Original Research Article

Comparison of Balance between Subjects with COPD and Normal Individuals- A Comparative Study

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ABSTRACT

Background: Recent studies on western population have shown that there is reduction in the functional balance and mobility in individuals with COPD relative to healthy controls. There is a need to find the level of balance affected in subjects with COPD compared with normal individuals in Indian population especially in Bangalore at ESIC model Hospital.

Aims The purpose of the study is to find the level of balance affected between subjects with COPD compare with normal individuals.

Methods and Material: A Comparative study design, 50 moderate COPD subjects and 50 Normal subjects with age group between 45 to 60 years were selected into COPD group and Normal group. Both groups were evaluated for functional balance using outcome measurements. Outcome measures such as Berg Balance Scale, Timed Up and Go Test, Single limb Stance time, and The Activities Balance Confidence scale were measured in both the groups.

Results: Comparative analysis using Independent 't' test as a parametric and Mann Whitney U test as a non-parametric test there is a statistically significant reduction in means of Berg Balance Scale, Timed Up and Go Test, Single limb Stance time, and Activity specific balance Scale in subjects with moderate COPD compared with normal subjects.

Conclusion: It is concluded that subjects with moderate COPD shown reduced functional balance compared to normal individuals.

Key words: Moderate COPD, functional balance, berg balance scale, Timed Up and Go Test, Single limb Stance time, Activity specific balance Scale.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a slow progressive disorder characterized by a gradual loss in lung function due to airway obstruction, which does not change markedly with time or treatment. [1] According to American Thoracic Society (ATS) and European Respiratory Society (ETS), COPD is defined as ''A preventable and treatable disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases, primarily caused by cigarette smoking. Although COPD affects the lungs, it also produces significant systemic consequences.'' [2-4]

Chronic obstructive pulmonary disease is one of the most important cause of death worldwide and is projected to rank 3rd in 2020 in global burden of disease. [5] In India Chronic obstructive pulmonary disease (COPD) constitute nearly 25-30 % of cases data according to chest clinics. [6]

Balance is the ability to maintain the body's center of mass over its base of support. [7]

Balance and mobility are the important elements of most of the activities of daily living and studies have shown that reduced muscle strength and hypoxia impairs balance.[8] Recent Studies have also shown that there is reduced static as well as dynamic balance in patients with COPD. [8-9] Studies on western population found that there is reduction in the functional balance and mobility in individuals with COPD relative to healthy controls. A study on Indian population concluded that COPD subjects had reduced functional balance compared to normal healthy individuals of same age group. So it should be considered as important component of assessment during pulmonary rehabilitation. [10]

The studies have been found that there is decrease in the skeletal muscle performance is seen in COPD which is exhibited by reduced muscle mass, fibre type profile, strength and endurance. [11-14] Muscle strength is thought to be an essential factor in maintaining postural control and minimizing postural sway. Studies have proven that patients with mild COPD shows a significant reduction in skeletal muscle endurance and strength compared with healthy and sedentary subjects. [15-16] Studies have shown that the quadriceps fatigability is more in individuals suffering from COPD compared to healthy control subjects. [12] This reduction may be because of the combined effect of various systemic factors in COPD. [8]

There is a need to find the level of balance affected in subjects with COPD compared with normal individual in Indian population especially in Bangalore at ESIC model Hospital. As growing body of evidence suggests that individuals with chronic lung disease have important defects in balance control that may be associated with an increased risk of falls that affects their health related quality of life. [5]

Therefore, this study was with research question that does balance is affected in moderate COPD patients compared with normal individuals? It was null hypothesized that there is no difference in level of balance affected between COPD patient compared with normal individuals. Hence the purpose of the study is to find the level of balance affected between subjects with COPD compare with normal individuals in Bangalore at ESIC model Hospital.

METHODOLOGY

A comparative study design with two groups- COPD Group and Normal Group. As this study involved human subjects the Ethical Clearance was obtained from the Ethical Committee of Padmashree Institute of Physiotherapy, Nagar Bhavi, Bangalore, as per ethical guidelines research from biomedical research on human subjects, 2000, ICMR, New Delhi. The approval for the study was obtained from the scientific and Research Ethical committee of RGUHS. This study was registered under Rajiv Gandhi University of Health Sciences for subjects for registration for dissertation for PhD in Physiotherapy program.

In COPD group, the subjects have been selected for the study from ESIC Model Hospital, Bangalore, referred by Pulmonologist and the physician diagnosed with moderate COPD based on spirometry test FEV1/FVC = <0.70, 50 % ≤ FEV1<80% Predicted[17], with age group between 40-60 years, [1] chest expansion less than 1.5 cms, with low risk of falls based on elderly falls screening score, [18] ability to communicate and follow commands, who had independent mobility. The subjects included in Normal Group are normal individuals who were selected in and around Rajajinagar, Bangalore. The study

was conducted at ESIC Hospital. Subjects in both the groups were excluded with musculoskeletal disorders affecting upper limb, pathological condition affecting muscle, joint and bone such as rheumatoid arthritis, severe osteoporosis, cardiovascular dysfunction (eg, ischemic heart disease, uncontrolled hypertension), and associated conditions restricting chest expansion. (eg, obesity, severe scoliosis, ankylosing spondylitis), recent chest or abdominal surgery, pathology of spine such as disc protrusion, spondylolisthesis.

Procedure: Subjects who met inclusion criteria were allotted into group A (subjects with Moderate COPD) and Group B (Normal subjects) by convenient sampling method. The purpose of the study was explained to the subjects and the informed consent was obtained from the subjects in both groups. The assessment of balance was done using Berg Balance Scale, Timed Up and Go Test, Single limb stance time and Activities Balance Confidence (ABC) scale in both groups. [11]

TUG test: The timed "Up and Go" test was used to provide a timed measure of balance and functional mobility in subjects. The test was performed by asking the subject to rise from a standard armchair, walk 3 meter at a comfortable pace, walk back to the chair, and sit down. Total time taken to complete the test was measured in seconds by using stop watch. A practice trial was performed in order to become familiar with the test and individuals were permitted to use a gait aid if required. [18]

Berg balance scale: Functional balance was measured using the 14 item BBS. Activities such as transfers, reaching, turning around and single legged stance were graded on a scale ranging from 0 (significant impairment) to 4 (normal) with higher scores indicating greater balance control. A cutoff of 45 points may be used to identify a subject at risk for falling ($>= 45$ low risk of falling, < 45 higher risk). [19]

Single limb stance test: Stand on one leg, place your arms across your chest with your hands touching your shoulders and do not let your legs touch each other. Subjects were given three trials and the best time was taken. [20]

ABC scale: The ABC scale requires subject to indicate their confidence in performing 16 activities without losing their balance or becoming unsteady on an 11-point scale (0%– 100%). Higher scores indicate higher balance confidence or less fear of falling. [21]

Figure-1: Balance assessment using timed Up and Go Test in COPD subject.

Figure-2: Evaluation of Single leg stance in normal individuals

Figure-3: Normal individual filling ABC scale

STATISTICAL METHODS

Descriptive statistical analysis was carried out in the present study. Out Come measurements analyzed are presented as mean ± SD. Significance is assessed at 5 % level of significance with p value was set at 0.05 less than this is considered as statistically significant difference. Paired 't' test as a parametric and Wilcoxon signed rank test as a non-parametric test have been used to analysis the variables pre-intervention to post-intervention with calculation of percentage of change. Independent 't' test as a parametric and Mann Whitney U test as a non-parametric test have been used to compare the means of variables between two groups with calculation of percentage of difference between the means. The Statistical software namely SPSS 16.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS

Table 1: Basic Characteristics of the subjects studied

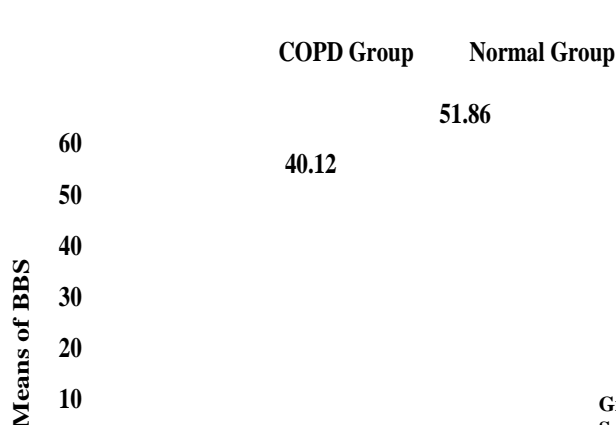| Basic Characteristics of the subjects d studied		COPD Group	Normal Group	Significance
Number of subjects studied (n)		50	50	--
Age in years (Mean± SD)		55.20± 3.73 (46-60)	54.92± 3.80 (43-60)	p= 0.776 (NS)
Gender	Males	35	70%	35	70%	--
	Females	15	30%	15	30%	

Table 2: Comparison of means of BBS. TUG, SLST, and ASBS between COPD Group and Normal Group

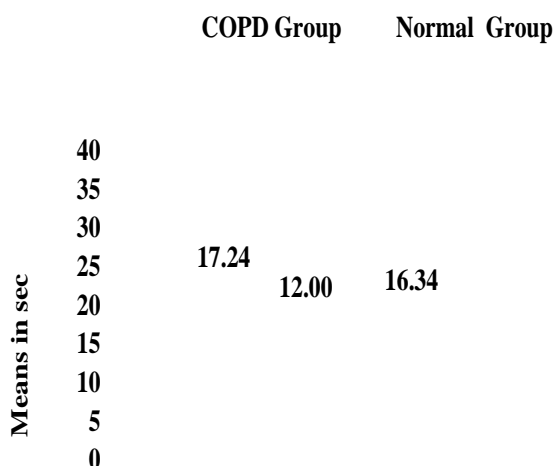|	COPD Group (Mean±SD) min-max	Normal Group (Mean±SD) min-max	Percentage of difference	Z value[b] (Non parametric)	t value[a] (Parametric)	df	Significance P value	95% Confidence interval of the difference		Effect Size r
								Lower	Upper	
BBS-Berg Balance Scale	40.12± 1.30 (38- 43)	51.86± 1.21 (50-56)	-25.52%	Z= -8.708 p=0.000**	-46.630	98	p=0.000**	-12.240	-11.240	+0.97 (Large)
TUG-Timed Up and Go Test in sec	17.24± 1.18 (15 - 20)	12.00± 1.67 (9-17)	-35.84%	Z= -8.512 p=0.000**	18.022	98	p=0.000**	4.663	5.817	+0.87 (Large)
Single limb Stance time (SLST) in sec	16.34± 2.99 (9 - 21)	39.68 ± 2.76 (35- 46)	83.32%	Z= -8.637 p=0.000**	-40.490	98	p=0.000**	-24.484	-22.196	+0.97 (Large)
Activity specific balance Scale (ASBS)	79.44± 1.11 (77 – 82)	91.82± 1.00 (90- 95)	14.45%	Z= -8.743 p=0.000**	-58.506	98	p=0.000**	-12.800	-11.960	+0.98 (Large)

** Statistically Significant difference p<0.05; NS- Not significant   a. Independent t test b. Mann-Whitney Test

The study was conducted on total of 100 subjects (Table-1). In COPD group there were 50 subjects with mean age 55.20 years and there were 36 males and 14 females were included in the study. In Normal Group there were 50 subjects with mean age 54.92 years and were 35 males 15 females were included in the study. There is no significant difference in mean ages between the groups.

Comparison of means of Berg Balance Scale, Timed Up and Go Test, Single limb Stance time, and Activity specific balance Scale between the groups (Table-2) shows that there is a statistically significant difference (p<0.05) between the groups. There is also clinically significant difference in means with large effect size.

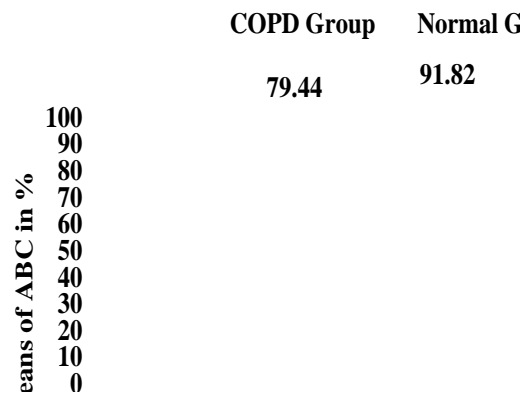The above graph shows that when means of Berg Balance Scale were compared between COPD group and normal Group there is a statistically significant difference (p<0.05) in means between groups. There is significant reduction in balance score in COPD Group than the normal group.

The above graph shows that when means of Timed Up and Go Test and Single limb Stance time were compared between COPD group and normal Group. There is a statistically significant difference (p<0.05) in means between groups. There is significant reduction in Timed up and go test and single limb stance time in COPD Group than the normal group.

Graph 1: Comparison of means of Berg Balance Scale between COPD Group and Normal Group

Graph 2: Comparison of means of Timed Up and Go Test and Single limb Stance time between COPD Group and Normal Group

Graph 3: Comparison of means of Activity specific balance Scale between COPD Group and Normal Group

The above graph shows that when means of Activity specific balance Scale were compared between COPD group and normal Group there is a statistically significant difference (p<0.05) in means between groups. There is a significant difference reduction in Activity specific balance Scale means in COPD subjects compared with Normal subjects with large effect size.

DISCUSSION

It is found from analysis that there is a statistically significant difference in means of Berg Balance Scale, Timed Up and Go Test, Single limb Stance time, and Activity specific balance Scale between COPD subjects and normal subjects. There is also clinically significant difference

between the COPD subjects and normal subjects with large effect size.

As there are no much studies done to find whether balance is affected or not in subjects with Moderate COPD in Indian population. The present study was carried to find the functional balance in subjects with moderate COPD and normal healthy subjects in Indian population. Results of this study showed that moderate COPD subjects have reduced functional balance compared to healthy individuals. [5]

Muscle strength is thought to be an essential factor in maintaining postural control and minimizing postural sway. [12] The previous studies have been found that there is decrease in the skeletal muscle performance is seen in COPD which is exhibited by reduced muscle mass, fibre type profile, strength and endurance. [12] Previous Studies have proven that patients with moderate COPD shows a significant reduction in skeletal muscle endurance and strength compared with healthy subjects. The categorization of subjects with COPD into mild limitation in functional balance would have been because of age related changes and disease process. Corticosteroids being given as a part of treatment in COPD patients could be the one of the cause for reduced muscle strength. Deconditioning and malnutrition may be the other possible causes for reduced strength there by reduced balance in COPD patients.

Purnima Bhosle et al., [10] conducted a case Control Study on 30 subjects (19 COPD, 11 normal subjects) to compare functional balance in subjects with COPD and normal healthy individuals by using various functional balance assessment tools. The study found out that subjects with COPD had reduced functional balance in comparison to normal healthy individuals of same age group, so it should be considered as important component of assessment during pulmonary rehabilitation. Marla K. Beauchamp et al., [12] did a study on Impairments in Systems Underlying Control of Balance in COPD to determine the specific components of balance that are impaired in COPD and they concluded that individuals with COPD exhibit impairments in all balance subcomponents and demonstrate slower reaction times in response to perturbations. Roca M Mihaescu T et al., [22] in their study explained regarding peripheral muscle dysfunction in chronic obstructive pulmonary disease that the skeletal muscles function is restricted in COPD, because of decreased endurance and strength. Skeletal muscle weakness has a great clinical importance in COPD, as it is recognized to contribute independently to poor health status, reduced quality of life and increased mortality. They describe the current knowledge of the structural and functional abnormalities of skeletal muscles in COPD and the possible physiopathology determination of these dysfunctions. The understanding of these abnormalities is essential in development of new therapeutic strategies to combat muscle dysfunction in COPD, including the pulmonary rehabilitation programs. Eduardo Foschini Miranda et al., [23] in their review on peripheral muscle dysfunction in COPD lower limbs versus upper limbs concluded that both Upper limb and lower limb strength and endurance are lower in COPD patients than in healthy individuals. Neuromechanical dysfunction (thoracoabdominal asynchrony) of respiratory muscles (diaphragm and accessory muscles); and changes in lung volume during activities involving the upper limbs. Regarding the lower limbs, reduced muscle strength and endurance are related to decreased muscle mass, decreased aerobic capacity. M.K Beauchamp et al., [24] in a Cross Sectional Study on Impairments in balance discriminates fallers from non – fallers in COPD. On 39 patients by using self report questionnaire, Berg Balance Scale, Timed Up and GO Test and the Activity Specific Balance Confidence (ABC) Scale and concluded that patients with COPD falls frequently.

In the present study there is significant reduction in balance score in COPD Group with mean 40.12 (1.30) than the normal group with mean 51.86 (1.21) and with percentage of difference is -25.52%. There is significant reduction in Timed up and go test and single limb stance time in COPD Group with mean 17.24 (1.18) and 16.34 (2.99) respectively than the normal group with mean 12.00 (1.67) and 39.68 (2.76) and with percentage of difference is -35.84% and 83.32% respectively. There is a significant reduction in Activity specific balance Scale means in COPD subjects with mean 79.44 (1.11) compared with Normal subjects with mean 91.82 (1.00) and with percentage of difference is 14.45%.

Therefore, based on the findings the present study found that there is a statistically significant reduction in functional balance in subjects with moderate COPD compared to normal subjects in Indian population. Hence, present study rejects null Hypothesis.

LIMITATIONS OF THE STUDY
1. Subjects with age group range between 40 to 60 years were considered for the study, age matched subjects were not considered, thus results cannot be generalized to all the groups.
2. The study was conducted on moderate COPD subjects, finding in mild and severe COPD subjects were not found.
3. Both male and female subjects were considered; therefore the association of balance affecting specific to male and females were not found.
4. Other factors affecting balance in subjects with moderate COPD is not considered to compare with normal individual.
5. Duration of COPD subjects were not considered to relate with balance affected.

RECOMENDATION FOR FUTURE RESEARCH
1. Study is needed to find the balance affected comparing with normal individuals with different age group and specific to the male and female subjects.
2. The study need to find the level of balance affected in mild and severe COPD considering the duration of the COPD comparing with normal individual.
3. The study is needed to find the balance impairment in COPD with other factors affecting balance and compare this with normal individuals.

CONCLUSION
The present study concludes that subjects with moderate COPD shown reduced functional balance compared to healthy individuals. There is a statistically significant reduction in means of Berg Balance Scale, Timed Up and Go Test, Single limb Stance time, and Activity specific balance Scale in subjects with moderate COPD compared with normal subjects. There is also clinically significant difference in balance affected between the subjects with moderate COPD and normal subjects with large effect size.

ACKNOWLEDGEMENT

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