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## HAND GRIP STRENGTH IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Almas Sirguroh<sup>1</sup>, Shakeel Ahmed<sup>2</sup><sup>1</sup> M.A Rangoonwala College of Physiotherapy and Research, Pune<sup>2</sup> DES College of Physiotherapy, Pune

E-mail of Corresponding Author: shakeel.physio@gmail.com

### ABSTRACT

**Purpose:** Skeletal muscle dysfunction is common morbidity in patients suffering from chronic obstructive pulmonary disease (COPD) with quadriceps muscle being the most severely affected and hence most research focuses on the changes occurring in the thigh muscles. Consequently not much is known about involvement of other muscles especially the ones in the arm, forearm and the hand. Hence this study aims determine whether hand grip strength is affected in patients with COPD and whether it has any correlation with patients peak expiratory flow rate (PEFR) and body mass index (BMI).

**Methodology:** 30 patients with COPD and 30 healthy age matched controls were selected. PEFR, hand grip strength and BMI were evaluated. **Results:** A poor non-significant correlation was found between PEFR and hand grip strength ( $r = -0.153$ ) and between BMI and hand grip strength ( $r = -0.179$ ) in patients with COPD. But hand grip strength was significantly lower in patients with COPD (17.4 +/- 4.49 kg force) compared to that in controls (28.43 +/- 8.35 kg force) ( $p = 0.00$ ). Similarly COPD patients had significantly lesser BMI (19.08 +/- 4.08 kg/m<sup>2</sup>) compared to the controls (27.67 +/- 4.15 kg/m<sup>2</sup>) ( $p = 0.00$ ).

**Conclusion:** Hand grip strength is reduced in patients with COPD but does not correlate with severity of obstruction as measured by PEFR or with BMI.

### INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a major cause of health concern worldwide and one of the leading causes of death that is increasing in prevalence<sup>1</sup>.

Prevalence of COPD is very high in India. In a study done across various centers where a total population of 35295 individuals was assessed, the prevalence was found to be 4.1%<sup>2</sup>.

Along with impairments such as dyspnea, increased work of breathing, decreased efficiency of muscles of inspiration, COPD is also associated with various local and systemic complications including cachexia, weight loss, osteoporosis, skeletal muscle dysfunction, cardiac failure, atherosclerosis, dementia and depression<sup>3,4</sup>. A major reason for morbidities and mortality seen in patients with COPD are these extra pulmonary

manifestations. Out of the above mentioned manifestations, skeletal muscle dysfunction is the most predominant complication contributing to early onset of fatigue and exercise intolerance. The consequences of exercise intolerance include increased difficulty in performing activities of daily living and difficulty participating in everyday events<sup>5</sup>. Changes observed in the skeletal muscles include reductions in type I fibers, atrophy of type I and II fibers, reduced capillary density, and altered metabolic enzyme levels<sup>3,4</sup>.

Various factors have been identified as contributing to skeletal muscle changes, which include hypoxia, hypercapnia, inflammation, nutrition, deconditioning, and steroid-induced myopathy<sup>5</sup>.

This systemic manifestation of muscle dysfunction is most commonly observed in large muscles,

especially the quadriceps and the current literature suggests that quadriceps weakness is found in about 32% - 43% patients suffering from COPD<sup>7</sup>. Most of the research focuses on changes occurring in the quadriceps and very less emphasis has been given to investigate changes occurring in other peripheral muscles especially the muscles of the upper extremity especially wrist and intrinsic muscles of the hand. Hence this study is aimed at determining whether hand grip strength is affected in patients suffering from COPD and whether the severity of airway obstruction correlates with the hand grip strength.

## MATERIALS AND METHODS

This was a case control study with a sample size of 60 which included 30 patients suffering from COPD and 30 age matched controls selected. Cases of the study were patients suffering from Chronic Obstructive Pulmonary Disease (COPD) admitted in the respiratory medicine ward of Sassoon General Hospital, Pune. Ethical clearance to conduct the study was obtained and subjects were recruited using convenience sampling. The Controls were also selected by convenience sampling and matched using individual matching. Patients and controls of both genders were included. In the group of COPD Patients, patients requiring supplemental oxygen or mechanical ventilatory support, Patients in acute exacerbation of COPD, patients with history of inflammatory joint disease affecting the dominant upper limb, neurological disorders affecting the upper extremities, History of fracture of the dominant upper limb, History of pain radiating from neck to fingers of dominant upper extremity and history of diabetes mellitus were excluded. Similarly, in the control group, individuals, with known history of respiratory disease, history of diabetes mellitus, history of trauma to the dominant upper limb and individuals with a history of neurological disorders affecting the upper limb were excluded.

## Outcome Measures

1. Hand Grip strength in Kg force
2. Peak Expiratory Flow Rate (PEFR) in liters/min
3. Body Mass Index (BMI) in Kg/m<sup>2</sup>

## Procedure

Prior to evaluation, each Subject's written Informed Consent to participate in the study was obtained. Patient's weight and height were checked. The PEFR of COPD patients was measured using a Wright's Peak flow meter as per the guidelines prescribed by the American Thoracic Society<sup>8</sup>.

Hand grip strength was measured in all sixty subjects using a Jamar Hand held dynamometer. Prior to testing, the procedure was explained to the subjects followed by a demonstration of the technique. Grip strength of the dominant hand was evaluated.

The Subjects were asked to sit on a chair with the back erect, with feet flat on the floor and were asked to look forward. The dynamometer was secured to the patient's hand using a wrist strap. The test position had the subjects placing their arms by their side with elbow flexed to 90 degrees, forearm in mid prone and the wrist in neutral position.

The Subjects were asked to hold the dynamometer in the hand and were instructed to attempt squeezing with maximal effort following which the hand grip in Kg force was noted down. Subjects were instructed to maintain their position during testing and advised not to brace the arm against their side or recruit other muscle groups by flexing or extending the elbow beyond 90 degrees or move the arm and do any trick movements. Three trials were taken with a rest period of one minute between each trial and the best of the three values was used for data analysis.

## DATA ANALYSIS

Data was analyzed using SPSS version 18. Pearson's correlation was used to correlate PEFR

with hand grip strength and BMI with hand grip strength in patients with COPD.

Paired T test was used to compare hand grip strength and BMI between patients with COPD and controls.

## RESULTS

Descriptive statistics of COPD group and controls are given in table 1 and table 2.

**Table 1: Descriptive statistics of COPD group**

	MEAN	STD DEV
AGE(yrs)	58.1333	11.70539
HEIGHT(cm)	157.1667	8.47342
BMI(kg/m <sup>2</sup> )	19.0853	4.08897

**Table 2: Descriptive statistics of control group**

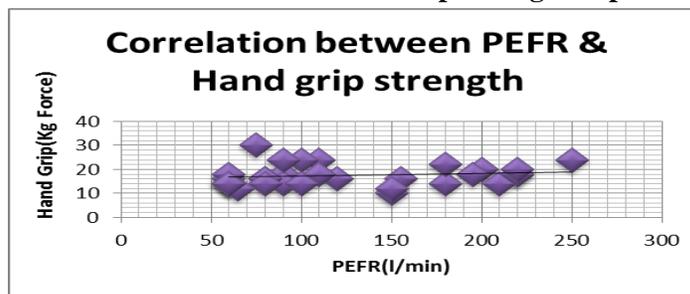
	MEAN	STD DEV
AGE(yrs)	58.1333	11.70539
HEIGHT(cm)	163.1167	9.00831
BMI(kg/m <sup>2</sup> )	27.6763	4.15518

A poor negative correlation was found between PEFR and grip strength ( $r = -0.153$ ) in patients with COPD and this correlation was not of any statistical significance ( $p > 0.05$ )

**Table 3: Correlation between PEFR & Grip Strength**

Pearson's Correlation (r)	-0.153
p value	0.419

**Graph 1: Correlation between PEFR & Grip Strength in patients with COPD**

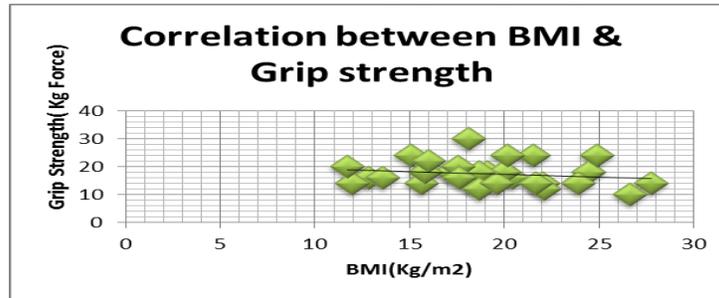


A poor negative and non significant correlation was found between BMI and hand grip strength ( $r = -0.179$ ,  $p > 0.05$ ).

**Table 4: Correlation between Grip Strength & BMI**

Pearson's Correlation (r)	-0.179
p value	0.345

**Graph 2: Correlation between BMI & grip strength in patients with COPD**

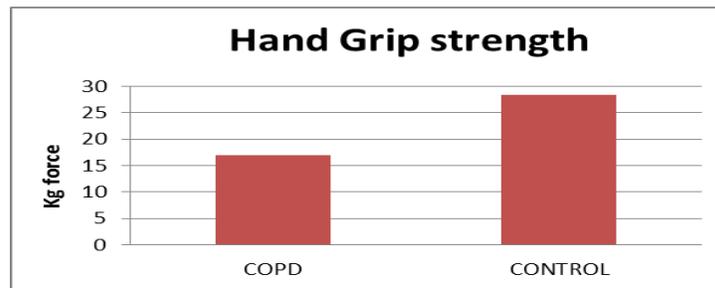


Patients with COPD had a grip strength( 17.4 +/- 4.49 kg force) which was less compared to their age matched controls( 28.43 +/- 8.35 kg force) and this difference was statistically significant (p =0.00).

**Table 5 : Grip Strength and BMI in COPD patients and in controls**

	Mean	Std. Deviation
Gripstrncopd(Kg Force)	17.4000	4.49214
Gripstrncontrl(Kg Force)	28.4333	8.35292
Bmicopd(Kg/m <sup>2</sup> )	19.0853	4.08897
Bmicontrl(Kg/m <sup>2</sup> )	27.6763	4.15518

**Graph 3: Comparison of hand grip strength between COPD patients and controls**

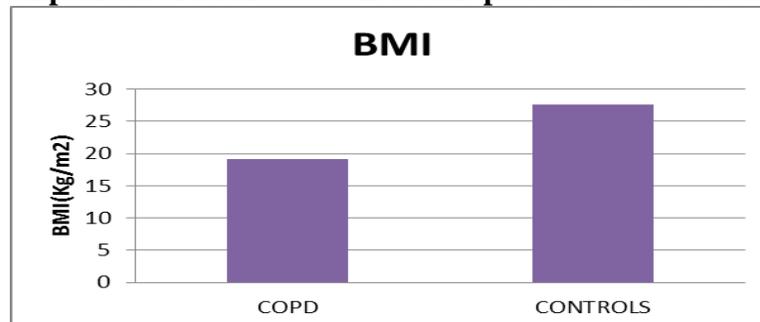


BMI of the patients with COPD( 19.08+/- 4.08 kg/m<sup>2</sup>) was low compared to that of the controls( 27.67+/- 4.15 kg/m<sup>2</sup>) and this difference was also of statistical significance (p = 0.00)

**Table 6: Comparison of grip strength and BMI between COPD patients and controls (paired t test)**

	MEAN	STD DEV	t	p
Grip strength(COPD - Control) Kg Force	-11.03	8.197	- 7.32	0.00
BMI(COPD – Control) kg/m <sup>2</sup>	-8.591	6.21639	-7.56	0.00

**Graph 4: Comparison of BMI between COPD patients and controls**



## DISCUSSION

In this study we found a very weak negative correlation between severity of airway obstruction as measured by PEFr and hand grip strength and between BMI and hand grip strength. The fact that muscles of the upper extremity are not subject to the effects of physical inactivity as demonstrated by earlier done research on muscles such as the deltoid, adductor pollicis which did not show biopsy changes found in quadriceps muscles<sup>3,9,10,11</sup> supports the weak insignificant correlation between severity of the disease and outcomes like BMI and hand grip strength.

Peripheral muscle dysfunction is probably the most extensively studied systemic effect of COPD with emphasis mainly on the involvement of the thigh muscles. Along with the structural changes in the muscles, physical inactivity is also found to play a role in augmenting the dysfunction. Though these changes have the most pronounced effects on the quadriceps, it has been found that even muscles of the upper extremity in patients with COPD demonstrate considerable weakness compared to the muscles of their healthy counterparts<sup>12</sup>. But muscles such as adductor pollicis, the pectoralis major and latissimus dorsi which are recruited in almost every activity of daily living are not as weak as the inactive muscles, such as quadriceps & vastus lateralis<sup>3,9,10,11,12</sup>.

Though hand grip evaluation is primarily an assessment of the muscles of the hand and the wrist, muscles of the shoulder girdle are recruited during the maneuver to stabilize the shoulder girdle<sup>13,14</sup>. Hand grip was also found to be significantly reduced in patients with COPD. This is supported by the findings of Sarah Bernard *et al*, who found that muscles of the upper extremity in patients with COPD are weak compared to healthy individuals<sup>12</sup>.

BMI of COPD patients was significantly lesser compared to the controls. Patients with COPD often lose weight during the course of their disease. It is hypothesized that this may be due to

skeletal muscle apoptosis<sup>15</sup>. Loss of skeletal muscle mass is reflected by the reduction in fat-free mass (FFM) observed in 20–40% of patients with COPD<sup>15, 16, 17</sup>.

## CONCLUSION

We conclude that though hand grip strength is affected in patients with COPD, it does not correlate with severity of airway obstruction and body composition of the patients.

## LIMITATIONS OF THE STUDY

The limitations of the study were that the controls were not selected by random sampling and outcomes assessing the strength and specific functions of the muscles of the upper extremity were not used.

## RECOMMENDATIONS

Though hand grip strength did not correlate with airway obstruction in patients suffering from chronic obstructive pulmonary disease, it was much weaker compared to that of healthy individuals. Hence on the basis of this study we recommend addition of hand grip strengthening exercises in pulmonary rehabilitation programs devised for patients with chronic obstructive pulmonary disease.

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