alternate contraction of all extensors and flexors muscles of forearm and hand so that opening and closing of the hand is possible. Hand grip strength (HGS) measurement involves maximal voluntary isometric contraction of all the muscles of upper extremity. This is accomplished with hand dynamometer. Three kinds of dynamometers are currently in use, they are - spring-loaded compression type, air compression type, and hydraulic compression devices. They measure strength either in Newton, or in kgs or in Pascal. Hand grip strength varies with age, gender, condition of upper extremity, handedness, nutritional status etc.

Utility of this instrument is manifold. Measurement of handgrip strength in clinical practice is a simple but efficient screening tool for health vulnerability. It is also indicate the functional recovery after hand surgery or hand injury. It is helpful for young players to choose their sports category. It could be useful for job placement purpose also. That is the motto of Ergonomics, which is the science and the process of designing or arranging workplaces, products and systems so that they fit the people who use them<sup>(1)</sup>. So, Ergonomics is defined as the study of people's efficiency of their work places.

Workplace designating is very crucial for maximum work output, but it is rarely possible in our current health sector. Moreover the health sector employee, specially nursing staffs are posted in remote areas which are far from their residence. They also face many kind of pressure in their workplaces. All might culminate into mental depression. It might lead to less work output on behalf of them. Dissatisfied employees are generally unproductive ones, while happy employees who are passionate about their jobs get the work done effectively.

So aiming towards that goal, that is by measuring different anthropometric parameters and correlates them with hand grip strengths and thereby we can recommend their place of posting.

We planned a study on first year nursing students, which include anthropometric measurements, like height, weight, Body Mass Index, measurements of dimensions of upper extremity, hand grip strength estimation. We then would try to correlate them.

### OBJECTIVE OF THE STUDY

- 1) To determine if hand grip strength varies with hand dimension of the study subjects

- 2) To determine if hand grip strength varies with Body Mass Index (BMI) of them.

### METHOD

An institution based cross sectional observational study was carried out in the Department of Physiology among the first year B.Sc. nursing students aged 18-20 years for 3 months, from February to April 2018. All the students were included in the study who fulfilled the inclusion criteria. Students with weakness of the hand or previous history of hand injury, numbness over upper extremity were excluded from the study. None of them came under exclusion criteria. Out of 50 students 3 students left the nursing course. So study population remained 47. After getting the ethics committee clearance we will planned to start our study.

Explaining the whole procedure to the participants and we assured them that their participation will not going to hamper their health and study, they were asked to give informed consent. After getting proper informed consent from the participants, different anthropometric measurement were taken, like, height, weight, body mass index, forearm length, hand length and finger length.

Demonstration of the whole procedure was done at the beginning of the study. Handle of the dynamometer was so adjusted that it could fit the hand of the particular individual. A practice session was allotted, so that any error could be corrected.

They were instructed to do the maneuver in sitting and standing position, both dominant and non-dominant hands, keeping the elbow in right angle, without touching the body. She was further instructed and motivated to squeeze the handle as maximum as possible. A least three measurement were taken at the 20 second interval to avoid muscle fatigue. Best attempt was recorded. She was also asked to exhale during procedure to avoid buildup of increased intra thoracic pressure.

### Method of data collection

All participants was interviewed for the previous history of illnesses that might impact on the study like any kind of neuropathic disease etcetera.

Initial screening with tone, power, reflex, general somatic sensations was tested. Handedness was asked for. Individual participant was then examined with proper method.

**RESULT**

Though we started with 50 student participants as all students fulfilled our inclusion criteria but we ended up with 47 students, as 3 students left the Nursing course in between the study. All results depicted with Mean ± standard deviation.

**Table-1 Distribution of different parameters among the participant n=47**

Variables	Mean ± standard deviation
Age (years)	18.94 ± 1.03
Height (cm)	154.72 ± 5.24
Weight (kg)	51.28 ± 9.01
BMI	21.45 ± 3.58
Length of dominant hand (cm)	24.01 ± 2.51
Length of non-dominant hand (cm)	23.89 ± 1.24
HGS of dominant hand (Newton)	34.43 ± 12.43
HGS of non-dominant hand (Newton)	25.53 ± 8.42
Forearm length of dominant hand (cm)	24.28±1.32
Forearm length of non-dominant hand (cm)	24.02±1.36

We found a very significant relationship between Body Mass Index and HGS of dominant hand, P=0.00. but no such relation was found in case of non-dominant hand. Students t test was applied to measure the level of significance in between the studied parameters. (T value 8.84) Level of significance was also found to be significant in between HGS and dominant hand length. (p value = 0.00), (t value = 8.16).

**TABLE:2 Relation of Hand Grip Strength of both of the upper extremity with different parameters n=47**

VARIABLES				
INDEPENDENT		DEPENDENT		
ENT		DOMINANT HAND GRIP STRENGTH (IN NEWTON)		NON DOMINANT HAND GRIP STRENGTH (IN NEWTON)
AGE (YEARS)	r	-.375**	r	-0.102
	p	0.009	p	0.494
HEIGHT (CM)	r	.378**	r	0.097
	p	0.009	p	0.519
WEIGHT (KG)	r	.421**	r	0.265
	p	0.003	p	0.072
BMI	r	.293*	r	0.257
	p	0.046	p	0.081
FOREARM LENGTH (CM)	r	.370*	r	.334*
	p	0.011	p	0.022
TOTAL HAND LENGTH (CM)	r	.356*	r	.315*
	p	0.014	p	0.031

**\*\* Correlation is significant at the 0.01 level (2-tailed).**  
**\* Correlation is significant at the 0.05 level (2-tailed).**

In 47 student participants, various parameters were checked, including – measurement of both dominant and non-dominant hand lengths, arm lengths, height, weight, body Mass Indices (BMI), hand grip strength measurement of both of the hands. Pearson correlation coefficient was calculated for 2-tailed test. Some of the parameters were correlated significantly at the 0.01 level; some were at the 0.05 level. Like, Hand Grip Strength (HGS) of dominant hand with age (p=0.009), height and weight with hand grip strength (p=0.009 and 0.003 respectively), forearm length of dominant and non-dominant hands are significantly related HGS (p=0.011 and 0.022 respectively). BMI is significantly related to dominant hand grip strength (p=0.46). total hand lengths are also significantly related with HGS (0.014, 0.031 respectively).

**DISCUSSION**

According to German Sports Scientist Jurgen Wejnck, in humans “the characteristic structure of the hand is related to its function as a grasping tool. Grasping ability is made possible by the fact that the thumb can be opposed to the fingers. The fingers and the thumb act as a versatile pair of pliers. They need the palm of the hand as a flat base, on which the object grasped can be held”. (2) There are 35 muscles

involved in movement of the forearm and hand, with many of these involved in gripping activities. During gripping activities, “the muscles of the flexor mechanism in the hand and forearm create grip strength while the extensors of the forearm stabilize the wrist (3)

Numbers of studies were published relating grip strength measurement and different sports, like in a study on young judo players of 15 to 19 years age groups, by Ageda Gutierrez Sanchez et al. proved that difference in hand grip strength among the different podium placements achieved was significantly different in female (p=0.001) but not in male.(4) Fry et al. also found a correlation between grip strength and performance in American Men Junior Weightlifting.(5)

Our study reveals with BMI of 21.45 ± 3.58, HGS of dominant hand is significantly correlated (p=0.046), which is corroborative with a study shows mean values of the hand grip strength went on declining from normal to overweight to obese group.(6)

Manjunath Hemberal et al. in their study called “study of correlation between hand circumference and maximum grip strength (mgs)” shows positive correlation between hand circumference with maximum grip strength, they concluded that Hand circumference is a good predictor of muscle grip strength (MGS) than BMI and forearm circumference. (7) Our study resembles the above study, it shows significant relation BMI and forearm length. In the young age group bone mineral density seems to be normal. As strong bone is related to the high grip strength, longer forearm and hand are significantly related to the maximum grip strength.

Job related study with HGS is very rare in web search, one comparative study between orthopedic surgeon and anesthetists reveals that orthopedicians had more grip strength as well has more intelligence level than their fellow anesthetists,(8) It reveals that might be increase their hand representation in brain had effect on their intelligence level.

**CONCLUSION**

With the above discussion, it is proved that proper job placement is very necessary for the improvement of the both cognitive and psychological domain of our behavior. Both of which are the prerequisite for the a better work output. So we can understand that it is very important to determine the proper job for the proper person for pursuing the job smoothly and fulfilling the motto of ergonomics. . So achieving the goal of ergonomics the proper placement of people to Increase efficiency in their workplaces, this study seems to be the first step. New strategies yet to be designed for modifying the workplaces. More studies are needed in this field(9) .

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