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EFFECT OF BODY MASS INDEX ON GRIP AND PINCH STRENGTH IN VARIOUS POSITION OF THE DOMINANT SIDE AMONGST YOUNG ADULTS

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ABSTRACT

Background: Upper limbs play an important role in everyone's daily life. The hand is used in many ways. The measure of handgrip and pinch strength is influenced by several factors including age, sex, and grip span, posture, and position of the shoulder and arm. Grip and pinch strength is integrated performances of muscular contraction.

Aims: The aim of the study was to evaluate the effects of body mass index on grip and pinch strength in various position of the dominant side amongst young adults.

Method: This study included 150 healthy subjects between the age group of 19-33 yrs. Handgrip strength of the subject was measured using a jamar dynamometer. and pinch strength of the subject was measured using a B&L pinch gauge. Grip strength was measurement in various position in shoulder and elbow. And the pinch strength was measurement in various elbow position.

Results: There is significant correlation between body mass index and pinch and grip strength in dominant hand girls and boys.

Conclusion: There is a significant difference between hand grip and pinch grip in various position. And there is also significant difference in between standing and sitting posture of pinch grip.

Keywords: Hand grip strength, Pinch strength, Pinch dynamometer, Grip dynamometer, Hand rehabilitation

INTRODUCTION

A human uses a hand by everyday life and various things can be treated. It may say that human using a hand is a very important duty human in itself with the rank and it is not the action that a hand is not used for everyday life **[1]**. Many daily task and sport activities need high level of forearm and muscles strength. These muscles contribute to grip strength which is necessary for performing tasks in many sports events such as wrestling, tennis, in addition to accomplish daily activities such as turning door handle and etc. It is assumed that grip strength can be predictive for whole body strength **[2]**. Hand is the most important part to the ability to manipulate activity of daily living. The most important function of the hand at work are grasping, applying muscular forces to control and manipulating objects. Disorders of hand function cause many difficulties due to the impairment of sensory and motor function **[3]**.

Hand is much more than a machine in the factory of human body. The hand is irreplaceable when it comes to performing any kind of movement be it gross or skilled. The prime function of hand is grip. Hand and wrist are the most active and intricate parts of the upper extremity. Their mobility is enhanced by a wide range of movements at the shoulder and complementary movements at the elbow and forearm.[4] Grip strength of many components to be considered in examination of hand function. Many of the items included in an upper assessment are based on observation and subjective impression, however, a grip strength measurement, when properly taken, can provide objective and quantifiable information regarding hand function.[5] Hand grip strength is widely considered as an objective index of functionality of upper extremity which can be optimized with a reliable evaluation. Hand functionality is considered to be vital in most of the daily activities involving upper limb be it carrying loads, lifting objects, opening or closing doors to name a few **[6]**. Several studies have shown that grip strength is affected by the body postures of the upper extremity **[7]**.

The measure of handgrip strength is influenced by several factors including age, sex, hand size and grip span, posture, and position of the shoulder, forearm, and wrist. The angle of the elbow is another important factor when measuring handgrip strength **[8]**. Although strength is one of the important characteristic of normal hand, this factor is not given enough attention in reconstructive surgery as compared to other parameters of motion and sensibility **[9]**. A multitude of scientific evidence exists about the importance of grip strength for some sports. Disciplines such as climbing, sailing, motocross, wrestling, and of course judo

among others, require in some form or another a good grip to provide security in other actions **[10]**. Maximal muscle strength is reached at the age of about 20 for men, and a few years earlier for women. Grip strength may reach its maximum value in the middle to late 20s and then declines as age advances. In terms of gender differences, there are also strength differences between male and female **[11]**. The hand is an organ specialized for grip and sensation of utmost importance **[12]**.

Muscles Involved in Grip Strength

There are 35 muscles Involved in movement of the forearm and hand, with many of these Involved in gripping activities **[13]**. During gripping activities, "the muscles of the flexors mechanism in the hand and forearm create grip strength while the extensors of the forearm stabilize the wrist **[14]**. There are four major joints of the hand, Carpometacarpal, Intermetacarpal, Metacarpophalangeal and Interphalangeal joint, with "9 extrinsic muscles that cross the wrist and 10 intrinsic muscles with both of their attachments distal to the wrist." **[15]** These muscles include the pronator radii teres, flexor carpi radialis, flexor carpi ulanris, flexor sublimis digitorum, and Palmaris longus on the extrinsic layer and the flexor profundus digitorum, flexor profundus digitorum, flexor policus longus, pronator quadratus, flexor pollicus brevis, and abductor pollicus brevis on the intrinsic layer. Each of these muscles is active during activities. According to Germar Sports Scientist Jurgen Weininck, "the characterisitic structure of the hand is realated 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 grasprd can be held **[16]**.

Grip and Pinch strength is one of the most important factors related to proper hand function. Many recent studies have been performed in order to evaluate grip and pinch strength and provide standard values among people of different age groups. There are various factors that may effect on grip and pinch strength, like hand dominance (being right or left handed, posture and armjoint angle , height, body weight, age, fingers length. The effect of hand dominance on grip and pinch strength among various groups of people **[2]**.

Motor function of hand divided into grip, pinch and hook, these main key factors should be in harmonic activity for normal finger movement. Pinch of them in daily life is fundamental and objective assessment of pinch strength is needed **[3]**.

Power grip is the result of a sequence-

1) Opening of the hand.
2) Positioning of fingers.
3) Approaching the fingers to the object.

4) Maintaining a static phase that actually constitutes the grip **[4]**.

MATERIALS & METHODOLOGY

DESIGN OF THE STUDY- Survey Study

SAMPLING OF THE STUDY- Convenient Sampling

SOURCE OF DATA- Subjects were selected from the CAEHS College and surrounding areas.

CRITERIA-

INCLUSION CRITERIA

- GENDER- Both Males and Females.
- AGE GROUP- Between 19-33 years.
- Informed consent.
- No restricted movements of upper limb.
- No inflammatory joint disease.
- No tightness and deformity in upper limb.
- No History of fracture.

EXCLUSION CRITERIA

- Lack of consent to participate in the study.
- History of fracture of shoulder, arm, elbow, forearm, wrist and hand.
- History of dislocation of shoulder joint, elbow joint, forearm and wrist joint.
- Restriction of movements of upper limb joints.
- Any history of inflammatory joint disease, neurological disorders or injury to upper extremity.
- Stiffness of upper limb joints.
- Tightness, deformity and contractures in upper extremity.
- Any Bone disease.

INSTRUMENTATION-

- A Jamar Dynamometer was used to test the grip strength.
- B&L pinch gauge was used to test the pinch strength.
- Inch tape was used to measuring height.
- Wight machine used to weight measure.

A convenience sample of 150 healthy subjects from the student population of College of Applied Education & Health Sciences,

Meerut and surrounding areas, (75 males, 75 females) in age group of 19-33 years participated in the study. Majority of subjects were right hand dominant. Subjects signed informed forms after being provided with a brief description of the study. The exclusion criteria for this study included any previous history of upper extremity abnormalities, inflammatory joint diseases, neurological disorder or injury to upper limb and other health conditions.

Al l the details were recorded like name, age and dominance and body mass index.

Medical history was asked for scrutinizing the subjects, which come under exclusion criteria. Prior to commencement of the data collection subjects were asked to read and acknowledge the consent form. Subjects were told about hand dynamometer and B&L pinch gauge and its use. How to use the hand dynamometer and B&L pinch gauge was demonstrated. After all briefing, subjects were made to stand with correct posture. The subject used pinch gauge and grip dynamometer with the dominant hand. The subject used lateral pinch with the dominant hand. For this test the pinch meter was held of the thumb and the lateral aspect of the index finger. Pinch strength measurement three position in two postures (Standing and Sitting). And grip strength measurement the dynamometer presented vertically. Grip strength measurement three position in one posture (Standing). The examiner instructed the subject to "squeeze as hard a possible… harder… harder… relax". Upper limb was in following position:

Pinch strength measurement in standing Position:

0^0 of shoulder flexion, elbow extension fully (P1)

0º of shoulder flexion, 45º elbow flexion (P2)

0º of shoulder flexion, 90º elbow flexion (P3)

Pinch strength measurement in sitting Position:

0º of shoulder flexion, elbow extension fully (P4)

0º of shoulder flexion, 45º elbow flexion (P5)

0º of shoulder flexion, 90º elbow flexion (P6)

Grip strength measurement in standing position:

90º of shoulder flexion, 90º elbow flexion (P7)

90º of shoulder flexion, elbow extension fully (P8)

180º of shoulder flexion, 90º elbow flexion (P9)

Subject was instructed to take two three second to reach the maximum effort and then verbal encouragement was given consistently throughout all measurement. For each strength test scores of three successive trails recorded for each hand. The highest grip and pinch strength for each hand was used for analysis. The trails for each measurement was separated by a rest of at least one minute to minimize fatigue. Body weight and height were measured the exam and values were expressed as kilograms and centimeter,

respectively. To calculate BMI, height was into meter (BMI = weight/ height^2)

RESULTS

The present study was to see the effect of BMI on grip and pinch strength. A total of 150 subjects examines for the grip strength and pinch strength in various position. According to the mean valve there is a statically significant difference between the pinch and hand grip of the dominant hand among boys and girls.

The mean valve of the pinch strength girls standing position :

The mean value of P1 - 0^0 Shoulder flexion, Elbow extended fully = 11.61

P2 - 0^0 Shoulder flexion, 45^0 Elbow flexion = 11.42

P3 - 0^0 Shoulder flexion, 90^0 Elbow flexion = 11.29

The mean valve of the pinch strength girls sitting position :

The mean value of P4 - 0^0 Shoulder flexion, Elbow extended fully = 11.49

P5 - 0^0 Shoulder flexion, 45^0 Elbow flexion = 11.28

P6 - 0^0 Shoulder flexion, 90^0 Elbow flexion = 11.14

The mean valve of the grip strength girls standing position :

The mean value of P7 - 90^0 Shoulder flexion, 90^0 Elbow flexion = 57.29

P8 - 90^0 Shoulder flexion, Elbow fully extension = 56.22

P9 - 180^0 Shoulder flexion, 90^0 Elbow flexion = 51.86

The mean value of BMI = 20.59

The mean valve of the pinch strength Boys standing position :

The mean value of P1 - 0^0 Shoulder flexion, Elbow extended fully = 15.6

P2 - 0^0 Shoulder flexion, 45^0 Elbow flexion = 15.41

P3 - 0^0 Shoulder flexion, 90^0 Elbow flexion = 15.29

The mean valve of the pinch strength boys sitting position :

The mean value of P4 - 0^0 Shoulder flexion, Elbow extended fully = 15.25

P5 - 0^0 Shoulder flexion, 45^0 Elbow flexion = 15.09

P6 - 0^0 Shoulder flexion, 90^0 Elbow flexion = 14.84

The mean valve of the grip strength boys standing position :

The mean value of P7 - 90^0 Shoulder flexion, 90^0 Elbow flexion = 84.73

P8 - 90^0 Shoulder flexion, Elbow fully extension = 80.34

P9 - 180^0 Shoulder flexion, 90^0 Elbow flexion = 75.13

The mean value of BMI = 21.16

The average mean valve of the grip and pinch strength in girls and boys:

The mean value of pinch strength in standing position:

P1 - 0^0 Shoulder flexion, Elbow extended fully = 13.60

P2 - 0^0 Shoulder flexion, 45^0 Elbow flexion = 13.42

P3 - 0^0 Shoulder flexion, 90^0 Elbow flexion = 13.2

The mean value of pinch strength in sitting position :

P4 - 0^0 Shoulder flexion, Elbow extended fully =13.37

P5 - 0^0 Shoulder flexion, 45^0 Elbow flexion =13.18

P6 - 0^0 Shoulder flexion, 90^0 Elbow flexion=12.99

The mean value of grip strength in standing position :

P7 - 90^0 Shoulder flexion, 90^0 Elbow flexion = 71.01

P8 -90^0 Shoulder flexion, Elbow fully extansion = 68.28

P9 - 180^0 Shoulder flexion, 90^0 Elbow flexion = 63.5

The average mean value of BMI = 20.87

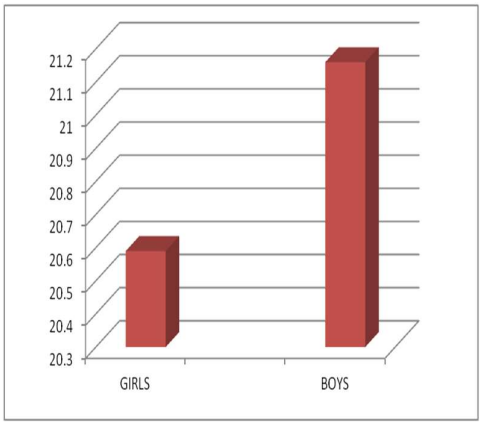
In this study it was found that in boys, on an average, 7 subjects were overweight, having BMI more than 24.9 and also had their pinch & grip strength, more than the other individuals. Similarly in girls, on an average, 5 girls were overweight, having BMI more than 24.9, also had their pinch and grip strength higher than the other girls. This signifies that there is a significant correlation between BMI and effective parameters for pinch and grip strength for dominant hand.

Table 1: Showing comparison in the mean value of grip and pinch strength of Girls and boys at different arm and forearm position

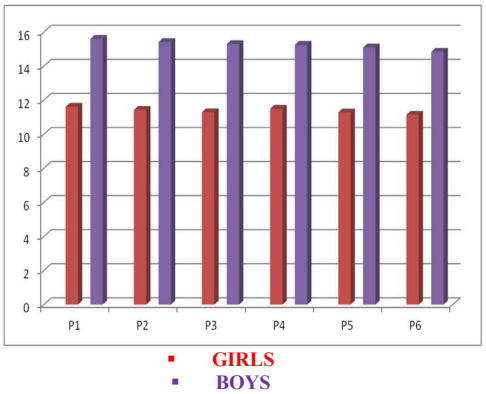
POSITION	MEAN(GIRLS)	MEAN(BOYS)
P1	11.61	15.6
P2	11.42	15.41
P3	11.29	15.29
P4	11.49	15.25
P5	11.28	15.09
P6	11.14	14.84
P7	57.22	84.73
P8	56.22	80.34
P9	51.86	75.13

Table 2: Showing comparison in the mean value of grip and pinch strength at different arm and forearm positions.

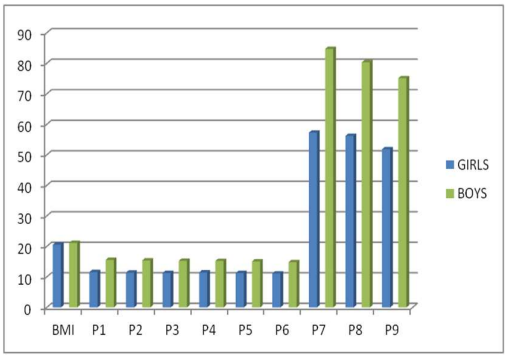
(AVERANGE-MEAN)	
P1	13.60
P2	13. 42
P3	13.29
P4	13.37
P5	13.18
P6	12.99
P7	71.01
P8	68.28
P9	63.5



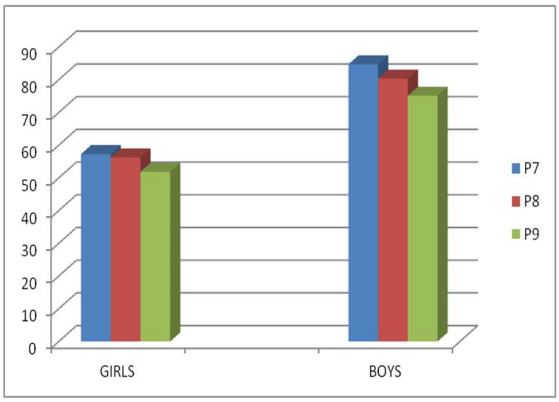
Graph 1: Showing comparison in mean value of body mass index of boys and girls.



Graph 2: Showing comparison in mean value of pinch strength of Boys and girls at different forearm position



Graph 3: Showing comparison in average mean value of BMI and pinch and grip strength of boys and different forearm and arm position



Graph 4: Showing comparison in average mean value of grip strength of Boys and girls at different forearm position

CONCLUSION

There is a significant differences between hand grip and pinch grip in various position. According to our study:

These is also a significant differences in between standing and sitting posture of pinch grip.

(1) The highest mean pinch grip were found in the (P-7) position, in which the shoulder is 0º flexion & elbow extended fully.

(2) The highest mean grip were found in the (P-1) position, in which the shoulder is 90º flexion & elbow is 90º flexion.

(3) The lowest mean grip were found in the (P-9) position, in which the shoulder is 180^0 of flexion & elbow is 90^0 of flexion.

(4) The lowest mean pinch grip were found in the (P-6) position, in which the shoulder is 0^0 of flexion & elbow is 90^0 of flexion.

These is also a significant differences in between standing and sitting posture of pinch grip.

Our study affirms that various joint position can affect grip and pinch strength

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