Evaluation of the Effects of Home-Based Deep Breathing Exercises in Parkinson’s Disease Patients

Parkinson Hastalarında Evde Yapılan Derin Solunum Egzersizlerinin Etkilerinin Değerlendirilmesi

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ABSTRACT
Objectives: The aim of our study was to investigate the effects of home-based deep breathing exercises (DBEs) on pulmonary functions and fatigue in patients with mild and moderate stages of Parkinson’s disease (PD).

Method: This study included 24 patients diagnosed with idiopathic PD in the Neurology Department at Dokuz Eylül University Hospital. The subjects were assigned to 15 repetitive DBEs 3 times a day for 12 weeks. The patients’ pulmonary function test results and fatigue were evaluated before and after a 12-week DBE program.

Results: After a 12-week BDE program, an increase was determined in the forced expiratory volume in 1 second (FEV1), forced vital capacity (FVC), peak expiratory flow (PEF) and maximum voluntary ventilation (MVV) (p<0.05). There was a decrease in the patients’ fatigue levels after the breathing exercises (p <0.05).

Discussion: Home-based DBEs improved pulmonary function test results and fatigue in patients with mild to moderate PD. Therefore, we consider that DBEs which can be easily performed in any environment and do not require any equipment should be recommended to all patients with PD to improve respiratory functions and fatigue.

Key words: Parkinson’s disease, pulmonary function test, deep breathing exercise, fatigue

OZET
Amacı: Bizim çalışmamızın amacı, hafif ve orta evredeki Parkinson hastalarında evde yapılan solunum egzersizlerinin pulmoner fonksiyonlar ve yorgunluk üzerindeki etkilerini araştırmaktır.


Bulgular: 1. saniye zorlu expiratuvar volümü (FEV1), zorlu vital kapasite (FVC), pik ekspiratuvar akışı (PEF) ve maksimum istemli ventilasyon değerlerinde 12 haftalık derin solunum egzersiz programı sonrası artış (MVV) (p<0.05). Derin solunum egzersiz programı sonrası hastaların yorgunluk düzeyi azalmıştır (p <0.05).


Anahtar kelimeler: Parkinson hastalığı, pulmoner fonksiyon testleri, derin solunum egzersizleri, yorgunluk

Introduction

Parkinson’s disease (PD) is a progressive motor extrapyramidal disorder dominated by a movement disorder and postural abnormalities associated with central dopaminergic cell loss (1). Respiratory problems are a common feature of the disease and respiratory complications are the most common cause of death (2,3). The documented pulmonary function abnormalities include obstructive and restrictive defects, respiratory dysrhythmias, and abnormalities in the central ventilatory control (4-8). Pulmonary rehabilitation programs and chest physiotherapy are used to treat the cardio-respiratory problems and to prevent their progression to more significant pulmonary complications. Physiotherapists use various techniques to improve the cardio-pulmonary function in pulmonary rehabilitation or physiotherapy programs for patients with PD (9-11).

Respiratory defects due to postural abnormalities (e.g. simian posture, decreased rib cage mobility, head flexion, decreased extensor tonus) and movement difficulty (e.g. rigidity, difficulty in starting movements, decreased movement amplitude and range of motion) are common features of Parkinson’s disease. These abnormalities can lead to a decrease in chest expansion, limitation of tidal volume, and impaired gas exchange. As a result, patients with Parkinson’s disease often experience shortness of breath, fatigue, and an increased risk of pulmonary complications. Early intervention with pulmonary rehabilitation and chest physiotherapy is essential to maintain respiratory function and quality of life.

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motion, loss of rotation component, freezing) result in increased physical effort while breathing and in fatigue during daily living activities in patients with PD. Besides, an increase in physical effort during breathing results in fatigue. DBEs are an important part of physiotherapy programs for PD patients, and their main goals are to assist both relaxation and removal of secretions, and increase the rib cage mobility and tidal volume so as to increase alveolar ventilation and oxygenation and to reduce physical effort while breathing (12).

Although some studies have examined the effects of physiotherapy or pulmonary rehabilitation programs consisting of combined strength, posture, balance, and breathing exercises on PD patients, to our knowledge, no study has examined home-based DBEs alone in PD patients (13-19). Therefore, we investigated the effects of home-based DBEs on pulmonary functions and fatigue in PD patients with mild to moderate disability.

Method

The study was approved by the local ethics committee and informed consent was obtained from the patients before inclusion. (Ethics committee for human research University Hospital (Protocol Number: 256/2007), Twenty-four idiopathic PD patients (12 male, 12 female) followed in the, Movement Disorder Outpatient Clinic, Department of Neurology at Dokuz Eylul University were included in the study. Patients who had never smoked and who had mild to moderate disability according to the modified Hoehn and Yahr Staging Scale were included in the study. Comorbid lung disease in modified Hoehn and Yahr stage 4 or 5, medication causing pulmonary dysfunction, inability to perform pulmonary function tests (PFTs) due to anatomical abnormalities, and clinical signs of dementia were excluded from the study.

The severity of patients’ disability was assessed using the modified Hoehn and Yahr scale (15) and scores on the motor section (part III) of the Unified Parkinson’s Disease Rating Scale (UPDRS). The patients’ fatigue was evaluated by visual analogue scale (VAS) (0=not tired, 5=moderately tired, 10=extremely tired).

Pulmonary function tests were measured using a hand-held spirometer (Superspiro Micro Medical, Rochester, England) before and after performing the home-based DBEs. The forced expired volume in 1 s (FEV1), forced vital capacity (FVC), FEV1/FVC, and peak expiratory flow rate (PEF) were evaluated. The maximum voluntary ventilation (MVV) was determined with instructions to breathe out and in as quickly and deeply as possible for 12 s (expressed in L/min). Each patient was requested to perform each maneuver three times with at least 1-min rest between each test in the sitting position. The best three technically accepted tests were used to determine pulmonary function parameters. All PFTs measurements were conducted during on period.

The patients performed DBEs (diaphragmatic and localized DBEs) daily for 3 sets of 15 repetitions for 12 weeks at home after they were instructed how to perform DBEs by the same physiotherapist. The patients were instructed to inspire as slowly and deeply as possible through the nose, with at least 3 s of breath holding, and to expire through the mouth in a relaxed manner. They performed apical, chest, abdominal and basal breathing exercises. The patients were encouraged to take each breath deeper than the last for five to ten deep breaths. The patients were telephoned and checked whether they performed the breathing exercises. The patients’ medication type and dose were not changed during the study period.

Measurements related with PFTs, disability and fatigue were performed before the patients were instructed on DBEs and after 12 weeks.

Statistical Analysis. The data were analyzed using the Statistical Package for the Social Sciences for Windows, version 11.0 (SPSS Inc., Chicago, IL). Descriptive statistics include frequency distribution of categorical variables as well as mean and standard deviations for continuous variables. Pulmonary function parameters before and after DBEs were compared using the Wilcoxon signed ranks test. Spearman’s correlation coefficient was used to determine the correlation between severity of motor dysfunction (UPDRS motor scores), the PFTs parameters and fatigue. (“the correlation of fatigue with severity of motor dysfunction (UPDRS motor scores) and PFTs parameters” A p-value of < 0.05 was considered statistically significant.

Results

Twenty-four outpatients (mean age: 67.62±SD 10.72 years) were in Hoehn-Yahr stages 2-3, on stable pharmacological treatment. The mean disease duration was 7.25±SD6.24 years, and the mean body mass index (BMI) was 26.74±SD 4.21 kg/m². Of the patients, 18 took levodopavirus, 20 - dopamine agonists (8 patients took ergot-derived dopamine agonists, 12 patients took non-ergot-derived dopamine agonist), 8 - MAO-B inhibitors, 3 - amantadine and 2 patients received biperiden.

Pulmonary function parameters were expressed as percentages of the predicted values before and after 12 weeks of DBEs. After DBEs, FVC, FEV1, PEF and MVV all increased significantly (p<0.05; Table 1). Patients’ fatigue level significantly decreased after a 12-week DBEs program (p<0.05; Table 1).

No significant difference was observed in the UPDRS motor scores before and after home-based DBEs (p>0.05).

Table 1. Pulmonary function test, fatigue score and UPDRS results in PD patients

<table>
<thead>
<tr>
<th></th>
<th>Before DBE (mean±SD)</th>
<th>After DBE (mean±SD)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>FVC</td>
<td>83.62±16.09</td>
<td>90.00±15.51</td>
<td>0.001</td>
</tr>
<tr>
<td>FEV1</td>
<td>90.20±12.79</td>
<td>96.54±13.59</td>
<td>0.001</td>
</tr>
<tr>
<td>FEV1/FVC</td>
<td>88.16±7.29</td>
<td>97.50±54.19</td>
<td>0.235</td>
</tr>
<tr>
<td>PEF</td>
<td>67.54±17.09</td>
<td>80.20±19.21</td>
<td>0.001</td>
</tr>
<tr>
<td>MVV</td>
<td>77.86±20.73</td>
<td>82.25±21.55</td>
<td>0.006</td>
</tr>
<tr>
<td>Fatigue Score (0-10)</td>
<td>6.86±1.12</td>
<td>5.53±1.24</td>
<td>0.004</td>
</tr>
<tr>
<td>UPDRS</td>
<td>24.64±8.15</td>
<td>25.66±6.97</td>
<td>0.625</td>
</tr>
</tbody>
</table>

* = Percentage predicted, PD= Parkinson’s disease, PFT= pulmonary function test, SD= standard deviation, DBE= deep breathing exercises, FVC= forced vital capacity, FEV1= forced expired volume in the first second, FEV1/FVC= FEV1 as a percentage of FVC, MVV= Maximal voluntary ventilation, UPDRS= Unified Parkinson’s Disease Rating Scale. Boldface p-values are statistically significant.
negative correlations of total motor UPDRS scores with several PFTs parameters, FVC (r = -.519, p < .05), FEV1 (r = -.583, p < .05), PEF (r = -.519, p < .05) and MVV (r = -.724, p < .05) were observed (p < .05).

Between the two sexes, no significant difference was observed in age, BMI, duration of PD, modified Hoehn and Yahr score, or UPDRS motor score (p > .05, Table 2). When the patients were analyzed according to their gender, significant differences in pulmonary function parameters were observed only in PEF measurements but not in others. The males achieved better PEF scores than the females did both before and after DBEs (p < .05, Table 2).

**Discussion**

In the final stages of PD, respiratory problems restrict daily activities of patients; especially pneumonia/influenza is common and patients are three to four times more likely to die from pulmonary complications (4,6,8). However, in the early stages of the disease, although there is physiological evidence of potentially severe pulmonary dysfunctions, most patients do not report respiratory symptoms. Probably this disturbance remains unnoticed because physical disability often leads to a sedentary lifestyle and limits the activities in PD patients. Thus, evaluation and management of respiratory problems that may arise in PD are of great importance.

We, therefore, aimed to evaluate the effect of breathing exercises on patients with PD. In previous studies, pulmonary functions were evaluated after PD patients had inspiratory muscle training or performed aerobic exercises (16-18,20,21). Unlike previous studies, in our study for the first time, the patients were assigned only to DBEs and the effects of the exercises were evaluated. DBEs do not require any equipment, are easy to perform and aim to improve lung expansion through slow and uniform nasal inspiration, followed by relaxed oral expiration. Our patients had mild to moderate disability and 8 patients took ergot-derived dopamine agonists. Our results indicate that home-based DBEs have beneficial effects on FVC, FEV1, PEF and MVV values. This result is explained by the beneficial effects of DBEs on chest wall mobility, lung compliance, and ventilatory efficiency with a consequent increase in respiratory muscle function. These findings are consistent with previous studies which indicated that after a pulmonary rehabilitation program, an improvement was observed in some of the PFTs parameters (5,22). In addition, fatigue levels in our patients significantly decreased after breathing exercises. Although it has been reported that fatigue seen in several diseases improves with breathing exercises (23), there are no studies evaluating fatigue after breathing exercises in PD. Decreases in fatigue level enable a person to perform daily activities more easily and make the person more active.

A simple spirometric measurement appears to be a convenient method for the evaluation of the patients’ airways and respiratory muscle effort (5,20-22). We, too, employed the simple spirometric measurement in our study and evaluated the PFT parameters. Since FEV1 and FVC parameters were above 80%, lung function tests were considered normal in our study. The reason why the pulmonary function test results were normal in our study might be due to the fact that patients’ disabilities were mild and that the measurements were performed during the “ON” stage (23). When the results in our study were evaluated in terms of gender, there were differences only in PEF scores of the PFTs parameters (the PEF scores were better in males than in females). On the other hand, Pal et al. (24) reported that women had significantly lower predicted values of FVC, FEV1 and MVV, and a higher prevalence of severe restrictive pulmonary dysfunction compared to men.

In our study, an inverse correlation was determined between the levels of disability and PFTs parameters. Correlation analysis between clinical disability and PFTs parameters revealed a significant association. All PFTs parameters were found to decrease in parallel with the increase in the severity of the disease, which is consistent with the findings of previous studies indicating that PFTs scores worsened as the level of disability increased. In our study, although patients’ clinical disability levels did not change, an improvement was observed in their PFTs parameters, which suggests that home-based DBEs had beneficial effects.

PD patients cannot adhere to exercise programs due to movement difficulty and fatigue patterns. However, this issue is of the utmost importance for a successful physiotherapy. Our study showed that only home-based DBEs without any equipment could improve respiratory functions and fatigue levels. We think that this result is important to reduce adverse effects of postural abnormalities on respiratory functions, fatigue levels and on functionality of patients.

**Conclusion**

Our findings suggest that performing home-based DBEs has beneficial effects on respiratory function and fatigue in PD patients with mild to moderate disability. Therefore, we consider that DBEs which can be easily performed in any environment and do not require any equipment should be recommended to all patients with PD to improve respiratory functions and fatigue.

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**Table 2. Comparison of characteristics of the patients according to gender**

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>67.75±10.48</td>
<td>67.50±11.41</td>
<td>0.799</td>
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<tr>
<td>BMI (kg/m²)</td>
<td>26.94±4.34</td>
<td>26.55±4.26</td>
<td>0.551</td>
</tr>
<tr>
<td>Duration of PD (years)</td>
<td>5.75±4.09</td>
<td>8.75±7.73</td>
<td>0.410</td>
</tr>
<tr>
<td>UPDRS</td>
<td>26.25±8.86</td>
<td>23.04±7.39</td>
<td>0.378</td>
</tr>
<tr>
<td>Modified Hoehn-Yahr score</td>
<td>2.33±0.51</td>
<td>2.25±0.45</td>
<td>0.820</td>
</tr>
<tr>
<td>Before DBEs PEF*</td>
<td>59.25±14.90</td>
<td>75.83±15.44</td>
<td>0.012</td>
</tr>
<tr>
<td>After DBEs PEF*</td>
<td>71.08±16.71</td>
<td>89.33±17.63</td>
<td>0.012</td>
</tr>
</tbody>
</table>

BMI= body mass index, PD= Parkinson’s disease, UPDRS= Unified Parkinson’s Disease Rating Scale,

DBEs= deep breathing exercises, PEF= peak expiratory flow.

*= Percentage predicted.

Boldface p-values are statistically significant.
References