



# A COMPARITIVE STUDY OF GRIP STRENGTH OF DOMINANT AND NON-DOMINANT HANDS WITHIN AND BETWEEN RIGHT AND LEFT HANDED SUBJECTS

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## *Abstract*

**Aim-** Is to investigate differences in grip strength of dominant and non-dominant hand within and between right- and left-handed subjects.

**Background-** Reliable and valid evaluation of hand strength is important for determining the effectivity of different treatment strategies and it also assesses the patient's initial limitations and provides a quick reassessment of patient's progress throughout the treatment. Handedness shows difference in qualities of an individual. Recent studies have attempted to provide a definitive picture of the performance differences between subjects' dominant and non-dominant hands. But still there are many controversies regarding the differences in hand grip strength values between the dominant and non-dominant hands in left and right handed people.

**Method-** With the use of handheld dynamometer maximal grip strength is measured in 24 left handed and 46 right handed subjects (Age group 18-35) with standard procedure. The paired and unpaired t-test were used for the Data Analysis. All the Statistical Analysis was performed using SPSS 28.0.0 Software.

**Result-** The result shows that the dominant hands of the right-handed subjects were significantly stronger than the non-dominant hands at both elbow positions ( $p < 0.05$ ). In left handed subjects, the dominant and non-dominant hands exhibit no significant differences at both elbow positions ( $p > 0.05$ ). For inter-group comparison of mean test values (dominant right-handed vs. Dominant left-handed) showed that the dominant hands of the right and left handers were not significantly different ( $p > 0.05$ ).

**Conclusion-** The study concluded that there is significant difference in the grip strength in within group comparison of Right-handed subjects, but in the within group comparison of Left-handed subjects and in intergroup comparison of dominant hands of right and left handers there is no significant difference.

**Keywords-** Hand dominance, Grip strength, Dynamometer.

## INTRODUCTION

**Hand dominance** or handedness is typically described as the hand one prefers to use for unimanual tasks <sup>(1)</sup>. It is the preference to use one hand over the other to perform fine and gross motor activities. It is well known that 90% of the human population is right-handed, where this proportion has remained relatively consistent for approximately 5000 years <sup>(2)</sup>. Left-handedness is far less common than right-handedness. Studies suggest that approximately 10% of the world population is left-handed <sup>(3,4)</sup>.

The left-handed individuals are living in a world designed for right handedness. They have to use the right (non-dominant) hand for many tasks that would naturally be done by the dominant hand <sup>(5)</sup>. Thus, the number of pure lefties is very less in the world. India has prevalence of left handedness at 5.20% across different countries <sup>(6)</sup>.

Hand dominance is an important skill in ones development as it ensures proficiency and efficiency in tasks that involve more complex motor plans, motor accuracy and greater skill. Most importantly, during our development from childhood, in order to achieve dexterity, fine motor coordination, motor accuracy and control, **hand dominance** is an essential prerequisite <sup>(7)</sup>.

Grip strength is a measure of muscular strength or the maximum force/tension generated by one's forearm muscles <sup>(8)</sup>.

Understanding the differences in Grip strength of dominant and non-dominant hands of right- and left-handers is important when assessing progress during hand rehabilitation <sup>(5,9)</sup>. It is widely accepted that, grip strength measurements provide an objective index of the functional integrity of the upper extremity <sup>(10,11)</sup>. Reliable and valid evaluation of hand strength is important for determining the effectivity of different treatment strategies and it also assesses the patient's initial limitations and provides a quick reassessment of patient's progress throughout the treatment <sup>(10)</sup>.

In the present climate of clinical and cost effectiveness, rehabilitation therapists must set outcome goals for their treatments. One of the most frequently used goals of therapy is the return to pre-injury or pre-illness muscle strength. Many treatment protocols compare the strength of the injured limb with that of the uninjured limb but this is useful only when the pre-injury strength is similar in both limbs; however the problem arises when this is not the case <sup>(5)</sup>.

For example, while assessing the progression of Grip strength of both the hands during hand rehabilitation, therapists often use the *10% rule*, as a general guideline for such goal setting which was first described in the 1950s. This rule states that a person's grip strength in the dominant hand is approximately 10% greater than in the non-dominant hand <sup>(14,15)</sup>.

However, despite numerous studies to quantify the differences between the strength of the dominant and non-dominant hand <sup>(14)</sup> this 10% "rule" has not been confirmed <sup>(5)</sup>.

Recent studies have attempted to provide a definitive picture of the performance differences between subjects' dominant and non-dominant hands <sup>(12,17,18,19)</sup>.

But still there are many controversies regarding the differences in hand grip strength values between the dominant and non-dominant hands in left and right handed people. This may be due to the differences in equipments, testing positions, data analysis and population size <sup>(5)</sup>. So this study is designed to evaluate the grip differences between sides for right and left handed population.

The measurement of Grip strength is an important test to follow people during growth, aging, injury, training or therapeutic trials. Grip force varies according to elbow position, and numerous studies have investigated this aspect of manual performance with respect to sex, age, and hand dominance <sup>(9)</sup>.

Its measurement is performed using dynamometers, which estimate the muscle strength primarily generated by the flexor muscles of the hand and the forearm. Dynamometers vary in terms of their mechanism, performance and display mode and energy supply <sup>(12)</sup>.

The Handheld dynamometer uses a spring to measure maximum isometric strength of the hand and forearm muscles during muscle contraction <sup>(12)</sup>. This dynamometer has many useful features for routine screening as well as in the evaluation of hand trauma and disease. In this study it is used for the evaluation of grip strength differences between sides for right and left handed population.

## MATERIALS AND METHODOLOGY

### ➤ MATERIALS:

- Pen
- Paper
- Handheld dynamometer

## ➤ **METHODOLOGY:**

- **Study design:** Cross-sectional study
- **Study type:** Comparative study
- **Study setup:** Dr. Ulhas Patil College of Physiotherapy, Jalgaon.
- **Sample size:** 70
- **Sampling technique:** Convenience sampling

## **SELECTION CRITERIA:**

- **Inclusion criteria:** Healthy individuals of age group between 18 to 35 years.
- **Exclusion criteria:**
  - Previous surgery on either UE
  - Any neurological, neuromuscular disorder that affected UE performance
  - Any history of injury, disease, pain or discomfort involving the upper limbs in the last two years
  - Individual practicing of a sport activity at a national level

**PROCEDURE:** To conduct the following study permission was taken from the principal of Dr. Ulhas Patil college of Physiotherapy, Jalgaon. Subjects were selected as per the inclusion and exclusion criteria and the procedure was explained and a written consent was obtained from the subjects.

The height and weight of the subjects was recorded as well as an estimation of the percentage of BMI was also recorded. Total 70 subjects were included. The right-handers and left-handers were categorized into number of males and number of females, in each group.

Each subject received standardized instructions before the test. The dominant hand was defined as the one used for writing. So, we conducted the test on the dominant hand first, and then on the non-dominant hand. All data was collected using the same test equipment.

Grip strength was measured by using a Handheld dynamometer. For this study, the subjects were seated on a height adjustable plinth in order to obtain a right angle at the hip, knee and ankle joints with the legs being vertical and feet flat on the ground. The UE positioned according to the recommendations of the American Hand Society of Hand Therapists: shoulder adducted and neutrally rotated, forearm in neutral position, and wrist slightly extended (0-30°). Grip strength was measured with the elbow in 90° and 0° flexion. The subject was asked to make a total of three attempts in each position, and the highest of these readings were recorded. To control for fatigue, the subject alternate between the two elbow positions and took a rest period of 30 sec between each attempt.

## **STATISTICAL ANALYSIS:**

The entire data of the study was entered and cleaned in MS Excel before it was statistically analyzed in Statistical Package for the Social Sciences (SPSS) 28.0.0. All the results are shown in tabular as well as graphical format to visualize the statistically significant difference more clearly.

For each of the two groups (right-handed and left-handed subjects), mean values (M) and standard deviations (SD) were calculated for the grip strength (Kg) in the dominant and non-dominant hands.

The paired-sample t-test was used to compare differences between dominant and non-dominant hands within each group. The independent sample t-test was also used to make inter-group comparisons of mean test values (dominant right-handed vs. Dominant left-handed.)

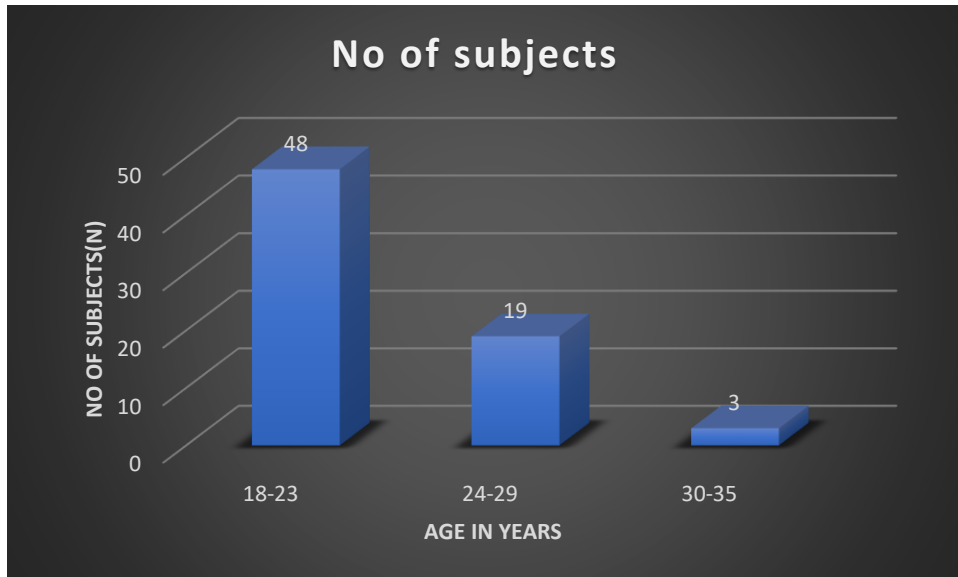
A  $p$  value  $< 0.05$  was accepted as significant. All statistical analyses were performed using Statistical Package for the Social Sciences 28.0.0. (SPSS) computer software.

## **OBSERATION AND TABLES**

**table1) the age wise distribution of study subjects**

Age in years	No of subjects (n=70)
18-23	48(68.57%)
24-29	19(27.14%)
30-35	3(4.28%)

In study group 48 subjects were between 18-23 years of age, 19 subjects were between 24-29 years of age, 3 subjects were between 30-35 years of age.

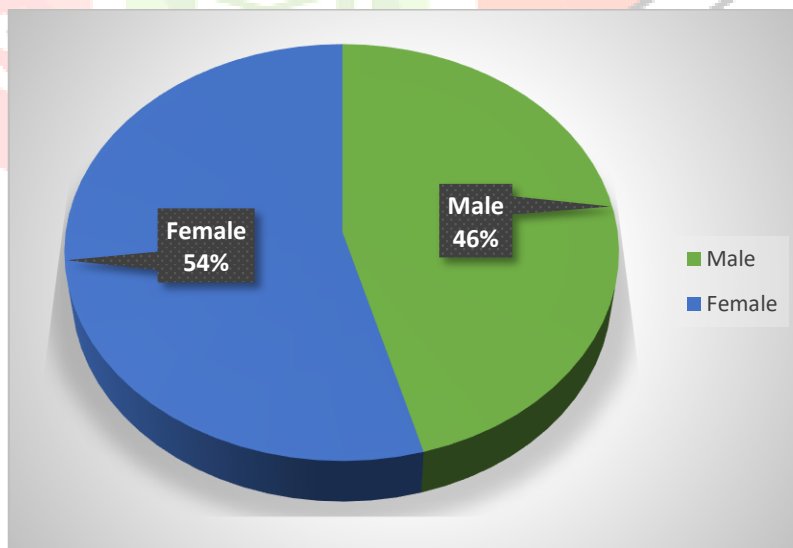


graph1) the age wise distribution of study subjects

**Comments-** The graph shows age wise distribution of study subjects.

table2) the gender distribution of study subjects

Gender	Total subjects (n=70)	
	n	%
Male	32	45.71%
Female	38	54.28%



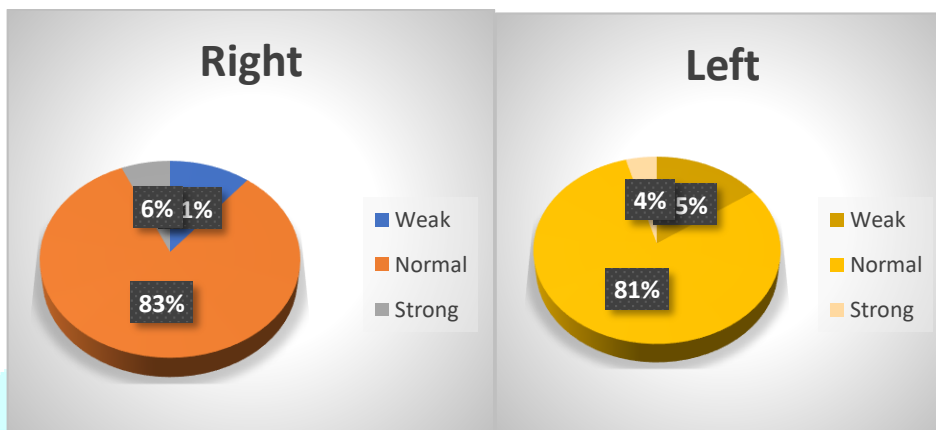
graph 2) the gender distribution of study subjects

**Comments** – The pie diagram shows gender distribution of study subjects. There were 32 males & 38 females in the study.

table 3) evaluation of grip strength among right-handed subjects

Dominance	side	Weak (n)	Normal (n)	Strong (n)
Right handed	Right	5	38	3
	Left	7	37	2

In this study group, grip strength ratings of Right hand has shown 5 weak, 38 Normal and 3 Strong subjects, also grip strength ratings of Left hand has shown 7 Weak, 37 Normal and 2 Strong subjects.



graph3) evaluation of grip strength among right-handed subjects

**Comments-** The graph shows grip strength rating wise distribution of study subjects.

table 4) evaluation of grip strength among left-handed subjects

Dominance	side	Weak (n)	Normal (n)	Strong (n)
Left handed	Right	8	15	1
	Left	4	19	1

In this study group, grip strength ratings of Right hand has shown 8 weak, 15 Normal and 1 Strong subjects, also grip strength ratings of Left hand has shown 7 Weak, 37 Normal and 2 Strong subjects.

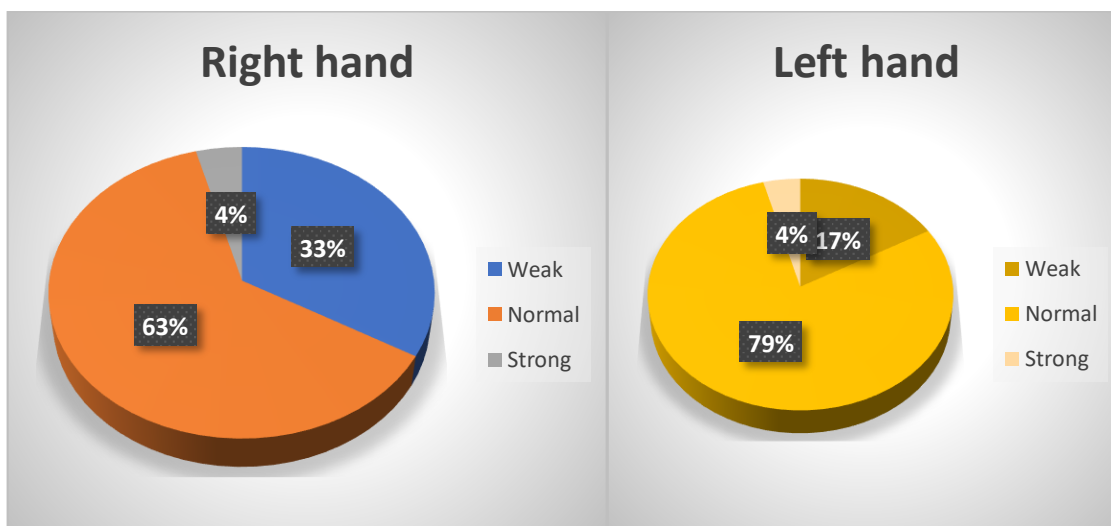


table 4) evaluation of grip strength among left-handed subjects

**Comments-** The graph shows grip strength rating wise distribution of study subjects.

table 5) comparison of grip strength between dominant and non-dominant hand in 90° and 0° of elbow flexion in right-handed

Elbow position	Side	Grip strength(mean)	t value	P value	significance
90°	Right	34±12.818	27.85	<0.001	Significant
	Left	27±11.980			
0°	Right	30±10.144	22.13	<0.001	Significant
	Left	24±10.126			

Values are Mean ±Standard deviation. P values are obtained using paired t-test, after confirming the underlying normality assumption. P value<0.05 is considered to be statistically significant.



graph 5) comparison of grip strength between dominant and non-dominant hand in 90° and 0° of elbow flexion in right-handed

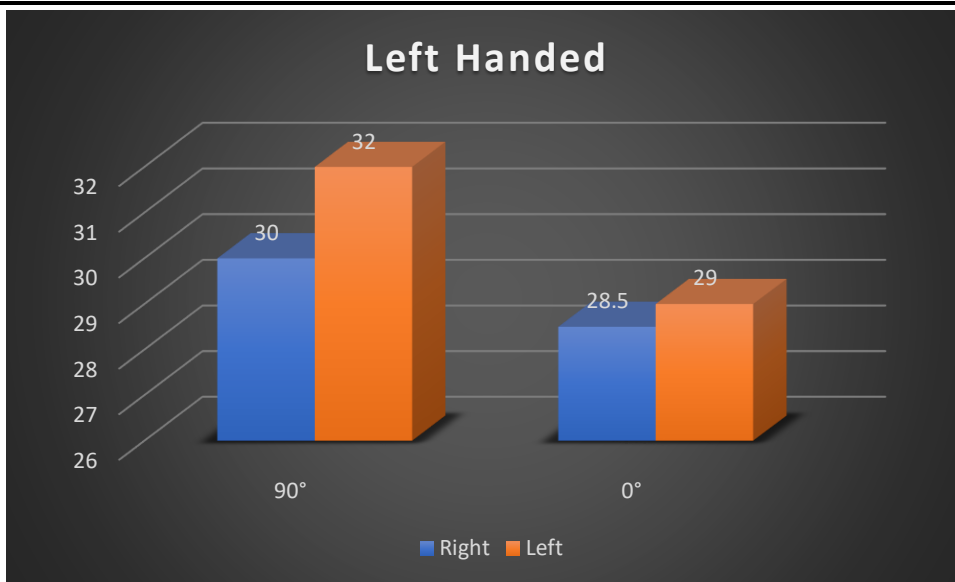
**Comments - (Intra-Group comparison):**

- In Right-handed subjects the average grip strength of Dominant hand is significantly more in both elbow positions.
- P value is <0.001.

table 6) comparison of grip strength between dominant and non-dominant hand in 90° and 0° of elbow flexion in left-handed

Elbow position	Side	Grip strength(mean)	t value	P value	significance
90°	Right	30±8.812	-1.446	<0.081	Not Significant
	Left	32±8.855			
0°	Right	28.5±8.519	-1.366	<0.093	Not Significant
	Left	29±8.420			

Values are Mean ±Standard deviation. P values are obtained using paired t-test, after confirming the underlying normality assumption. P value<0.05 is considered to be statistically significant.



graph 6) comparison of grip strength between dominant and non-dominant hand in 90° and 0° o- elbow flexion in left-handed

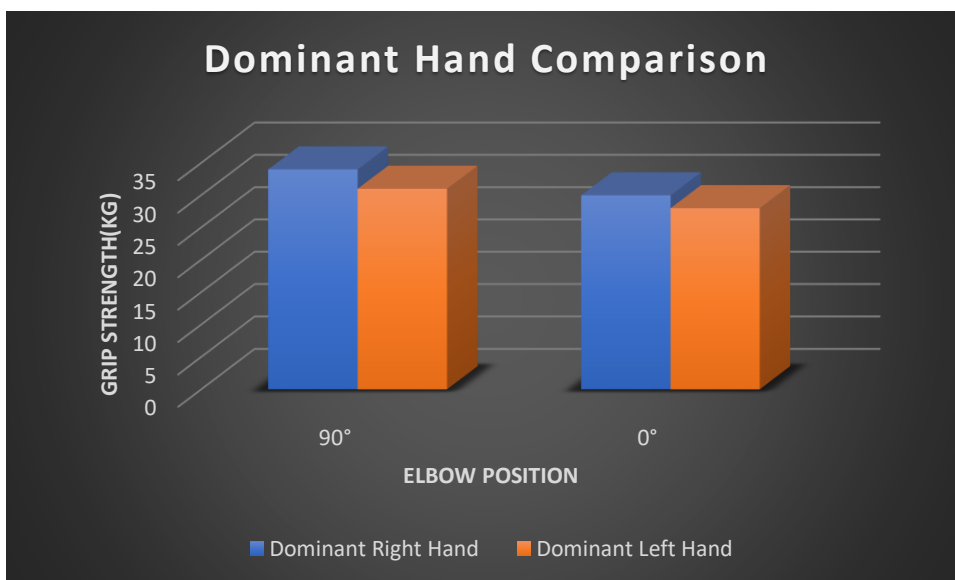
**Comments - (Intra-Group comparison):**

- c. In Left handed subjects the average grip strength of Dominant hand and non-dominant hand is not significantly different in both elbow positions.
- d. P value is <0.081.

table 7) comparison of grip strength between dominant hands of right-handed and left-handed subjects at 90° and 0° of elbow flexion.

Hand side with elbow position	Grip strength (mean difference)	P value	Significance
Dominant Right hand at 90°	0.228	.476	Not significant
Dominant Left hand at 90°			
Dominant Right hand at 0°	0.228	.476	Not significant
Dominant Left hand at 0°			

Values are Mean ±Standard deviation. P values and mean difference are obtained using independent t-test, after confirming the underlying normality assumption. P value<0.05 is considered to be statistically significant.



graph 7) comparison of grip strength between dominant hands of right handed and left handed people in 90° and 0° of elbow flexion.

### Comments-

- a. The average grip strength of Dominant hands of both Left and Right handers were not significantly different in both elbow positions.
- b. P value >0.05.

### Result

1. Total 70 subjects were included in the study. Out of 70 subjects there were 46 Right-handed and 24 Left-handed subjects.
2. Evaluation of grip strength among Right-handed subjects shows that the grip strength ratings of Right hand are 5 weak, 38 Normal and 3 Strong subjects, also grip strength ratings of Left hand are 7 Weak, 37 Normal and 2 Strong subjects.
3. Evaluation of grip strength among Left-handed subjects shows that the grip strength ratings of Right hand are 8 weak, 15 Normal and 1 Strong subjects, also grip strength ratings of Left hand are 4 Weak, 19 Normal and 1 Strong subjects.
4. For the comparison of grip strength of dominant and non-dominant hand of Right-handed subjects at 90° and 0° of elbow flexion, within group 'paired t test' was used. The result in the present study shows that the dominant hand of the right-handed subjects was significantly stronger than the non-dominant hand at both elbow positions ( $p < 0.05$ ).
5. For the comparison of grip strength of dominant and non-dominant hand of Left-handed subjects at 90° and 0° of elbow flexion, within group 'paired t test' was used. The result in the present study shows that the dominant and non-dominant hands exhibit no significant differences at both elbow positions ( $p > 0.05$ ).
6. The independent sample t-test was also used to make inter-group comparison of mean test values (Dominant right-handed vs. Dominant left-handed). Intergroup comparison showed that the dominant hands of the right and left handers were not significantly different ( $p > 0.05$ ).

### Discussion

The superior performance of the dominant hand over the non-dominant hand in most tasks has been documented extensively. In correspondence with grip strength, the dominant hand has more strength than the non-dominant one. This superiority has been attributed to cerebral laterality.

Recent studies have attempted to provide a definitive picture of the performance differences between subjects dominant and non-dominant hands.

But still there are many controversies regarding the differences in hand grip strength values between the dominant and non-dominant hands in left and right-handed people. This may be due to the differences in equipment, testing positions, data analysis and population size.

These could be applied in both the diagnosis and treatment of impaired hand function. This was our rationale for assessing manual performance that is hand grip strength in dominant and non-dominant hands of self-reported right- and left-handers, and comparing within and between these groups.

**The present study established data of maximal grip strength in healthy subjects aged from 18 to 35 years old in both the elbow position 90° and 0°. The results showed that maximal grip strength has significant difference in the value in dominant Right hand of Right-handed subjects. The hands of the left-handed subjects exhibited no significant difference at either elbow positions. In addition to Intra group comparisons we also did inter group comparison which shows that the dominant hands of the right and left handers were not significantly different with respect to grip strength at both elbow position.**

A recent investigation by Nurgul et al<sup>[10]</sup> It is found that the dominant hand is significantly stronger in right handed subjects but no such significant difference between sides could be documented for left handed people. This difference may be attributed to the fact that left-handed people are temporarily forced to use their nondominant hands for daily activities in this right-hand dominant world.

A study conducted by Armstrong and Oldham<sup>[5]</sup> compared dominant and non-dominant hand strength in both right- and left-handed participants. The authors found no significant differences between the hands in the left-



handed group, and observed small but significant differences between the dominant and non-dominant hands in the right-handed group. They concluded that, this result may in part be due to left-handed participants living in a world designed for right handedness. They have to use the right (non-dominant) hand for many tasks that would naturally be done by the dominant hand.

The findings of the study done by Shyamal Koley et al<sup>[19]</sup> indicate that statistically significant differences ( $p < 0.05$ ) were found for hand grip strength both in males and females between right hand dominant and nondominant groups ( $t=3.13$  and  $2.78$  respectively) and left hand dominant and nondominant groups ( $t=2.66$  and  $3.13$  respectively). When comparisons were made between dominant right and left hand groups and non-dominant right and left hand groups, both in males and females, statistically no significant differences were noted in any case.

Incel et al<sup>[18]</sup> documented significantly more grip strength in dominant hands than in non-dominant hands for right-handed people. Similarly, the results from our righthanded subjects indicated significantly greater grip strength in the dominant hand in both flexed and extended elbow positions. The left-handed subjects exhibited no such difference in either elbow position.

The study done by Kolev et al<sup>[20]</sup> revealed significantly higher rate of force for left hand in left-handed group, as compared with left hand of right-handers in both UL and BL tasks.

Peterson et al<sup>[21]</sup> in the study of grip strength and hand dominance in 310 students (challenging 10% rule) found 12.72% difference between left and right hand for right-handed subjects and a -0.08% difference between left hand and right hand for left-handed subjects.

Considerable variability was observed between the responses of individual participants, reflected in the large range of values for grip strength measure. On the basis of this large variability these authors concluded that there was no difference between the dominant and non-dominant hands of left-handed subjects.

**The optimal position for maximal Grip strength has been accepted as 90°. We hypothesized that the optimal position would be associated with minimum amount of compensatory shoulder motion. As the elbow is in 0° of flexion the ability of extensor muscles of elbow to produce torque may diminish. In this instance, the muscle is shortened over both the elbow and shoulder joint.**

**There is not sufficient data available regarding the influence of the elbow position on the assessment of handgrip strength<sup>[22,23]</sup>. Handgrip strength is part of several health-related fitness tests, and it has been widely used in experimental and epidemiologic studies<sup>[24]</sup>. Therefore, from a public health perspective, it is important to standardize the procedure because otherwise the measurement error may be too large to detect actual changes in strength.<sup>[22,24]</sup>**

In the present study, the inter-group comparison of grip strength revealed no significant differences between the dominant hands of right- and left-handed subjects. These results may be partially explained by left-handed people living in a world designed for right-handers. This requires a left-handed person to use the right (nondominant) hand for many tasks that would naturally be done by the dominant hand of right-handers. Understanding the extent of grip strength asymmetry is very important in many respects. A counter argument, however, is that differences may not exist between the two hands of left-handed people but this varies between individuals and does not conform to any rules. It is thus virtually impossible to estimate accurately from the opposite hand what the strength of an injured hand would have been before the injury. In summary, it would appear that the clinician must be cautious in using right to left hand strength comparisons as indicators of pre-injury strength.

## Conclusion

The results of the study showed that-

- The dominant hands of the right-handed subjects were significantly stronger than the non-dominant hands at both elbow positions.
- There is no significant difference in dominant and non-dominant hand of the left-handed at both elbow positions.
- The dominant hands of the right and left handers were not significantly different with respect to grip strength.

Thus, the study concluded that there is **significant difference** in the grip strength in within group comparison of Right-handed subjects, but in the within group comparison of Left-handed subjects and in intergroup comparison of dominant hands of right and left handers there is **no significant difference**.

### Limitations:

We used only handheld dynamometer to assess grip strength.

### Suggestions and future scope of study:

- We can conduct hand grip assessment using Jammer Hand Dynamometer.
- Study can be performed with large sample size.

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