EFFICACY OF WHOLE BODY VIBRATION ON MOBILITY SCREENING TESTS IN CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS

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ABSTRACT

Background: Reduced balance function has been linked to an increased risk of falling in people with chronic obstructive pulmonary disease (COPD). The goal of this study was to look into mobility tests time up and go test and one leg stance test (TUG ,OLS) and the effect of whole body vibration (WBV) on dynamic balance. Materials and Methods: This 12-week trial involved sixty participants with chronic obstructive lung disease, ranging in age from 45 to 60 years old. They were split into two groups, one for control and the other for total body vibration. both groups were evaluated by the same methods for TUG and OLS tests before and after twelve weeks. The protocol for whole-body vibration training was as follows: Three times per week, for three sets of three minutes every day at 25-35 HZ, and 6mm peak-to-peak amplitude that stimulates muscle contractions all over the body, patient standing with static squatting "semiflexion in knees". Results: there was a statistically significant reduction in TUG in both groups (14.8,22.5) respectively and significance increase in OLS in both groups ( 1.5 ,22.5) respectively. Conclusion: whole body vibration training in COPD patients is beneficial and resulting in significant effect on mobility tests (TUG - OLS), with concomitant improvement of dynamic balance.

Key words: Chronic obstructive pulmonary disease, Time up and go test, One leg stance test, whole body vibration.

I-INTRODUCTION

Chronic obstructive pulmonary disease COPD is a prevalent and curable lung disease characterized by gradual airflow restriction and tissue damage. It is linked to structural abnormalities in the lungs as a result of chronic inflammation caused by extended exposure to irritating particles or gases, the most frequent of which is cigarette smoke. Chronic inflammation narrows the airways and reduces lung recoil. Cough, dyspnea, and sputum production are common signs of the condition. Asymptomatic to respiratory failure are all possible symptoms (GOLD-Report.,2020).

When comparing COPD patients to healthy controls ,both static and dynamic balance are compromised ,and postural sway affected more in severe COPD than moderate COPD leading to functional disability and risk of falls which increases with age. when dynamic balance assessed using Timed Up and Go Test (TUG) and quiet standing to assess postural sway using sway meter with eyes closed and opened narrow, semi tandem and tandem stance for 30 seconds ,balance changes can be moderately correlated to forced expiratory volume in the first second (FEV1) (Sayed S. et al.,2021).

When compared to healthy people ,people with moderate COPD had lower functional balance .in people with moderate COPD, the means of berg balance scale, timed up and go test, single limb stance time, and activity specific balance scale are significantly lower than normal subjects (Suresh etal.,2017).
In comparison with healthy controls, people with COPD showed lower functional and static balance. Their static balance was examined using forced platform in one-legged stance and functional balance was assessed using with the Timed Up and Go test. Depending on kind of balance examination (force platform or functional test), Sex can influence these outcomes, depending on the type of balance evaluation (force platform or functional test), as men had superior functional balance but lower postural control on force platform. Finally, there was no link between balance and disease severity (Larissa et al., 2016).

It has been shown that COPD patients balance function may be tested with “performance or activity based measurements” (as Berg Balance Scale (BBS), Balance Evaluation System Test (BESTest), timed up and go test, Tinetti scale) and balance confidence questionnaires (Activities-Specific Balance Confidence (ABC) Scale) proved that impaired functional balance has been observed (Beauchamp MK, 2018).

Balance training performed on a WBV platform is superior to improve objectively measured balance performance and muscular power compared to conventional balance board training in patients with COPD and functional impairment (Gloeckl R et al., 2021).

II- MATERIALS & METHODS

The Physical Therapy Faculty at Egypt Cairo University performed a randomized control trial. The study contained a convenient sample of 60 patients with COPD volunteers aged between 45 and 60 from the University of Cairo, kasr el ainy clinic. The criteria for inclusion were as follows:

(1) Patients in the study will have chronic obstructive pulmonary disease patients stage II, stage III, (2) Their age were ranged from 45-60 years and (3) Absence of knee flexion contracture. Two groups equal in number were all divided. Group of control (A) and the whole body vibration group (B).

Evaluation procedures were conducted by all participants before and after 12 week to measure dynamic balance time up and go test TUG and one leg stance test (OLS). they provided written informed consent to participate in the study. control group were received traditional physiotherapy program(breathing exercises, breathing control techniques and home program (walking for 20-30 minutes in days out from session, incentive spirometer. study group were received whole body vibration exercises and traditional physiotherapy program (breathing exercises, breathing control techniques + home program (walking for 20-30 minutes in days out from session, incentive spirometer.

- Test methods and measurement:

Timed up & go test Liwsrisakun C et al.(2020): materials

1) Stopwatch, chair with armrest and backrest, measure tape. Notebook. TUG test evaluates how long it takes an individual to straighten up from a chair, walk a distance of 3 m (10 feet), turn, walk back to the chair, and sit down again. the participants back against the back rest of the chair as part of this test. each participant must get up from chair, go to a line /block on the floor three meters away, turn around, walk back to their chair on the “go” instruction.

2) Until they reach the specified end of marked route. all competitors were instructed to walk as fast as they felt safe and comfortable. All the patients will be allowed to wear their regular footwear and use a walking aid if needed; however, no participant required any walking aid or self-helped device. The test will be timed with help of a stopwatch (in seconds). prior being timed, the participants will walk through the test once to become comfortable with it. then, three readings of the real test will be gathered and averaged for statistical analysis through the test once before being timed to become familiar with the test, and three readings of the actual test will be obtained and averaged for statistical analysis.

One leg stance test McLay R et al.,(2020):

Patients were asked to stand barefoot on the limb of their choice with other limb lifted so that the raised foot was near, but not touching the ankle of their stance limb. This test examine postural stability. Each patient was instructed to fix his or her gaze on a place on the wall straight in front of them, at eye height, the patient was told to cross his arms...
over his chest and lie on his back. to find out how long the individual could stand on one leg, we utilized a stopwatch. when the individual lifted his foot off the floor, clock started. when the person did one of the following:

- Not folded arms (used his arms)
- Used the flexed foot (moved it toward or away from the ground limb or touched the floor).
- Moved the weight-bearing foot to keep his equilibrium (ie, rotated foot on the ground). The procedure was repeated 3 times.

**Whole body vibration WBV (crazy fit massage, China)**

Practical protocol: Training frequency three times per week, for duration three sets three minutes per day at 25–35 HZ, and 6mm peak-to-peak amplitude that’s evokes muscle contractions all over the body, that occurs passively. Patient standing with static squatting (semiflexion in knees) (Gloeckl et al., 2021).

- **Statistical procedures**
  
  - **Data collection:**
    In the Social Science Statistical Package (IBM SPSS), version 19, data were collected, reviewed, coded and entered.

  - **Data analysis:**
    Mean ± standard deviation is reported as results. The Chi square test was used as the comparison of categorical data [number (percent)]. The normality test was conducted to measure data distribution, the Kolmogorov-Smirnov test. A comparison was conducted using unpaired t-test comparing the usual distributed data (variables) in both groups. To determine the effects of the pre-treatment values, between the post-treatment values, the pre- treatment values of both groups were tested for covariance analysis (ANCOVA). A comparison between pre- and post-treatment data of the same group has been done with paired t tests. A comparison between the data (variables) not normally distributed in the two groups was made using the Mann Whitney test. The pre- and post-treatment comparison results were carried out in the same group in the Wilcoxon Signed Ranks test. In the analysis of data, the computer application (version 19 windows) of the Social Sciences Statistics Package (SPSS) was used. Substantial "P value of 0.05" was evaluated.

**III- RESULTS**

- **1- "General characteristics of the patients":**
  
  **A- Age (yrs.)**

  The mean SD values of age in groups (A) and (B) were 51.87 ± 4.64 and 52.50 ± 4.45 years, respectively, as shown in table (1) and figure (1). There was no statistically significant difference between them, according to the unpaired t test (t value= -0.539, p= 0.592).

  **B- Gender**

  In group A, the number of females and males were 13 (43.3%) and 17 (56.7%), respectively. Also in group B, the number of females and males were 13 (43.3%) and 17 (56.7%), respectively. They were statistically comparable (Chi square test= 0.00 & p value= 1.000) (Table(1) & Fig.(2).

  **C- Weight (kg.)**

  As presented in table (1) and figure (3, the mean ± SD values of weight in groups (A) and (B) were 81.50 ± 11.13 and 82.80 ± 7.70 kg., respectively). The unpaired t test revealed that there was no statistically significant difference between them (t value= -0.526, p= 0.601).

  **D- BMI (kg/m2)**

  As presented in table (1) and figure (4), "the mean ± SD values of BMI in groups (A) and (B) were 30.32 ± 3.66 and 29.98 ± 2.95 kg/m2, respectively". The unpaired t test revealed that there was no statistically significant difference between them (t value= 0.396; p= 0.694).
Table 1. Mean and standard deviations for and for TrA and IO muscles.

<table>
<thead>
<tr>
<th></th>
<th>Group A (n= 30)</th>
<th>Group B (n= 30)</th>
<th>t value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (yrs.)</strong></td>
<td>51.87 ± 4.64</td>
<td>52.50 ± 4.45</td>
<td>-0.539</td>
<td>0.592 (NS)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>13 (43.3%)</td>
<td>13 (43.3%)</td>
<td>χ² = 0.00</td>
<td>1.000 (NS)</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>17 (56.7%)</td>
<td>17 (56.7%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Weight (kg.)</strong></td>
<td>81.50 ± 11.13</td>
<td>82.80 ± 7.70</td>
<td>-0.526</td>
<td>0.601 (NS)</td>
</tr>
<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td>30.32 ± 3.66</td>
<td>29.98 ± 2.95</td>
<td>0.396</td>
<td>0.694 (NS)</td>
</tr>
</tbody>
</table>

Studied groups, Data are expressed as mean ± SD or number (%), NS= p> 0.05= not significant.

Fig.1: Mean values of age in both groups.

Fig.2: Gender distribution among the two studied groups.

Fig.3: Mean values of weight in both groups.
Within group comparison (intra-group comparison)

In group A, there was a statistical significant decrease in the mean value of TUG measured at post-treatment (15.43 ± 1.65) when compared with its corresponding value measured at pre-treatment (18.13 ± 1.96) with t value= 21.060 and p value = 0.001 (Table (2); Fig.(5)).

Also in group B, there was a statistical significant decrease in the mean value of TUG measured at post-treatment (13.77 ± 1.98) when compared with its corresponding value measured at pre-treatment (17.77 ± 2.57) with t value= 21.541 and p value = 0.001.

The percent decrease in TUG value in groups A and B was 14.89% and 22.51%, respectively (Table 2). The percent decrease in TUG value in groups A and B was 14.89% and 22.51%, respectively (Table 2).

Between groups comparison (inter-groups comparison)

At pre-treatment, in groups A and B, the mean values (± SD) of TUG were 18.13 ± 1.96 and 17.77 ± 2.57, respectively. There was no statistical significant difference between the two groups (F= 0.386 & p= 0.537) as shown in table (2).

ANCOVA test revealed that there was a statistical significant decrease in TUG values in group B (13.77 ± 1.98) when compared to its corresponding value in group A (15.43 ± 1.65) (F= 66.988 & p= 0.001).

Table 2. Inter- and intra-groups comparison between mean values of TUG in the two studied groups measured at pre- and post-treatment.

<table>
<thead>
<tr>
<th></th>
<th>Group A (n= 30)</th>
<th>Group B (n= 30)</th>
<th>F value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-treatment</td>
<td>18.13 ± 1.96</td>
<td>17.77 ± 2.57</td>
<td>0.386</td>
<td>0.537 (NS)</td>
</tr>
<tr>
<td>Post-treatment</td>
<td>15.43 ± 1.65</td>
<td>13.77 ± 1.98</td>
<td>66.988</td>
<td>0.001 (NS)</td>
</tr>
<tr>
<td>Mean difference</td>
<td>2.70</td>
<td>4.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>% change</td>
<td>14.89 ↓↓</td>
<td>22.51 ↓↓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t value</td>
<td>21.060</td>
<td>21.541</td>
<td></td>
<td></td>
</tr>
<tr>
<td>p value</td>
<td>0.001 (S)</td>
<td>0.001 (S)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD, F value= ANCOVA test; t value= paired t test. NS= p> 0.05= not significant; S= p≤ 0.05= significant.
• **One leg stance test (OLS)**

*Within group comparison (intra group comparison)*

In group A, there was a statistical significant increase in the value of OLS measured at post-treatment (21.77 ± 1.91) when compared with its corresponding value measured at pre-treatment (21.43 ± 1.91) with t value = -3.340 and p value = 0.002 (Table (3) ; Fig.(6)).

Also in group B, there was a statistical significant increase in the value of OLS measured at post-treatment (26.50 ± 1.46) when compared with its corresponding value measured at pre-treatment (21.63 ± 2.04) with t value = -15.712 and p value = 0.001.

The percent increase in OLS value in both groups A and B were 1.59% and 22.52%, respectively (Table 3).

*Between groups comparison*

At pre-treatment, in groups A and B, the mean values (± SD) of OLS were 21.43 ± 1.91 and 21.63 ± 2.04, respectively. There was no statistical significant difference between the two groups (F value= 0.154 & p= 0.696).

ANCOVA test revealed that there was a statistical significant increase in the mean value of OLS in group B (26.50 ± 1.46) when compared to its corresponding value in group A (21.77 ± 1.91) (F= 270.368 & p= 0.001).

**Table 3.** Inter- and intra-groups comparison between mean values of OLS in the two studied groups measured at pre- and post-treatment.

<table>
<thead>
<tr>
<th></th>
<th>Group A (n= 30)</th>
<th>Group B (n= 30)</th>
<th>F value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-treatment</strong></td>
<td>21.43 ± 1.91</td>
<td>21.63 ± 2.04</td>
<td>0.154</td>
<td>0.696 (NS)</td>
</tr>
<tr>
<td><strong>Post-treatment</strong></td>
<td>21.77 ± 1.91</td>
<td>26.50 ± 1.46</td>
<td>270.368</td>
<td>0.001 (S)</td>
</tr>
<tr>
<td><strong>Mean difference</strong></td>
<td>0.34</td>
<td>4.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>% change</strong></td>
<td>1.59 ↑↑</td>
<td>22.52 ↑↑</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>t value</strong></td>
<td>-3.340</td>
<td>-15.712</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>p value</strong></td>
<td>0.002 (S)</td>
<td>0.001 (S)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data are expressed as mean ± SD, F value= ANCOVA test; t value= paired t test., NS= p> 0.05= not significant; S= p≤ 0.05= significant.
Fig. 6: Mean values of mean OLS in the two studied groups measured pre- and post-treatment

IV- DISCUSSION

There are many extrapulmonary manifestations of the disease known as Chronic obstructive pulmonary disease (COPD), often patients with COPD will have problems with their balance, which can lead to function issues in daily life, as well as increased risk of falling. COPD patient’s quality of life and risk of injury are both improved by maintaining their balance function. This is why patients with COPD should have their balance tested after pulmonary rehabilitation. According to the American Thoracic Society/European Respiratory Society guidelines (Spruit, M.A. et al., 2013).

Earlier COPD research focussed mostly on one or more of the risk factors for equilibrium disorder including age, lung health, e.g., severity of lung disease, COPD (Tudorache, E et al., 2015), strength of muscles, physical activity levels, mobility, and the use of oxygen (Iwakura, M et al., 2016), and Porto, E.F. et al., 2017).

In this study there is significant (p=0.001) in time up and go test (TUG) in both groups and one leg stance (OLS) in study group. So significant effect of whole body vibration training on mobility screening tests in chronic obstructive pulmonary disease patients.

Complementary to these finding our study also supported by study of Mkacher W et al., 2014 have found that rehabilitation and physical activity improve balance in COPD patients in time up and go test (TUG) and one leg stance test (OLS).

The current study’s findings back up to those Furness T et al., 2014 who supported that whole body vibration (WBV) improve of functional performance in people with COPD as measured by time up and go test (TUG). These results of this study were coincided with results of many studies as study of Suresh Babu Reddy A, 2020 who revealed that pulmonary rehabilitation with balance improved on time up and go test (TUG) in patient with moderate COPD.

In line with pervious research Öztürk M et al., 2018, we found that pulmonary rehabilitation improved performance on time up and go test (TUG) and one leg stance test (OLS) in COPD patients.

According to Camila D. C. Neves et al., 2018, whole body vibration training (WBVT) had no effect on time up and go test (TUG), inflammatory biomarkers and white blood cell count but did affect 6 minute walking (6 MWD) and hand grip strength significantly.

V- CONCLUSION

The following could be compromised given the study’s limitations:

- Whole body vibration training used in COPD patient’s to help them to improve their dynamic balance.
The time up and go test TUG and one leg stance test OLS have been improved. The study findings could be put to use in a variety of ways:

1- When designing a chronic obstructive pulmonary disease rehabilitation programme, take balance assessment into account.

2- The use of whole body vibration as a management tool for COPD patients is highly recommended.

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