



EFFECT OF ELECTRONIC WOBBLE BOARD TRAINING ON BALANCE AND RISK OF FALL IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS: A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Background:- Chronic Obstructive Pulmonary Disease (COPD) is a condition associated with a lot of physical impairment and its long term effects can cause impairment in functional mobility and peripheral muscle weakness, which can cause balance impairments in such patients. Conventional balance exercises are found to have positive effects on patients suffering with COPD but there is lack of knowledge on the effectiveness of electronic wobble board exercises on balance and risk of falls in these patients. Hence, the present study aimed to find out the effectiveness of electronic wobble board on balance and risk of falls in these patients.

Methods:- 20 subjects (10 male and 10 female) were included in the study and were randomly allocated to control group (conventional balance board exercises) and experimental group (electronic wobble board). The outcomes were timed up and go test (TUG) and Berg Balance scale (BBS). Outcomes were recorded pre and post after 2 weeks of intervention.

Result:- 20 participants completed the study. The results were calculated using the independent t test and it was found that the comparison of the pre-test and post-test scores of TUG within the groups was significant for both the groups and the comparison of the pre-test and post-test scores of BBS within the groups was significant for both the groups.

Conclusion:- The present study concluded that electronic wobble board exercises were effective in improving balance and reducing risk of fall in subjects with COPD.

KEYWORDS : COPD, electronic wobble board, TUG, BBS

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a common respiratory disease associated with a lot of physical impairment¹. Patients with COPD are prone to exhibit cardiovascular comorbidities such as peripheral muscle dysfunction, weight loss, systemic inflammation and psychological problems. Although COPD is a treatable condition, if proper treatment is not taken it can lead to secondary impairments such as decreased functional mobility and peripheral muscle weakness leading to balance impairments. It is a condition which causes difficulties while performing activities of daily living which requires additional muscle strength and endurance². A cross-sectional study in 2003 was carried out which evaluated the association of lung function impairment with increased functional impairment and suggested higher ratio of functional limitation in patients suffering from COPD³.

There is an increased risk of fall in subjects with COPD secondary to pulmonary manifestations. There is also a contribution of impaired bone strength, muscle strength and balance. The main cause for balance impairment is associated with proprioceptive control in lower limbs. In subjects with COPD, diaphragm which is a main inspiratory muscle is responsible for stabilizing the spine during the loading and balance tasks. Due to the increased demand for the inspiratory function and with the increased work of breathing, there is inhibition of trunk stabilization and the segmental stability is reduced⁴. This strongly challenges the maintenance of balance and impairs the dynamic performance as well as reduces the responses against postural perturbations. In addition to diaphragm, there is peripheral muscle weakness where in the extensors and abductors are most commonly affected⁵.

There is hyperinflation of the airways which causes the retention of CO₂ and the increased demand of oxygen by the peripheral muscles along with increased lactic acid production that leads to early fatigue. As a result, muscles do not show adequate endurance to accomplish various dynamic activities⁶.

These balance issues have been quantitatively measured using Timed Up and Go test (TUG), Berg Balance Scale (BBS), Single Leg Stance Test and Activities-specific Balance Confidence (ABC) scale as a part of clinical balance assessment tools⁷. A study done on evaluation of balance impairments between fallers and non-fallers in COPD, recommended the need for further evaluation and treatment for the same⁷. Several studies have demonstrated that balance training through virtual reality such as Nintendo wii, balance board exercises is effective in reducing fall risks in subjects with COPD. Since there is a dearth of literature comparing the effect of electronic wobble board and conventional balance exercises in patients with COPD, the present study aims to examine the efficacy of the same in terms of balance and risk of falls.

METHODOLOGY

Patients diagnosed with COPD between the age group of 40-60 years were assessed for baseline data of balance and risk of falls using the TUG^{8,9} and BBS¹⁰. Patients with grade 5 dyspnoea according to ATS guidelines, acute exacerbation within last three months before study, any neurological condition, postural or orthostatic hypotension, recent lower limb fracture were excluded from the study. The subjects were randomly divided into two groups using the convenience sampling method. The subjects received treatment for 3 days a week for two weeks. Group A received conventional balance board exercises¹¹ and Group B received Libra balance board training which had an electronic wobble board which was attached to a computerised game where in the subjects were asked to guide the ball on the screen¹². Treatment lasted for 40 minutes for both the groups.

RESULTS

Statistical analysis of the current study was done by using SPSS version 23. The TUG and BBS were measured on the second week (at the end of the sixth session) were shown as mean \pm SD and the changes in the experimental group were compared with control group by the independent t test. The pre-test difference between the two groups was not significant but the post-test difference was significant for TUG. The pre-

test and post-test difference between two groups was not significant for BBS. The comparison of the pre-test and post-test scores of TUG within the groups was significant for both the groups and the comparison of the pre-test and post-test scores of BBS within the groups was significant for both the groups.

Table 1: Comparison of demographic data between the groups

Variable	Groups	Mean (SD)	SE	t-value	P-value
Age in yrs	Group A	54.60 (3.95)	1.25	-0.2859	0.7782
	Group B	55.10 (3.87)	1.22		
Height	Group A	165.10 (4.68)	1.48	0.8918	0.3843
	Group B	163.20 (4.85)	1.53		
Weight	Group A	55.90 (9.83)	3.11	-0.5559	0.5852
	Group B	58.10 (7.75)	2.45		
BMI	Group A	20.52 (2.99)	0.94	-1.1196	0.2776
	Group B	21.87 (2.35)	0.74		

Table 2: Comparison of Group A and B with respect to Timed up go test (TUG) scores

Time points	Groups	Mean \pm SD	SE	t-value	P-value
Pretest	Group A	16.56 \pm 1.13	0.36	0.6344	0.5338
	Group B	16.27 \pm 0.90	0.28		
Posttest	Group A	14.39 \pm 0.40	0.13	3.4188	0.0031*
	Group B	13.75 \pm 0.44	0.14		

*p<0.05

Table 3: Comparison of Group A and B with respect to Berg balance Scale (BBS) scores

Time points	Groups	Mean \pm SD	SE	t-value	P-value
Pretest	Group A	41.20 \pm 3.12	0.99	0.2313	0.8197
	Group B	40.80 \pm 4.49	1.42		
Posttest	Group A	52.30 \pm 1.64	0.52	-0.3855	0.7044
	Group B	52.60 \pm 1.84	0.58		

Table 4: Comparison of pretest and posttest scores of TUG and BBS within the groups

		PRE	POST	p-value
GROUP A	BBS	41.20 \pm 3.12	52.30 \pm 1.64	0.0001*
	TUG	16.56 \pm 1.13	14.39 \pm 0.40	0.0001*
GROUP B	BBS	40.80 \pm 4.49	52.60 \pm 1.84	0.0001*
	TUG	16.27 \pm 0.90	13.75 \pm 0.44	0.0001*

DISCUSSION

The results of the present study demonstrated that there was an improvement of balance in patients with COPD thus supporting the experimental hypothesis that electronic wobble board is effective in improving balance and reducing risk in patients with COPD. There are several studies determining a similar effect of balance exercises on subjects with COPD.

There was a significant improvement in both the groups in terms of TUG and BBS but group B showed more improvements as compared to group A in TUG scores. A literature reviewed on assessment of posture and balance using the Nintendo Wii board and Clinical tests demonstrated that both the parameters are affected in subjects with moderate to severe COPD.

The patients showed significant improvements in TUG in Group B as the modulation of a few muscle synergies can strongly explain variations in muscle activity across reactive balance responses during different perturbations to standing. In response to multidirectional support-surface perturbations, muscle synergy recruitment is directed towards the perturbation, and generates a specific biomechanical function to restore the center-of-mass (CoM). The various muscles recruited provide a motor repertoire for trunk muscles

during balance testing and training⁵.

Incorporating specific exercises, concentrating on improvement of posterior muscle strength such as rectus femoris, hamstrings, dorsiflexors, gluteal muscles and essentially the core muscles, improves balance.¹⁶ In the present study, after a 2 week (6 days) balance training period, subjects with COPD experienced an improvement in balance. Major improvements were demonstrated in dynamic balance activities requiring muscle endurance. As muscles engaged in dynamic activities require more amount of repetition for a particular activity, it relies more on aerobic metabolism⁶. This could be because of the training induced on the balance board, which made the subjects to rely strongly on their proprioceptive system, thereby causing increased muscle co activation. This causes stability of the postural system. The targeted balance training included in this study through electronic wobble board and conventional balance board included greater challenges resulting in increased firing of motor units of the extensor group of muscles. This theory is supportive of a study carried out by Mkacher et al where the importance of a 6 month balance training was effective in subjects with COPD. The study demonstrated improvement in muscle strength of lower limbs, improved vestibular functioning due to exercise training, and decrease in dyspnea due to decreased lactic acid production¹³. Another study done by Veronica Barbier also showed that exercise training has a statistically significant effect on balance in subjects with COPD¹⁴. There are many studies suggesting the use of Nordic walking exercise, water based training, virtual reality training in improving balance and physical function in subjects with COPD¹⁵. One of the postulated cause of postural instability is decreased muscular strength of lower limbs mainly the dorsiflexors, gluteal muscles, which causes the COG to move anterior to ankles, increasing the risk of fall⁵. This explains why there was less improvement in BBS scores as it included tasks which are more challenging for the patients whose balance was compromised.

The limitations of the study were:- Lack of treatment for dyspnea which would have added to the improvement associated with balance and individualized training for the patients. Various gait parameters could also have been checked associated with an improvement in the balance. The muscle strength was not evaluated prior to the tests which would have given a better idea regarding specific training for every subject.

It is recommended to extend future research on this population with these parameters taken into consideration.

CONCLUSION

The present study concluded that electronic wobble board exercises were effective in improving balance and reducing risk of fall in patients with COPD.

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