

## Association of Hand Grip Strength and Hand Anthropometrics in Physically Inactive Undergraduate Students

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### ABSTRACT

#### Background:

Hand Grip Strength (HGS) reflects the strength of the upper limb muscles as well as reflects the overall strength of the skeletal muscles and physical fitness. Undergraduate students have been described as having low physical fitness due to their sedentary lifestyle in many studies.<sup>1</sup> Hence, this study describes the HGS and its association with, Hand Dominance, Hand & Forearm anthropometrics in a group of young undergraduate students who do not participate in regular physical training.

#### Method:

This is an analytical study and was conducted in healthy physically inactive undergraduate students [n = 75, 64 females, 11 males]. The Main outcome measures were HGS, hand dominance, hand length, hand span, forearm length, forearm girth.

#### Results:

The average Right HGS was 23.06 whereas the average Left HGS was 22.80. The Average Right Girth was 9.21 whereas the Average Left Girth was 9.25. Upon correlating the Average Right-Hand Grip Strength of the subjects and average right forearm girth by linear regression method, the P value is 0.0001, which is considered extremely significant. Upon correlating Average Left Hand Grip Strength and average left forearm girth by linear regression method, the P value is 0.0063, which again came out to be extremely significant.

#### Conclusion:

This has provided an insight into the association of low HGS with reduced physical activity that is inclining towards a sedentary lifestyle in an academically oriented group

#### Keywords:

Hand Grip Strength, Hand dominance, Undergraduate students, and Hand anthropometrics.

## INTRODUCTION

Hand Grip Strength (HGS) reflects the strength of the upper limb muscles as well as reflects the overall strength of the skeletal muscles and physical fitness. Undergraduate students have been reported as having low physical fitness due to their sedentary lifestyle in many studies.<sup>(1)</sup> Hence, this study describes the HGS and its association with, Hand Dominance, Hand & Forearm anthropometrics in a group of young undergraduate students who do not participate in regular physical training.

Hand Grip Strength (HGS) is considered as the force applied by the hand to hold on, pull on, or suspend objects in the hand. It is a reliable measurement that can be easily used to evaluate the functional integrity of the hand.<sup>(2)</sup> Strength of the skeletal muscles depends on multiple factors such as body build and composition, physical activity, hormonal influence, etc. HGS reflects total muscle strength and physical fitness. Therefore, it can be used as a powerful indicator of the overall strength of the body<sup>(3-5)</sup>.

The hand represents the most revolutionary and transformed musculoskeletal tool in human beings. The human hand is efficient in performing varied and accurate functions which can be divided into grasping potentiality and manual dexterity.<sup>(2)</sup>

Sedentary people who were not actively participating in sports have demonstrated remarkably lower HGS compared to physically active people that involved in regular sports activities such as badminton, tennis, cricket, handball, throw ball, basketball and so on.<sup>(11)</sup> Therefore, HGS can be used to indicate the sedentary nature of a population, and it would facilitate to predict their potential risk of developing non communicable diseases such as stroke and myocardial infarction.<sup>(12)</sup>

A total of 35 muscles are involved in the movement of the forearm as well as the hand. Many of these are involved in gripping activities, the flexor muscles in the hand and forearm form the grip strength, while the extensor muscles of the forearm balance the wrist.<sup>(6)</sup> Anatomically, there are four major joints in the hand which are carpometacarpal, intermetacarpal, metacarpophalangeal, and interphalangeal joint along with nine extrinsic muscles that cross the wrist and ten intrinsic muscles with both of their attachments distal to the wrist.<sup>(7)</sup>

Handedness is succeeded genetically; Hand Grip strength is influenced immensely by nutritional status of an individual. That's why Hand Grip strength has been considered as a functional index of nutritional status.<sup>(8)</sup> Poor muscular strength (MS), which is decided with the use of a Hand Grip dynamometer, is considered as a marker of poor metabolic profile during adolescence and is associated with disease and mortality in adult phase of life.<sup>(9)(10)</sup>

HGS values have been influenced by many factors such as age, gender<sup>(30,31)</sup>, hand and forearm anthropometries, and hand dominance.<sup>(7)</sup> Study done by Jasim et al found that gender and personal anthropometric variables such as height, hand span, and BMI have a notable correlation with HGS, and gender came out to be the most noteworthy factor.<sup>(13)</sup>

A significant difference has been reported between males and females where males have had higher HGS than the females.<sup>(31,7,32-35)</sup> Bansal reported normative data for Hand Grip strength in young adults between The age group of 18 to 25 years, and concluded higher HGS in males than females.<sup>(14)</sup> Men were found to possess greater strength for all muscles than women<sup>(15,16)</sup> due to difference in muscle mass because of the male testosterone hormone which enlarges muscles and increases type II fibers with high activity of glycolytic enzymes..<sup>(17,18,19)</sup> It is a known fact that males have greater muscle mass and thus larger amount of contractile tissue leading to greater grip strength as compared to females.<sup>(20)</sup>

Males have a greater height and length of forearm when compared to females who have shorter height and lesser length of forearm. Thus, greater the height of the person, longer the arms which leads to greater lever arm for force generation and mechanical advantage. Thus, it results in generation of an efficient amount of force and higher grip strength. <sup>(21)</sup> Analysis of Hand Grip Strength by gender shows higher Hand Grip Strength by males in all the respective age group, and analysis by age group demonstrated a peak of grip strength in the fourth decade followed by a gradual decline in Hand Grip Strength for both males and females respectively. <sup>(16,36,67,38)</sup>

The Hand Grip Strength values of dominant hand, irrespective of sex, were higher than those of non-dominant hand. <sup>(2)</sup>

A general rule often used states that the dominant hand is approximately 10% stronger than the non-dominant hand. <sup>(39)</sup> In our day-to-day life, almost all the activities are performed using dominant hand. Although, we also use non-dominant hand in our activities but the amount of contribution from dominant hand is much greater as compared to non-dominant hand in terms of power, skill and agility. This results in to the differences in muscle mass and also hypertrophy of the muscle in dominant arm as compared to non-dominant. Thus, it concludes that greater higher grip strength is seen in dominant hand as compared to non-dominant hand. <sup>(2)</sup>

According to Jasim et al, in right-handed students, a significant difference was found between right and left handgrip strength. The difference was 11.9%. However, in the left-handed students, no significant difference was found between right and left handgrip strength. <sup>(13)</sup> Forearm girth, wrist girth, hand length, hand span <sup>(40-43)</sup> and forearm length <sup>(44)</sup> are known to have a significant correlation with the HGS.

Nevill and Holder (2002) concluded that the greater strength of the hand is directly related to the bigger size of the hand. <sup>(45)</sup> Nicolay and Walker (2005) indicated that the size of the hand as well as the forearm generally serve as higher level predictors of grip strength than the body height and body mass. <sup>(22)</sup> In addition, Fallahi et al. showed hand length, palm length, forearm length, forearm circumference and wrist circumference were significantly associated with grip strength in different populations. <sup>(23)</sup>

According to Alahmari et al, hand dimensions like hand circumference, hand span, hand length, palm length were significantly correlated with the HGS and Pinch strengths. <sup>(46)</sup> A previous study that showed individuals with larger hand circumference or longer palm length have a stronger grip power in all age groups. <sup>(23)</sup>

## **MATERIALS AND METHODOLOGY**

This analytical study was conducted in the university for a period of six months. Ethical approval was taken from the ethical committee of Tilak Maharashtra Vidyapeeth, Department of Physiotherapy, Pune. The consent form was taken from the students. The subjects were chosen as per inclusion and exclusion criteria This analytical study was carried among 75 physically inactive undergraduate students. Students who are having any trauma or pain in the upper limb, neck or back region were excluded from the study. Also. Students who participated in regular physical training were also excluded.

The age of the subjects included in this study were between the age group of 18 to 25. A total of 75 participants were included. Among them, 64 were female and 11 were male. 60 students had Right-Hand dominance and 15 students had left hand dominance.

Hand Grip Strength was measured by using a Hand-Held Dynamometer (CAMRY-EH101), a valid and reliable instrument. <sup>(24)</sup> It is an isometric, hydraulic hand-held dynamometer. The handle of Dynamometer

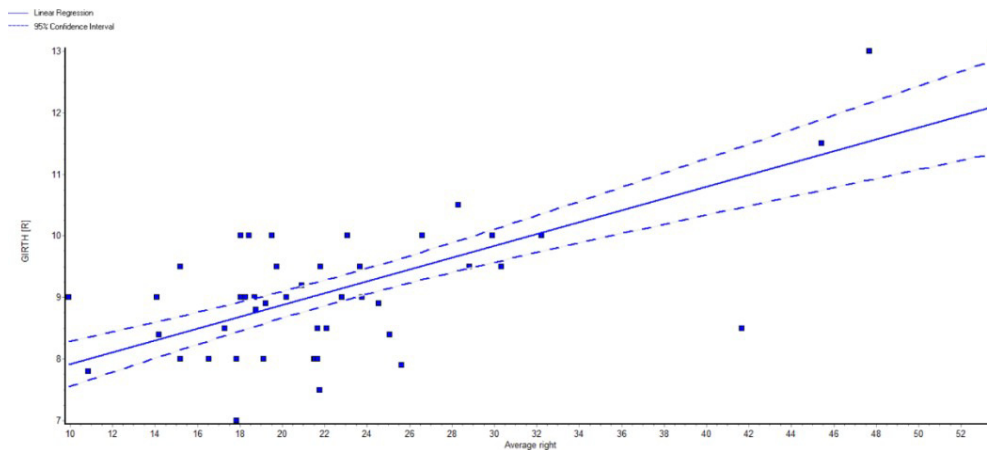
was adjusted to second position for all subjects. The norms followed for standardized positioning, instructions and calculations are given by American Society of Hand Therapists.<sup>(12)</sup> The subjects were made to sit on a chair, without any arm rest, back rest, the shoulders adducted and neutrally rotated, the elbows flexed to 90 degrees, and the forearm in neutral position, and the wrist in 0 to 15 degrees of extension and 0 to 15 degrees of ulnar deviation. The feet were completely flat on the ground. The subjects were instructed to squeeze the handle of the dynamometer as maximally as possible and release. No encouragement was given to the subjects. Three grip strength measurements for each dominant and non- dominant hand were taken by alternating the hands with a 1- minute rest period in between each task to avoid muscle fatigue. The mean of three successive trials of strength measurements were noted.

The hand length was measured using a measuring tape in each subject, defined as the distance between the mid-point of the distal wrist crease and the tip of the middle finger. The hand width also measured using the tape measure just below the knuckles excluding the thumb. Hand span was measured in dominant and non – dominant hand from the tip of the thumb to the tip of the little finger with the hand opened as wide as possible. Forearm girth was also measured using a measuring tape.

## RESULTS

A total of 75 students participated. Among them, 64 were girls and 11 were boys. 60 students had Right-Hand dominance and 15 students had left hand dominance.

Correlation of average Right-Hand grip strength of the subjects, average forearm girth of right dominance was done by linear regression method and following analysis was obtained.



Number of points =60

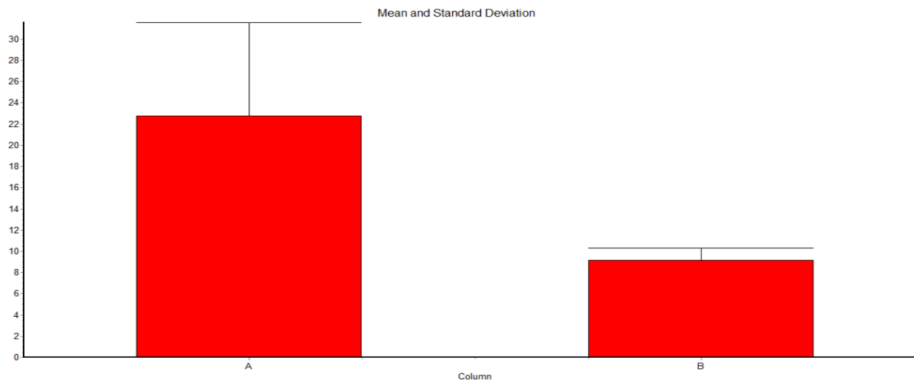
Correlation coefficient (r) = 0.7278

rsquared = 0.5297

Standard deviation of residuals from line (Sy .x) =0.7989

The P value is <0.0001, considered extremely significant.

Comparing means of the average Right-Hand grip strength and the average right forearm girth by unpaired t test, the following analysis was done.



The two-tailed P value is <math><0.001</math>, considered extremely significant.

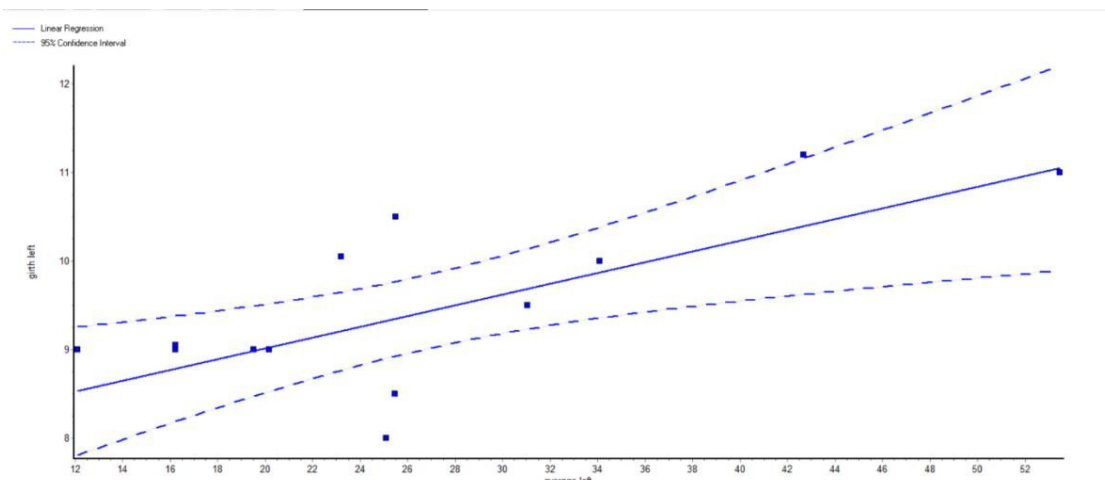
95% confidence interval:

Mean difference = - 13.636 (mean of forearm Girth (r) minus mean of average Right-Hand grip strength)

The 95% confidence interval of the difference: - -15.898 to -11.373

| Parameter          | Average Right-Hand Grip Strength | Girth [Right] |
|--------------------|----------------------------------|---------------|
| Mean               | 22.789                           | 9.148         |
| Standard deviation | 8.744                            | 1.155         |
| Minimum            | 9.933                            | 7.000         |
| Maximum            | 53.533                           | 13.000        |
| Median             | 21.517                           | 9.000         |

Correlation of average left Hand Grip Strength of the subjects, average forearm girth of left dominance was done by linear regression method and following analysis was obtained.



Number of Points: - 15

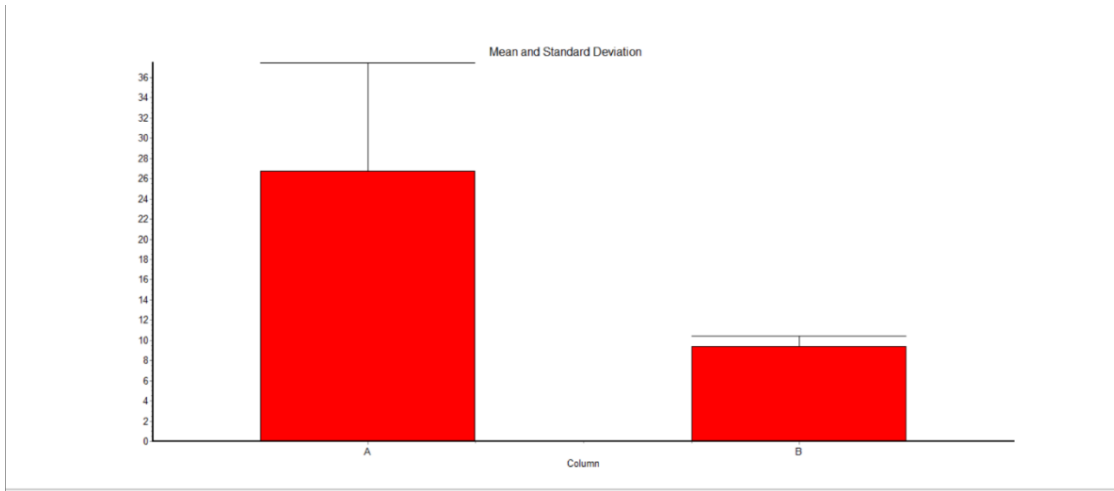
Correlation Coefficient [r] =0.6699

r squared =0.4487

Standard Deviation of residuals from line [Sy.x] =0.7510

The P value is 0.0063, considered very significant.

Comparing means of the average left Hand Grip Strength and the average left forearm girth by unpaired t test, the following analysis was done.



The two-tailed P value is <0.0001, considered extremely significant.

t= 6.223 with 28 degrees of freedom

95% confidence interval

Mean difference: -17.307

The 95 % confidence interval of the difference = -23.003 to -11.610

| Parameter          | Average Left Hand Grip Strength | Girth [Left] |
|--------------------|---------------------------------|--------------|
| Mean               | 26.72                           | 9.42         |
| Standard Deviation | 10.727                          | 0.9746       |
| Minimum            | 12.100                          | 8.000        |
| Maximum            | 53.467                          | 11.200       |
| Median             | 25.100                          | 9.050        |

## DISCUSSION

The main Aim of this study was to study the Association of Hand Grip Strength and Anthropometrics in Physically Inactive Undergraduate Students by using hand held dynamometer and a measuring tape.

The age of the subjects included in this study were between the age group of 18 to 25. A total of 75

participants were included. Among them, 64 were female and 11 were male. 60 students had Right-Hand dominance and 15 students had left hand dominance. Initially synopsis was approved by the ethical committee of Tilak Maharashtra Vidyapeeth, Pune and permission for data collection was received as well. The Hand Grip Strength was assessed by Hand held dynamometer [CAMRY-EH101]<sup>(24)</sup> according to the American Society of Hand Therapist's [ASHT] protocol. The forearm girth and the hand anthropometrics were assessed using a measuring tape.<sup>(25)</sup>

In our study, the Female: Male ratio was 64:11. The ratio of Right Dominant Hand: Left Dominant Hand was 60:15. The average Right HGS was 23.06 whereas the average Left HGS was 22.80. The Average Right Girth was 9.21 whereas the Average Left Girth was 9.25.

Upon correlating Average Right-Hand Grip Strength of the subjects and average right forearm girth by linear regression method, the P value is 0.0001, which is considered extremely significant.

Upon correlating Average Left Hand Grip Strength and average left forearm girth by linear regression method, the P value is 0.0063, which again came out to be extremely significant.

A study similar to that of the present one was conducted by Maynard & Triyanti (2016)<sup>(26)</sup> on sedentary undergraduate students in Jakarta, Indonesia. The study was conducted using 47 male and 47 female college students who were classified as sedentary according to a physical activity questionnaire. Their mean HGS values for dominant hand among both males and females were similar to that of our study ( $35.99 \pm 6.37$  and  $21.89 \pm 4.89$  for males and females respectively). They too had used the Smedley dynamometer and the standard ASHT protocol.

Further, Mullerpatan et al., (2013)<sup>(27)</sup> have described HGS among 1005 (413-males, 592-females) healthy, sedentary adults in various states of India aged 18-30 years and had found approximately similar HGS values for both males ( $33.67 \pm 7.2$  kg) and females ( $19.51 \pm 3.9$  kg). HGS was measured by using a standard Jamar hand-held dynamometer in standing position. Kim et al., (2018)<sup>(28)</sup> have established normative HGS values for the Korean population. They also have found higher HGS values for both males ( $42.5 \pm 0.5$  kg) and females ( $25.9 \pm 0.3$  kg) between the 20-24 age group by using hand-held Takei dynamometer in the standing position

The present study describes the HGS and factors associated with it among an academically oriented group of undergraduate students of Tilak Maharashtra Vidyapeeth, Pune who are physically inactive with a sedentary lifestyle.

A study done by Piumi, et al (2019)<sup>(1)</sup> provided an insight into the association of low HGS with reduced physical training that is shifting towards a sedentary lifestyle in an academically oriented group where the BMI is within the normal range. Further, it has shown that male gender and hand dominance are responsible for higher HGS, while other internal factors such as hand anthropometrics have a weak association. Therefore, an increase in HGS would provide a sign of involvement in the physical activity when the BMI is not able to show such changes. As reduced physical activity level is related with the development of non – communicable diseases later in life, it is essential to study this matter at the clinical level to identify whether this population is at such risk.

Academically oriented individuals mostly spend a lifestyle characterized by low physical activities. Hence, HGS would be a good signal of the sedentary nature of individuals as it reviews the changes before BMI, which is commonly used to assess the body composition. Other than the low physical activity, inadequate calorie intake too can cause lower muscular strength.<sup>(29)</sup> Therefore, both underweight as well as



overweight categories also can have low HGS due to weakness in the muscular strength, although the power of the muscle is in the normal range.

## CONCLUSION

This has provided an insight into the association of low HGS with reduced physical activity that is inclining towards a sedentary lifestyle in an academically oriented group. As reduced physical activity level is linked with the development of non – communicable diseases later in life, it is essential to study this matter at the clinical level to identify whether this population is at such risk. Also, it was noted that the grip strength is greater in dominant hand than the non-dominant hand.

**LIMITATION:** Smaller sample size. This study is not a community – based study and is based on a healthy student population. Thus, the findings can only be generalized to similar academically oriented young people but not to all young adults in the general population.

**FUTURE SCOPE:** Similar studies should be performed for the general young population at the community level. Study can be conducted in larger sample size, with availability of almost equal number of male and female population, with availability of more of left-hand dominance. It will be interesting to study HGS for various ethnic groups.

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