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HAND GRIP STRENGTH IN YOUNG ADULTS: INFLUENCE OF ARM CIRCUMFERENCE, BMI, GENDER AND HANDEDNESS

Physiology

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ABSTRACT

AIM: In our study we assessed the association between hand grip strength and arm circumference, BMI, dominant hand and gender. **METHODOLOGY:** Our study population includes 146 young adults (Female-84, Male-62) from Guntur medical college, Guntur, Andhra Pradesh. We have calculated each student's BMI (kg/m2). We measured Hand grip strength in (kg) by taking the average of two hand grip attempts using a handspring dynamometer. We measured the Upper arm circumference using a measuring tape in cm around the thickest part of the upper arm. We compared Hand grip strength with arm circumference, BMI, handedness and gender. **Results:** The mean values for Maximal grip strength in the right hand for severely underweight, underweight, normal, overweight, and obese are 21, 26, 31.1, 31.6 and 32. The mean values for Maximal grip strength in the left hand for severely under-weight, underweight, normal, overweight and obese are 19, 26, 29.4, 29.6 and 30. The mean values for the arm circumference of the muscle in the right limb for severely underweight, underweight, normal, overweight and obese are 20.8, 21.6, 26.2, 28.6, and 30.6. The mean values for the arm circumference of the left-limb muscles in severely underweight, underweight, normal, overweight and obese are 20.3, 21.3, 25.8, 28.4 and 30.4. Pearson coefficient for maximal grip strength and bulk of the right arm is 0.9095, indicating a strong positive correlation. The P-Value is <0.00001, which is significant at P<0.05. Pearson coefficient for maximal grip strength and the bulk of the left arm is-0.382, indicating a negative correlation. The P value is <0.00001, which is significant at P<0.05. **Conclusion:** Maximal Grip Strength is more in males than females. Bulk and Maximal Grip Strength is more in the dominant hand (right hand).Maximal Grip Strength is less in severely underweight and underweight participants. Maximal Grip Strength is more in overweight and obese.

KEYWORDS

BMI, Dominant Hand, Gender, Hand Grip Strength, Handspring dynamometer

INTRODUCTION

Many daily activities require flexor musculature of the hand and forearm. These muscles are involved in gripping strength[1]. Hand grip strength is a measure of muscle function and physical health. Handgrip strength is usually used to predict the whole body strength in both males and females as well as different age groups.[2] Sports which use hands for grasping like wrestling, tennis, handball, and basketball require a certain degree of grip strength. Coaches and athletes uses the handgrip strength test in assessing the performance[3].Handgrip strength is negatively associated with poor health[4].

One of the most commonly used methods of measuring muscle strength is the isometric hand grip strength test. Hand grip strength can be quantified by measuring the amount of static force that the hand can exert on a Hand spring dynamometer. The tool is easy to handle and inexpensive.

Hand Grip strength is found to be associated with various factors like age, gender, body height, weight, bone mineral density, hand dominance, forearm circumference, arm circumference, occupation, social status, lifestyle.[5-9] Less literature is available in establishing the association of maximum hand grip strength with arm circumference and anthropometry. If the association between these variables is well established, it will be possible to use the maximum hand grip strength as a more accurate and sensitive tool for various studies. So, we undertook this study to evaluate hand grip strength in young adults and influence of arm circumference, BMI, handedness, and gender.

AIMS AND OBJECTIVES

The main aim of this study was to evaluate maximal handgrip strength in male and female healthy young adults and influence of arm circumference, BMI, handedness, gender on maximal hand grip strength.

METHODOLOGY

We conducted this study on 146 young adults (Female-84, Male-62) from Guntur medical college, Guntur, Andhra Pradesh aged between 18-25 years. Study includes only healthy young adults. Young adults with any deformity or function loss in the upper extremities were excluded from the study.

Participation in the study was voluntary. The student's consent was taken prior to the study. The BMI of each student was measured by using their respective height and weight. The subjects were classified under five categories as per WHO ASIAN BMI SCALE. We measured the Upper arm circumference using a measuring tape in cm around the thickest part of the upper arm. The instrument used for measuring Hand grip strength in (kg) was Handspring dynamometer. Handedness was assessed by using Edinburgh Handedness Inventory (EHI) Scale. All the study population showed Right Handedness.

Prior to the study, subjects were given education regarding the procedure of the study.

Subjects were asked to warm up the hands and fingers by shaking both hands and bending and stretching all fingers two-three times. Then the subjects were asked to grasp the handspring dynamometer between fingers and the palm at the base of the thumb initially with the dominant hand and later with the other hand by holding the dynamometer in line with the forearm at thigh level so that it was not touching the body. Subjects were instructed to squeeze the dynamometer with maximum effort by motivating them to perform at their optimum level with a gap of 60 seconds for two times and the average strength was calculated.

RESULTS:

Table1: Classification of the study population based on BMI

Category	No.of females	No.of males	Total
Severely Underweight	12	0	12
Underweight	8	4	12
Normal weight	44	48	92
Overweight	14	6	20
Obese	6	4	10
Total	84	62	146

Table2: Descriptive statistics of Maximal Grip strength in Males

Variable	Right Hand	Left Hand
Mean±SD(kg)	39.62±7.027	36.39±6.525
Median	40	39.5
Range	30(25-55)	28(25-53)
P Value	0.0093*	

Table3: Descriptive statistics of Maximal Grip strength in Females

Variable	Right Hand	Left Hand

Mean±SD(kg)	22.45±4.761	20.0±5.087
Median	21.5	20
Range	19(15-34)	21(13-24)
P Value	0.0015*	

From the above data there was an association between dominant hand and the other hand for maximal grip strength in both genders. Maximal grip strength mean was higher in males than females.

Table4: Descriptive statistics of Maximal Grip strength as per BMI in Right Hand

Category	Mean±SD(kg)	Median	Range
Severely Underweight	21±3.605	20.5	12(15-27)
Underweight	26.83±11.066	24	30(16-46)
Normal weight	30.6±10.938	28.5	29(20-49)
Overweight	30.94±10.245	29	31(19-50)
Obese	32±9.757	30	40(15-55)

Table5: Descriptive statistics of Maximal Grip strength as per BMI in Left Hand

Category	Mean±SD(kg)	Median	Range
Severely Underweight	19±4.546	17.5	12(14-26)
Underweight	26.2±6.852	22	21(17-38)
Normal weight	26.33±11.14	26	28(15-43)
Overweight	29.1±10.406	28	32(16-48)
Obese	29.65±10.28	29	40(13-53)

As per the above data in both hands order of mean of Maximal grip strength is obese>overweight>normal weight>underweight>severely underweight

Table6: Descriptive statistics of Arm circumference as per BMI in Right upper limb

Category	Mean±SD(cm)	Median	Range
Severely Underweight	20.8±0.748	21	2(20-22)
Underweight	21.66±0.745	21.5	2(21-23)
Overweight	28.63±1.226	28	4(27-37)
Obese	30.6±2.332	30	7(27-34)

Table7: Descriptive statistics of Arm circumference as per BMI in Left upper limb

Category	Mean±SD(cm)	Median	Range
Severely Underweight	20.3±1.105	20.5	3(19-22)
Underweight	21.33±1.105	21.5	3(20-23)
Overweight	28.45±1.499	29	5(26-31)
Obese	30.4±2.653	30	8(26-34)

Table8: Association between Maximal grip strength and Arm circumference

	Right	Left
Pearson coefficient	0.9095	-0.382
P-Value	<0.00001*	<0.00001*

In both the upper limbs there is a significant association of Arm circumference with maximal grip strength at P<0.05. There is a strong positive correlation with right upper limb and negative correlation with left upper limb.

DISCUSSION

The main purpose of our study was to analyse the influence of gender, BMI, Arm circumference, dominant hand on hand grip strength in young adults.

All the subjects in our study population are right handed. The mean value of maximal Hand grip strength in dominant hand in males and females are 39.62kg and 22.45kg, in non-dominant hand the values are 36.39 kg and 20.0 kg respectively. In both the sexes, Maximal Hand grip strength is comparatively higher in dominant hand (Right). This is most likely due to the fact that the dominant hand is utilised more strongly than the non-dominant hand, resulting in larger and stronger muscles on the dominant side[10]. Our result is similar to the findings of the study conducted by Özcan A.et.al[11].

The mean values of maximal hand grip strength as per BMI in severely underweight, Underweight, Normal weight, overweight and obese in right hand were 21kg, 26.83kg, 30.94kg and 32 kg. The mean values of maximal hand grip strength as per BMI in severely underweight, Underweight, Normal weight, overweight and obese in left hand were 19kg, 26.2kg, 26.33kg, 29.1kg and 29.65kg. In both hands maximal hand grip strength is in the order of severely underweight < underweight < normal-weight < overweight < obese. It has been hypothesized that a decrease in nutrient intake results in a corresponding loss of whole-body protein, preferentially from muscle mass, the body's greatest protein reserve. This process results in cellular adjustments that decrease protein synthesis and increase proteolysis, which causes muscle fiber atrophy. In turn, this causes a decline in muscular function and strength.[12]

The mean value of Maximal grip strength in males and females in Right hand are 39.62 kg and 22.45 kg. In left hand the mean values in male and female are 36.39 kg and 20 kg. The maximal grip strength is comparatively high in males than females. This gender difference is due to, males have significantly higher number of Type 1 muscle fibers, which in turn increases the muscle strength and also due to muscular hypertrophy because of high levels of testosterone[13,14]

The arm-circumference showed a positive correlation with right upper limb and a negative correlation with left upper limb. In both the upper limbs there is a significant association of Arm circumference with maximal grip strength at P<0.05.

This study was limited to young adults aged between 18-25 years. Hence the results can't be generalised to the whole population. All the subjects in our study were right handed and further studies should be carried out in left handed, and ambidextrous individuals to know if the results may vary.

CONCLUSION

In our study, we assessed the influence of BMI, Gender, Arm Circumference and Handedness in young adults. In regard to gender, males had stronger Maximal hand grip strength than females. Maximal Hand Grip Strength is stronger in dominant hand and subjects with High BMI. There is a positive association between Arm circumference and Maximal Hand grip strength.

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