INFLUENCE OF GENDER ON HAND GRIP STRENGTH AND HAND GRIP ENDURANCE

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ABSTRACT:

Background-Grip strength is an indicator of current health status and is used as a single indicator to represent overall muscle strength. The maximum amount of force produced by a muscle is known as Handgrip Strength . Endurance is the capacity of a muscle to withstand the power produced during activity.

It is seen that men have greater proportional area of Type II muscle fibres than women and women have more Type I muscle fibres than men.

Objective – The objectives of the study is to see if gender has any influence on hand grip strength and hand grip endurance.

Methods and Materials:This observational study was conducted at Banarsidas Chandiwala Institute Of Physiotherapy , Delhi . 60 healthy volunteers in the age group of 18-25 years were included. Peak Hand grip strength was assessed usingjamar dynamometer followed by hand grip endurance in the dominant hand.

Result:Data was analysed to examine the influence of gender on hand grip strength and hand grip endurance. Significant difference between hand grip strength and hand grip endurance in both the genders was seen ($p<0.05$).

Conclusion:The result of the study showed that there is a significant difference between hand grip strength and hand grip endurance according to gender. The hand grip strength was more in males, females had higher hand grip endurance compared to males.

Key Words- Hand Grip Strength , Hand Grip Endurance , Type 1 and Type 2 muscle fibres
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INTRODUCTION*

The most active and interactive part of the upper extremity of the human body is human hand. It is due to the high degree of development of the human hand, like its prehensile grasp and opposing thumb, various unique functional and creative capabilities are allowed. A few of the unique abilities of human hand are reaction time, aiming, and hand and arm stability. All this majorly contribute to the dominance of human species.[1]

The term "Hand Dexterity" means the functional ability of the hand. The quality of performance in daily living skills, work-related functions, and recreational activities is determined by hand function and manual dexterity..Handgrip comes under the International Classification of Functioning, Disability and Health domain of 'body function and structure'. Measuring hand function is one of the most fundamental for any evaluation. [1]

A common way to test simple muscle function is muscular strength and is assessed by handgrip strength.[2] Handgrip strength (HGS) is a simple and reliable measurement of maximum voluntary muscle strength. It is an indicator of the efficacy of various treatment strategies for the hand.[3]It is an excellent

indication of decline in physical function and biological aging . Handgrip strength, which is mainly used to evaluate muscle strength, reflects the strength of the whole body. It has the advantage of being simple and safe to assess . [2]

HGS can predict not only muscle mass and physical activity , but also the incidence of chronic diseases, nutritional status, quality of life, independence of daily life, length of hospital stay, general body strength, body cell mass depletion, postoperative complications, premature mortality, early onset of disability and functional decline. [1,3]It is also an important tool for diagnosing sarcopenia.

HGS has been found to be affected by various known factors including age, sex, body size, posture, hand dominance, forearm girth etc and some anthropometric parameters especially BMI . [4]

Cross-sectional and longitudinal studies showed that handgrip strength decreases over the life span,as a result of decline in hand sensation, loss of finger dexterity, muscle-fibre deterioration, and central nervous system degeneration. This loss of handgrip strength can affect activities of daily living (eg, bathing, grooming, dressing, eating, and toileting) and lead to the loss of independence. Thus, the reliable evaluation of handgrip strength may be used for strength monitoring, for prevention and rehabilitation of hand-related injuries .[5]

The reliability of measurement of handgrip strength has focused on the evaluation of maximal handgrip strength and not endurance and this has been examined through previous studies.However, handgrip endurance has been projected as a more important indicator of hand function and over- all functional capacity . There are many activities of daily living (ADL) that require a sustained effort exerted over a period of time. Therefore along with muscle strength , muscle endurance is also an important aspect of physical performance and needs to be considered when assessing the total musculoskeletal function. [6]

Endurance is the ability of a muscle group to perform repeated contractions over a time period, sufficient to cause muscular fatigue or to maintain a specific percentage of maximum voluntary contraction for a prolonged time. An exercise induced reduction in the maximal force capacity of the muscle is known as Muscle Fatigue.It is characterised by a decrease in muscle force production capacity and shortening velocity, and a prolonged or extended relaxation of motor units between recruitment. [1]

Many professions require repetitive or forceful gripping movements or lifting and holding heavy loads with a proportionately static grip . A diverse range of tasks, from comparatively dynamic movements involving concentric and eccentric contractions, to comparatively static tasks mainly producing an isometric contraction, comprise the manual activities involving grip at work place.[7]Manual activities under poor ergonomic conditions can predispose an individual to work related musculoskeletal disorders (WRMDs).

There are 2 forms of handgrip endurance that are vital for several household and work-related activities :static(sustained submaximal grips for a long period) and dynamic(repeated maximal grips). For example, daily activities such as typing, screwing, wiping, raking a yard, mopping a floor, and cleaning a window etc. have dynamic handgrip strength as an important component· For carrying shopping bags, moving a furniture, or holding a heavy object for a sustained period, static handgrip strength endurance is very essential in people's daily life. Hand grip strength is not a true measure of hand function, since it is measured isometrically, while most daily activities require dynamic gripping.[1] Thus, the reliable evaluation of both static and dynamic handgrip strength and hand grip endurance may provide a more complete picture of hand function and of overall functional capacity in healthy individuals. [5]

The measurement of dynamic endurance has been considered safer, easily applicable and less fatiguing as compared with the measurement of static endurance, especially in older individuals, untrained people and in patients who suffer from cardiovascular diseases . [5]

From many years, instruments like strain gages, sphygmomanometers and dynamometers have been used to assess the grip strength . [1]

Since the 1970s researchers have biopsied skeletal muscles from living men and women to determine muscle fibre types . In early studies, myofibrillar adenosine triphosphatase (mATPase) histochemistry was used to classify fibre as Type I ("slow twitch") or Type II ("fast twitch") .Type II fibres shorten at faster velocities and produce more force and power than Type I fibres, whereas Type I fibres possess a greater capacity for oxidative energy production and are more endurant than Type II fibres. Sex difference in muscle fibre type has implications for discussions about biological sex and its impacts on neuromuscular physiology, sport performance, and disease pathology. Differences in muscle fibre types and its composition might help to explain how men produce more force than women, as greater muscle mass in men than women does not appear toexplain the sex difference in muscle strength fully.

It is seen that men and women have similar proportional numbers (i.e., distribution percentages) of Type I and Type II fibres but that Type II fibres acquire a greater proportional area or the area percentage of muscle in men than women. Type I muscle fibres aquire a greater area percentage of muscle in women, leading to higher Type II/I fibres area ratios in men than women. [8]

METHODOLOGY*

An observational research design with purposive sampling method was used for this study. A total of 60 college going subjects were taken (30 males and 30 females) of age group 18 – 25 years residing in Delhi, India based on the inclusion and exclusion criteria. Consent was taken from all the subjects taking part in the study. The participants were explained about the purpose of the study and their demographic data was collected.Their grip strength and grip endurance was measured.

Positioning – participant was seated upright with feet fully resting on the floor, back fully supported and hips and knees positioned at 90° approximately. The elbow was placed on the armrest at approximately 90° and the shoulder of the Dominant arm was maintained in adduction; with elbow flexed comfortably between 90° and 120°. The position of wrist was held between 0° and 30°of extension and between 0° and 15° ulnar deviation.

Hand grip strength measurement- Peak grip strength was measured on the dominant hand using Jamar Dynamometer. The dynamometer was held with an index finger at the top of the grip, while keeping all fingers on the grip band. The second dynamometer handle position was used and the participant was instructed to produce a smooth gripping force, without any sudden jerking movements. Participants were instructed to hold the grip for 3 seconds and a rest period of 15 seconds was given between the grip repetitions. The dynamometer was used to measure the grip strength score. Three repetitions were taken and there mean was taken.[1]

Grip endurance measurement- Hand grip endurance test consisted of 12 maximal isometric grip contractions of the dominant arm. Contractions were held for 3 seconds and a 5 second rest period was given between each repetition. Standardised verbal commands were provided by the researcher to ensure that the participants were contracting at the appropriate times. Percentage fatigue index value was calculated to assess the endurance. It was calculated by [(first repetition − last repetition)/first repetition] × 100. [6]

RESULTS*

Participant characteristics

The study included a total of 60 participants, 30 males and 30 females.The demographic data of all the participants is shown in the table below.

VARIABLE	MALE(n=30, 50%)	FEMALE(n=30, 50%)	TOTAL(n=60, 100%)
	Mean± SD	Mean± SD	Mean ± SD
Age (years)	20.86±1.92	21.56±1.43	21.22 ± 1.71
Weight(kg)	66.45±8.79	53.15±7.05	59.805±10.36
Height(m)	1.72±0.06	1.59±0.06	1.6582±0.09
BMI(kg/m2)	22.33±2.69	21.00±3.09	21.6678±2.95
Mean Strength(kg)	29.94±7.96	15.06±4.04	22.5023±9.77
Mean PFI(%)	34.66±13.65	22.70±10.62	28.6875±13.54

TABLE 1- DEMOGRAPHIC DATA

Hand grip strength and Gender

An independent samples T test was conducted using SPSS 25 software to determine the relationship between gender and hand grip strength .Significant difference between hand grip strength in both the genders was seen ($p<0.05$).

Independent Samples Test

		Levene's Test for Equality of Variances		t-Test for Equality of Means		t-Test for equality of Means	
		F	Sig.	t	df	95% Confidence Interval of the Difference	
						Lower	Upper
Mean Strength	Equal variances assumed	11.863	.001	-9.127	58	-18.146	-11.618
	Equal variances not assumed			-9.127	43.007	-18.170	-11.594

TABLE 2- INDEPENDENT SAMPLE T – TEST FOR MEAN GRIP STRENGTH AND GENDER

Hand grip endurance and Gender

An independent samples T test was conducted to determine relationship between gender and percentage fatigue index i.e. hand grip endurance . Significant difference between hand grip endurance in both the genders was seen ($p<0.05$).

Independent Samples Test

		Levene's Test for Equality of Variances		t-Test for Equality of Means		t-Test for equality of Means	
		F	Sig.	t	df	95% Confidence Interval of the Difference	
						Lower	Upper
PFI	Equal variances assumed	4.117	.047	-3.786	58	-18.279	-5.635
	Equal variances not assumed			-3.786	54.690	-18.287	-5.627

TABLE 3- INDEPENDENT SAMPLE T TEST FOR PFI (GRIP ENDURANCE) AND GENDER

DISCUSSION*

In this study we saw the influence of gender on hand grip strength and hand grip endurance . The implication of this is that gender has an influence on hand grip strength and hand grip endurance and females have more endurance compared to males whereas males have more strength. This might be a result of the difference in muscle fibre composition in both the genders. Females have greater proportion of type 1 muscles fibres as compared to men. Type 1 muscle fibres are more endurant than type 2 fibres and type 2 fibres produce more force or power than type 1 .[9]

This study evaluated hand grip strength and hand grip endurance in both the genders of age group 18 to 25 years and it was seen that male subjects produced greater average grip force which has been documented many times in previous studies as well . This finding is in agreement with the findings of Manjuanth et el , Das and Dutta , Shetty et al and Rolland et al who reported a positive and significant relationship between males and more hand grip strength.

Like wise a very important study by Dhananjaya J R (2017)[10] revealed that testosterone increases type 2 fibres which are fast fibres with high glycolytic enzyme activity. Thus the high proportion of type 2 fibres in males increases strength in them.

A study conducted by Sami FarisAlmashaqbeh included of 41 females and 59 males to study

the hand grip strength on different arm positions using a mechanical dynamometer.for dominant hand the maximal hand strength was 48.6 kg and 32.9 kg on average for males and females, respectively. [11]

Also the handgrip strength and its association with gender, the body mass index, and hand anthropometric data for 524 Sri Lanka, undergraduate university students (350 females and 174 males), have been investigated .The results of handgrip strength showed a significant difference among the different genders. The strength of the dominant hand for male students was 35.27 kg compared to 19.52 kg for females.[12]

The hand grip endurance in this study was assessed using the Percentage Fatigue Index (PFI) in which 12 maximal contractions were noted and the fatigue of both the genders was calculated. The study showed that females have more endurance compared to males as the mean fatigue of males was higher than females according to PFI. This finding is in agreement with the finding of GaurangBaxi et el , they conducted a study on 500 healthy individuals aged 18-25 years to test static and dynamic hand grip endurance in both males and females. They concluded that women have better ability to adapt themselves to performance of endurance activity than men because of higher potentiality for oxidation of fat. Also the rate of depletion glycogen is much lower in muscles of women, compared to men during endurance activity. Thus, females are more capable of performing better than males at workloads equal to 80% of maximum oxygen uptake. [1]

Another study conducted by R.J. Maughan included of 25 males and 25 females. Repeated isometric and dynamic muscle contractions were performed by them and they concluded that endurance capacity of women s greater than that of men in both dynamic and isometric muscle exercise.

Previous studies have also documented that grip force was found to decrease as time duration and repetitions of test progressed which was also consistent with the findings in this study.

More studies with large sample size assessing more parameters like different age group, BMI and arm muscle girth can be done in future to further substantiate the findings obtained in this study.

CONCLUSION*

The study provides data on hand grip strength and hand grip endurance in healthy young adults in the age group of 18 - 25 years . The results of our study demonstrated that there is significant effect of gender on hand grip strength and hand grip endurance . In case of mean hand grip strength there is a significant difference in hand grip strength in males and females ($p<0.05$) . In case of hand grip endurance or percentage fatigue index there is a significant difference in hand grip endurance in males and females ($p<0.05$). It was seen that males have more hand grip strength as compared to females whereas females have higher hand grip endurance compared to males.

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