

The Correlation between Incidence of Falls and Quadriceps Muscle Strength among Patients with COPD from Two Selected Government Hospitals in Colombo District

DGS Malsri, LA Gordon, VR Wijesiriwardana and GAD Perera[#]

Department of Physiotherapy, General Sir John Kotalawala Defence University, Ratmalana, Sri Lanka

[#]amaradamayanthi@gmail.com

Abstract— Skeletal muscle dysfunction is one of the extrapulmonary manifestations in patients with chronic obstructive pulmonary diseases (COPD). Quadriceps muscle strength plays an important role in maintaining the postural stability of a human. The objectives of the study were to determine the incidence of falls and to identify the probability of risk of falls among COPD patients in relation to quadriceps muscle strength among patients who presented to the National Hospital for Respiratory Diseases, Welisara, and the Chest Clinic at the Medical Research Institute, Sri Lanka. This descriptive cross-sectional study was conducted among 35 COPD patients between 40-60 years of age. The quadriceps strengths of bilateral lower limbs were measured using the one repetition-maximum (1RM) strength test and the incidence of falls was assessed using an interviewer-administered questionnaire. The test results indicated a significant positive correlation between the incidence of falls and right side 1RM ($p=0.019$, $r=0.395$) and left side 1RM ($p=0.033$, $r=0.362$). The results showed a significant positive relationship between the probability of risk of falls and right side 1RM ($p=0.030$, $r=0.601$) and left side 1RM ($p=0.040$, $r=0.537$). According to the results of the study, a significantly positive correlation between the incidence of falls and the quadriceps muscle strength of COPD patients was identified. Further, the results show an increase in the probability of falls risk with the reduction of quadriceps muscle strength.

Keywords: *quadriceps muscle strength, COPD, falls Incidence*

I. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a combination of diseases which is characterized by limitation of lung airflow that restricts normal breathing (Devine, 2008; Celli et al, 2015; World Health Organization, 2020). Even though COPD is

defined as a preventable and treatable disease, it is not a completely reversible disease (Celli et al, 2015). It is a life-threatening chronic inflammatory lung disease with progressive, debilitating clinical symptoms (World Health Organization, 2020).

COPD is one of the worldwide main causes of morbidity and mortality. It has been identified as the worldwide third leading cause of mortality by the Burden of Disease Studies (Celli et al, 2015). Global initiative for Chronic Obstructive Lung Diseases, (2018) has shown that, the global prevalence of COPD is 11.7% reference to the results of 384 million of COPD cases in 2010 Skeletal muscle dysfunction is one of the main extrapulmonary manifestations found in patients with COPD. The skeletal muscle function plays an important role in maintaining the quality of life of a person.

Skeletal muscle dysfunction can be identified with reduced muscle strength and reduced endurance of a patient. In COPD, Skeletal muscle dysfunction involves both respiratory and peripheral muscles. Even though the peripheral muscle functions of both upper and lower limbs are affected in patients with COPD, the lower limb muscles are more severely affected than the upper limb muscles. Gea et al, (2015) In consideration of the lower limb muscle dysfunction in patients with COPD, the most affected muscle group is the Quadriceps muscle group of the lower limbs (Kharbanda, 2015). Also, Shah et al, 2019 has mentioned that there is a significant reduction in unilateral or bilateral quadriceps muscle strength in COPD patients. Degree of the muscle weakness changes according to the severity of the COPD (Kharbanda, 2015).

Even the patients with mild severity of the disease, can develop quadriceps muscle weakness (Seymour, 2010; Kharbanda, 2015). One Repetition Maximum (1RM) is described as the maximum weight that an individual can lift only in one

attempt, using a correct lifting method (Seo et al, 2012) with completing full range of motion (Rydwick et al, 2007). Levinger et al, (2009) and Seo et al, (2012) state that 1RM is a gold standard measurement to assess the muscle strength of individuals in non-laboratory situations. The 1RM test is a well-tolerated test by the patients who have undergone pulmonary rehabilitation program (Zanini, 2015).

Impaired balance increases the risk of falls among the patients with COPD (de Castro LA et al, 2016; Marla, 2018). Orr, (2010) in his study mentions the contribution of muscle power to postural instability in the elderly people, tibialis anterior, gastrocnemius, hamstrings, and quadriceps muscle groups have major influence on maintaining the postural stability. According to Crişan et al, (2015), COPD patients of acute stage (Specifically GOLD severity stage 2) and patients with exacerbation suffer impaired balance and greater risk of falls.

This paper examines the correlation between the fall's incidence and the quadriceps muscle strength of COPD patients. In addition, this paper identifies the probability of risk of falls among COPD patients in relation to quadriceps muscle strength of patients with COPD.

II. METHODOLOGY

This descriptive cross-sectional study was conducted with 35 COPD patients in age between 40-60 year who attended the National Hospital for Respiratory Diseases, Welisara and the Central Chest Clinic at Medical Research Institute of Sri Lanka within the course of one month. Both male and female patients with COPD, Age group between 40 to 60 years, Patients who had been diagnosed with COPD according to the Global Initiative for Chronic Obstructive Lung Diseases, patients who extended their consent having complied with the information about the research study were included in the study. Patients with lower extremity joint replacement surgeries and spinal surgeries, Patients with a history of neuro-muscular conditions (example: Parkinson disease, Arthritic conditions, Osteoporosis) and Patients who did not give their consent were excluded from the study.

In order to measure the quadriceps muscle strength, 1RM strength test was conducted (Gosselink, n.d.) with the use of free weights which could be strapped round the ankle. Prior to the quadriceps muscle strength testing, all the participants were given

instructions as to how the techniques should be performed correctly. The participants were instructed to engage in warm up activities of walking with arms and leg movements for about 5 min prior to the test (Rydwick et al, 2007; Seo, 2012). The test was performed in the seated position. The chair was with a fixed height which had no armrests, back rest with an angle of 90-degrees. The subjects who were unable to reach the floor were given a foot stool. The starting position of the test was sitting position with the straight back, hip, knee and ankle flexed in the angle of 90-degrees. The subject was then instructed to stretch forward the testing leg up to the angle 180 degrees, (through full ROM) with the corresponding weight (Zanini, 2015). Quadriceps muscles strength of both the sides were tested in this manner (Figure 1)



Figure 1- Testing 1 Repetition Maximum

Number of incidences of falls during the last 3-6 months were collected using the interviewer administered questionnaires.

III. RESULT

The mean value and standard deviation of age were 55.63 ± 4.222 years whereas the gender distribution of the study was 08 women and 27 males. Spearman's correlation coefficient test was used to measure the correlation between falls incidence and quadriceps muscle strength. The test results indicated a significant moderate positive correlation between falls incidence and right side 1RM ($p=0.019$, $r=0.395$) (table 1) and left side 1RM ($p=0.033$, $r=0.362$) (table 2). The logistic regression test was used to measure the probability of risk of fall in relation to quadriceps muscle strength. The results showed a significant positive relationship between the probability of a patient not falling with increased quadriceps muscle strength of the right side ($p=0.030$, $r=0.601$) (table 3) and left side ($p=0.040$, $r=0.537$) (table 4).

Table 1- The relationship between right side quadriceps muscle strength and risk of falls among the COPD patients

	Right side 1RM (kg)	Correlation Coefficient	1.000	Falls' History (within 3 to 6 months)
Spearman's rho	Right side 1RM (kg)	Correlation Coefficient	1.000	.395*
		Sig. (2-tailed)		.019
		N	35	35

*. Correlation is significant at the level of 0.05 (2-tailed).
 ~One Repetition Maximum ~Significance
 ~Total number of participants

Table 2- The relationship between left side quadriceps muscle strength and risk of falls among the COPD patients.

	Left side 1RM (kg)	Correlation Coefficient	1.000	Falls' History (within 3 to 6 months)
Spearman's rho	Left side 1RM (kg)	Correlation Coefficient	1.000	.362*
		Sig. (2-tailed)		.033
		N	35	35

Table 3- The probability of risk of falls among COPD patients in relation to the level of right quadriceps strength.

		B	S.E.	Df	Sig.
Step 1a	Right side 1RM (kg)	.601	.276	1	.030
	Constant	-3.823	2.054	1	.063

Table 4- The probability of falls risk among COPD patients in relation to the level of left side quadriceps strength.

		B	S.E.	Df	Sig.
Step 1a	Left side 1RM (kg)	.537	.262	1	.040
	Constant	-3.179	1.868	1	.089

IV. DISCUSSION

This chapter contains a detailed discussion of the research findings based on the prevailing literature. The objective of this research was to identify the correlations between Incidence of falls and quadriceps muscle strength among patients with COPD from two selected government hospitals in Colombo district. All the patients with COPD, who presented themselves to the Chest Clinics within a period of one-month were recruited for the research study. A total number of 35 patients who satisfactorily completed the requirements relevant to the exclusion and inclusion criteria were selected for recruitment. They all belonged to the age group ranging from 40 to 60 years.

The results of this research revealed that there is a correlation ($p=0.019$ in right side and $p=0.033$ in left side) between quadriceps muscle strength and falls incidences with the patients of COPD. According to the research conducted by Loughran et al, 2020, it has highlighted that there is a significant

balance impairment associated with reduced quadriceps muscle strength which increases the risk of falls among patients with COPD. The results of this research study indicate that there is a significant moderate positive correlation between left ($p=0.033$) and right ($p=0.019$) quadriceps muscle strength with falls incidences of patients with COPD. Accordingly, the results indicate an increased probability of not falling of patients, in relation to the increased quadriceps muscle strength.

V. CONCLUSION

According to the result of the study a significantly positive correlation between falls incidence and

quadriceps muscle strength of COPD patients was identified. Further, the results show an increase of probability of not falling in parallel to the improvement of bilateral quadriceps muscle strength with increasing

severity from moderate, severe to very severe stage of COPD respectively.

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AUTHOR BIOGRAPHIES

Mrs.GAD Perera
MPhil (Kelaniya)
Senior Lecturer/Head
Department of Physiotherapy
Faculty of Allied Health Sciences
General Sir John Kotelawala Defence University



Ms.D.G. Sandali Malsri
BSc (Hons) Physiotherapy
Physiotherapist
TASS Sports Science and
Recreation Centre



Ms.L.A. Gordon
BSc (Hons) Physiotherapy
Intern Physiotherapist
Institute of Sports
Medicine



Ms. V.R. Wijesiriwardane
BSc (Hons) Physiotherapy
Intern Physiotherapist
Institute of Sports
Medicine