The Effect of Pulmonary Rehabilitation Program on Work Productivity and Clinical Parameters in Patients with Ankylosing Spondylitis

Abstract

Objectives: The objective of the present study was to investigate the effect of the Pulmonary Rehabilitation Program on work productivity, disease activity, functional status, quality of life, Respiratory Function Tests (RFTs), physical capacity,and depression in Ankylosing Spondylitis (AS) patients.

Method: Twenty-five patients diagnosed with AS were included in the study. The disease severity was evaluated with Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), functional status was evaluated with Bath Ankylosing Spondylitis Functional Index (BASFI), and quality of life was evaluated with AS-Related Quality of Life scale (ASQOL). Physical capacity was evaluated with the 6-Minute Walking Test (6MWT), depression level was evaluated with Beck Depression Scale (BDS),and work productivity was evaluated with Spondyloartropathy Work Productivity and Activity Impairment (WPAI-SpA) Survey. RFT was evaluated with spirometry measurement. The patients were included in the Pulmonary Rehabilitation Program for 8 weeks.

Results: A total of 30% of the patients who were included in the study were unemployed; 35% of them were on and below hunger limit; 25% were on and below poverty line; and 40% were on normal income line. No significant changes were detected in the RFTs after the exercise program in AS patients ($p > 0.05$), but significantly improvements were detected in the BASDAI, BASFI, WPAI, 6MWT, ASQOL and BDS scales ($p < 0.001$).

Conclusion: Pulmonary Rehabilitation Program was found to be an effective method of improving work productivity in AS patients. Also, the Pulmonary Rehabilitation Program has positive effects on disease activity, functional status, physical capacity, depression level, and quality of life.

Keywords: ankylosing spondylitis, disability, work productivity, rehabilitation, exercise

What is already known about this topic?

- **Pulmonary rehabilitation positively affects disease activity, functionality, physical capacity, depression and quality of life.**

What does this article add?

- **Unemployment rates in AS patients are higher than in the population.**
- **Pulmonary rehabilitation is an effective method to increase work productivity.**

Introduction

Ankylosing Spondylitis (AS) is a chronic, progressive, inflammatory and rheumatic disease that is characterized by axial and sacroiliac joint involvement [1]. Symptoms usually begin in late adolescent period or during early adulthood. It is more common in men than in women. It often presents with inflammatory low back pain and morning stiffness [2]. It involved primarily the spine and root joints; and decrease in physical activity, fatigue, sleep disturbance, and deterioration in emotional state are common in disease course. Extra-articular findings can be seen at varying rates, and may significantly contribute to mortality and morbidity. The most common pulmonary involvement in AS patients was reported to be respiratory dysfunction of the secondary type because of apical lobe fibrosis, interstitial pulmonary involvement, pleural effusion and decrease in chest mobility [3]. There may be restrictions in daily life activities because of factors such as pain, joint movement restrictions, and dyspnea due to pulmonary involvement [4]. Although there are rapid improvements in pharmacological treatment methods, exercise and physical therapy are still an important part of the treatment [5].

AS affects business life since it starts in the early years of life, and can cause serious costs and socioeconomic effects [6]. Business problems are more common in patients with AS than in normal population [7, 8]. AS was reported as the reason for changing the profession of some patients, reducing working hours or limiting career progression [7, 9]. It was reported that patients have decreased work productivity compared to general population, and several studies investigated related factors [10, 11]. However, there are no sufficient data on how to improve business efficiency. The objective of the present study was to investigate the effect of Pulmonary Rehabilitation Program on work productivity, disease activity, respiratory functions, daily life activities and depression in AS patients.

Materials and Methods

The study was conducted in the Pulmonary Rehabilitation Unit of xxxx University Medical Faculty Physical Medicine and Rehabilitation Clinic between December 2018 and June 2019. A total of 25 patients between the ages of 18 and 65 who were diagnosed with AS according to modified New York criteria were included in the study. Patients with additional respiratory and cardiac diseases such as coronary artery disease, heart failure, chronic obstructive pulmonary disease, and those with another rheumatic disease other than AS, those with any disease that would prevent them from participating in the rehabilitation program (e.g. psychiatric or neurological diseases) were not included in the study. The approval was obtained from the Local Ethics Committee before the study was initiated, and the study was conducted according to the Helsinki Declaration. Two patients were excluded from the study because of changing drug therapy, 2 patients were excluded because they could not have permission from their workplaces, 1 patient was excluded because he did not continue the exercise program; and therefore, the study was completed with 20 patients.

All patients were given detailed information about the Pulmonary Rehabilitation Program, and the informed consent forms were received. Physical examinations and clinical evaluation scales of all patients were done by the same physical therapy specialist before and after the rehabilitation program (in week 8).

The sociodemographic data such as age, gender, height, weight, income status of all patients who participated in the study were questioned and recorded. The annual income status was evaluated as hunger limit, poverty line, and normal limit, according to the Confederation of Trade Unions Report [12].

The Pulmonary Rehabilitation Program

The participants underwent the Pulmonary Rehabilitation Program 3 days a week for 8 weeks in addition to the clinical treatment and recommendations for AS. Before starting the Pulmonary Rehabilitation program, the patients were informed about general precautions such as exercise habits and smoking. Then, the patients were taught to practice pursed lips breathing, bending forward posture, diaphragmatic respiration (abdominal respiration), and relaxation exercises, which are known as controlled breathing techniques, were taught to the patients in a practical manner.

In the pursed lips breathing, the patient breathes from his/her mouth for a few seconds, and then slowly exhales from his mouth in a whispering manner. The patient sits in the forward bending position (in 20-45-degree forward-tilt position according to the vertical axis), and in this way practices the pursed lips breathing.

In the diaphragmatic breathing technique, the patient lying in a supine position puts his/her dominant hand in the upper-middle on the abdomen, and the non-dominant hand on the front-upper part of the chest inhaling from the nose and gradually exhaling with pursed lip breathing. During this, the hand lying on the chest does not move as much as possible, and the

diaphragm is tried to move as loosely as possible towards the abdomen. During the inspiration, the patient feels that the abdomen rises even though the chest cage is standing still. The patients were requested to apply controlled respiratory techniques at home as twice a day with 10-15 repetitions.

The exercise program that consisted of respiratory muscles exercises, upper extremity-shoulder exercises and endurance (resistance aerobic) exercises was implemented to the patients. Gravitational resistance exercises with 1-2 kg weights were done 3 times a week for 20-30 minutes under the supervision of physicians and physiotherapists to train the upper extremity-shoulder muscles (subclavius, pectoralis major and minor, serratus anterior, upper and lower part of trapezius, latissimus dorsi, sternocleidomastoid muscles).

The aerobic exercise program was applied 3 times a week as 8 weeks with the Ergoline brand Ergoselect 200 Reha model Bicycle Ergometer Device as 5 minutes warm-up step, 20-30 minutes training step, and 5 minutes cooling step.

The aerobic exercise training was started submaximally to 70-85% of the maximal heart rate of the patient to coincide with the 12-16 range of fatigue severity that patients perceived according to the Borg Scale. The aerobic exercise resistance and duration were increased according to the tolerance of the patient. Vital signs such as Blood Pressure (BP), Heart Rate (HR), and SpO2 were monitored with monitoring systems connected to the Bicycle Ergometer Device during the aerobic exercise training.

Physical Capacity

The exercise capacity measurement of the patients was performed with 6-Minute Walking Test (6MWT). The patients who rested for 10 minutes before the test walked in a specially marked 20-m corridor. After 6 minutes, the distance was recorded in meters [13].

Respiratory Function Test

The Respiratory Function Tests (RFT) of the patients were done with Viasys Vmax Spectra 229 brand spirometer device, while they were in a position sitting upright while the nose was closed with a nose clamp. The Forced expiration volume at the first second (FEV1) and forced vital capacity (FVC), FEV1/FVC (%) values from dynamic ventilation tests were recorded. The measurements were made in line with the recommendations of the American Thorax Association, and all spirometry measurements were performed by the same technician [14].

Evaluation of the Work Productivity

Work productivity was evaluated with Spondyloartropathy Work Productivity and Activity Impairment Survey (WPAI-SpA). WPAI-SpA is used to evaluate the effect of AS on work and daily activities over the last 7 days, and consists of 6 questions [15]. Absenteeism, presenteeism, overall work impairment and daily activity impairment are the main components of WPAI. Presenteesim refers to the decrease in business productivity or performance because of health problems. Absenteeism refers to the inability of people to continue their work because of the disease.

The life quality of the patients was evaluated with Ankylosing Spondylitis Quality of Life Scale (ASQOL), and the disease activity was evaluated with Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), and the functional status was evaluated with Bath Ankylosing Spondylitis Functional Index (BASFI) [16, 17]. Beck Depression Scale (BDS) was used to evaluate the depression status of the patients.

Statistical analysis

The SPSS (Statistical Package for Social Sciences) for Windows 15.0 Program was used for statistical analyses when the findings were evaluated. The clinical parameters were

evaluated twice as before and after the treatment. The “One Samples T test” was used to calculate the group averages, and the “Paired Sample T Test” was used to compare the data before and after the treatment. The data were expressed as mean ± standard deviation. The statistically significance limit was considered as $p < 0.05$.

Results

The study was completed with 20 patients. The mean age of the 20 AS patients included in the study was 41.5 ± 10.8 years, disease duration was 81.5 ± 11.5 months, and the mean Body Mass Index was 27.5 ± 3.8kg/m^2. Five of the patients were at and below hunger limit, 7 were on poverty line, and 8 were on normal income limits. A total of 14 of the patients were working, and six were unemployed. The sociodemographic data of the patients are shown in Table 1.

Significant improvements were detected in pre- and post-treatment comparisons in the BASFI, BASDAI and ASQOL scales ($p < 0.001$, for all). The mean 6MWT scores increased significantly after the treatment compared to before treatment values ($p < 0.001$). The WPAI scale scores were also significantly improved after the treatment in the 4 sub-group mean values ($p < 0.001$, for all). Statistically significant improvements were detected in BDS scores at the end of the treatment, and there was an increase in FEV1, FVC and FEV1/FVC values, but no statistically significant improvements were detected in this respect (Table 2).

Discussion

We investigated the effectiveness of the 8-week Pulmonary Rehabilitation Program on work productivity, disease activity, functionality, daily life activities and depression in AS patients and found improvements in all parameters in this study. Since AS affects especially young people in productive age, there are several studies on labor loss and work productivity in these patients. In their study, Barlow et al. reported that 31% of AS patients were unable to

work because of their disease, and 15% had to make changes because of AS, such as reducing working hours or changing jobs [18]. Similarly, in our study, 30% of the patients stated that they were unable to work because of their disease. It was 2.17-fold more than official unemployment rates (13.8%) [19]. Similar to our study, a study that was conducted in the Netherlands also found that the unemployment rate was approximately 3-fold of the normal population in AS patients [20]. Regarding these high rates, there are decreases in the workforce and economic losses. In their study, Ariza et al. reported labor loss because of AS to be 25%, and Forejtova et al. found that 30% of patients had permanent job losses [21, 22]. In our study, 70% of the patients were working, and 30% were unemployed. These high rates cause significant costs and socioeconomic effects.

In AS patients, pulmonary involvement is one of the most common extra-articular findings. The frequency of pulmonary involvement was reported to be between 20-57% with spirometry, and 40-80% with High-Resolution Computed Tomography [23]. Both pulmonary involvement and muscular involvement may end up with reduced functional exercise capacity [24]. In AS patients, positive effects of pulmonary rehabilitation on pain, disease activity and functionality were shown in previous studies. Ortancil et al. applied 6-week home-based exercise program on 22 patients, and detected an increase in chest expansion and functionality in patients at the end of 6 weeks, but did not detect any significant improvement in 6MWT [25]. It was found in our study that there were significant improvements in disease activity, functionality, and 6MWT. This difference might have occurred due to the fact that the exercises were done under supervision, not home-based, and the rehabilitation program was carried out for 8 weeks in our study. Supervised exercise programs were found to be superior to home-based exercise programs in many previous studies [26]. Durmus et al. conducted a study with a 12-week exercise program, and found significant improvements in BASDAI, BASFI, 6MWT and pulmonary function parameters compared to their control group [27].

Similarly, BASDAI, BASFI and 6MWT were significantly improved in our study. Although increases were detected in FEV1, FVC and FEV1/FVC values, these were not a statistically significant levels, which may be associated with the small number of patients included in this study.

AS patients can be seen in mood disorders at varying rates; however, many studies focused on physical health rather than psychological health [26]. Compared to the initial values in their study, Karapolat et al. detected significant decreases in BASDAI and BASFI scores as a result of 8-week Pulmonary Rehabilitation Program, but did not detect any significant changes in BDS scores [28]. In our study, significant decreases were detected in BDS scores. This difference may have occurred due to the fact that the BDS scores were initially high in our patient group compared to those in the study of Karapolat et al. Since increased disease activity and decreased functionality are associated with quality of life in AS patients, psychosocial conditions must be considered when patients are evaluated.

There are no studies conducted on the effect of rehabilitation programs on work productivity in AS patients. Previous studies showed that elevated disease activity scores and low functional condition are associated with low work productivity [29]. In our study, an increase was detected in work productivity with the 8-week Rehabilitation Program. This increase may be associated with decreased disease activity and increased functionality. Also, there might have been an increase in the motivational levels of people with the decrease in depression scores. Decreased depression levels and increased quality of life scores may be the possible cause of the increase in work productivity. For this reason, we believe that rehabilitation programs must be used more often to decrease the use of healthcare resources and to increase work productivity and activity levels.

This study had some limitations; the number of patients was relatively low, and the measurements of the patients were made before and after the rehabilitation program. For this

reason, long-term follow-up was not performed. Another limitation was that, the number of male patients was more than that of women, which is the case in many studies. There is need for future studies to be conducted with a wider number of patients with longer-term follow-up.

As a conclusion, it was found that the 8-week Pulmonary Rehabilitation Program applied to AS patients had positive effects on work productivity, disease activity, functional status, depression, and pulmonary functions.

Ethics Approval: Ethics Committee approved the study protocol.

Conflict of interest: The authors did not report any conflict of interest.

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Table 1. The sociodemographic data of the Ankylosing Spondylitis patients

Age (years) (Mean±SD†,)	41.5 ± 10.8
Disease duration (month) (Mean±SD†)	81.5 ± 11.5
Marital Status	
Married (n/%)	18/ 90
Single (n/%)	2/ 10
Gender	
Male (n/%)	17/85
Female (n/%)	3/15
Medication	
Anti TNF-α‡ (n/%)	8/40
NSAID§ (%)	12/60
Smoking	
Yes (n/%)	7/35
No (n/%)	13/65
Income Status	
Hunger limit (n/%)	5/ 25
Poverty limit (n/%)	7/ 35
Normal (n/%)	8/ 40
Working status	

Working (n/%)	14/ 70
Not working (n/%)	6/ 30

†: Standard Deviation, ‡: Anti-Tumor Necrosis Factor-Alpha, §:Nonsteroidal Anti-Inflammatory Drug

Table 2. Comparison of clinical parameters before and after the treatment of Ankylosing Spondylitis patients

n = 20	Before treatment Mean ± SD	After treatment Mean ± SD	*P*
BASFI†	2.8 ± 0.9	0.6 ± 0.1	*< 0.001*
BASDAI‡	4.2 ± 0.8	1.7 ± 0.2	*< 0.001*
ASQOL §	9.2 ± 0.3	2.6 ± 0.2	*< 0.001*
FEV 1¶	99.0 ± 13.2	101.5 ± 11.8	*0.335*
FVC[a]	105.7 ± 10.3	106.2 ± 7.9	*0.808*
FEV1/FVC	77.5 ± 5.2	81.5 ± 9.2	*0.196*
6 MWT[b]	529.2 ± 70.0	642.7 ± 54.8	*< 0.001*
WPAI-1 [c]	5.5 ± 0.3	1.4 ± 0.2	*< 0.001*
WPAI-2	53.7 ± 16.8	16.5 ± 8.9	*< 0.001*
WPAI-3	26.8 ± 1.3	11.2 ± 0.6	*< 0.001*
WPAI-4	45.2 ± 13.4	13.9 ± 7.7	*<0.001*
BDS [d]	12.4 ± 8.2	7.4 ± 0.5	*< 0.001*

†: Bath Ankylosing Spondylitis Functional Index; ‡: Bath Ankylosing Spondylitis Disease Activity Index; §: Ankylosing Spondylitis Quality of Life Survey; ¶: Volume at first second of forced expiration; [a]: Forced Vital Capacity: [b]:6-Minute Walking Test; [c]: Survey on Work Productivity and Decrease in Activities (WPAI 1: Lost work time due to health problems; WPAI 2: Decrease in work productivity, WPAI 3: Decrease in total work force, WPAI 4: Decrease in daily activities); [d]: Beck Depression Scale