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Evaluation of Pulmonary Functions and Aerobic Capacity in Patients with Ankylosing Spondylitis and Rheumatoid Arthritis

Ankilozan Spondilit ve Romatoid Artritli Hastalarda Pulmoner Fonksiyonların ve Aerobik Kapasitenin Değerlendirilmesi

Damla CANKURTARAN,[a]
Eda GÜRÇAY,[a]
Özgür Zeliha KARAAHMET,[a]
Ebru KARACA UMAY,[a]
Aytül ÇAKCI[a]

[a]Clinic of Physical Medicine and Rehabilitation,
Ankara Dışkapı Yıldırım Beyazıt Training and Research Hospital, Ankara

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Yazışma Adresi/*Correspondence:*
Eda GÜRÇAY
Ankara Dışkapı Yıldırım Beyazıt Training and Research Hospital, Clinic of Physical Medicine and Rehabilitation, Ankara, TURKEY/TÜRKİYE
dredagurcay@gmail.com

ABSTRACT Objective: Ankylosing spondylitis (AS) and rheumatoid arthritis (RA) are chronic inflammatory diseases that mainly involve the musculoskeletal system but also affect the cardiovascular and pulmonary systems. In this study, we aimed to compare pulmonary functions and aerobic capacities of healthy controls with AS and RA patients, and to investigate the effects of disease-specific evaluation parameters and quality of life on pulmonary functions and aerobic capacity. **Material and Methods:** This cross-sectional study included 87 participants including AS (n=36), RA patients (n=27) and healthy controls (n=24). Patients were evaluated for disease activity, functional status and quality of life. In addition, 6-minute walking test (6-MWT), exercise tolerance test and ergospirometric procedure were performed to determine exercise tolerance and functional capacities of patients and healthy controls. **Results:** Forced expiratory volume in one second (FEV1), forced vital capacity (FVC), peak oxygen uptake (VO2 peak) and 6-MWT values were higher in healthy subjects than in AS and RA patients. In regression analysis, it was seen that the most effective factor on FEV1 and FVC in AS patients and on VO2 peak values in RA patients was the age. In AS patients, spinal mobility and thoracic expansion were associated with pulmonary functions and functional status was asscociated with aerobic capacity. In RA patients, the only factor associated with pulmonary function and aerobic capacity was determined as the physical function. **Conclusion:** Pulmonary functions may be adversely affected in rheumatic diseases. The negative effects of musculoskeletal system limitations on the pulmonary system and the positive reflections of functional well-being demonstrate the benefits of physical activity and emphasize the importance of aerobic exercises, especially in RA patients with low aerobic capacity.

Keywords: Ankylosing spondylitis; rheumatoid arthritis; pulmonary function; aerobic capacity; quality of life

ÖZET Amaç: Ankilozan spondilit (AS) ve romatoid artrit (RA) temelde kas iskelet sistemini tutan ama yanı sıra kardiovasküler ve pulmoner sistemleri de etkileyebilen kronik inflamatuar hastalıklardır. Bu çalışmada, AS ve RA tanılı hastalar ile sağlıklı kontrollerin solunum fonksiyonları ve aerobik kapasitelerini karşılaştırmak, hastalığa özgü değerlendirme parametrelerinin ve yaşam kalitesinin solunum fonksiyonları ve aerobik kapasite üzerine etkilerini incelemek amaçlanmıştır. **Gereç ve Yöntemelr:** Kesitsel tipteki bu çalışma AS (n=36), RA (n=27) tanısı almış hastalar ve sağlıklı kontrollerden (n=24) oluşan 87 katılımcıyı kapsamaktadır. Hastalar, hastalık aktivitesi, fonksiyonel durum ve yaşam kalitesi bakımından değerlendirildi. Yanı sıra hastaların ve sağlıklı kontrollerin egzersiz toleransını ve fonksiyonel kapasitelerini belirlemek amacıyla 6-dakika yürüme testi (6-DYT), egzersiz tolerans testi ve ergospirometrik uygulama yapıldı. **Bulgular:** Sağlıklı bireylerde, AS ve RA hastalarına göre bir saniyede zorlu ekspiratuar hacim (FEV1), zorlu vital kapasite (FVC), pik oksijen alım miktarı (VO2 peak) ve 6-DYT değerleri daha yüksekti. Regresyon analizinde; AS hastalarında FEV1 ve FVC, RA hastalarında VO2 peak değerleri üzerinde en etkili faktörün yaş olduğu görüldü. AS hastalarında, spinal hareketlilik ve torasik genişleme pulmoner fonksiyonlarla, fonksiyonel durum ise aerobik kapasite ile ilişkiliydi. RA hastalarında, pulmoner fonksiyon ve aerobik kapasite ile ilişkili tek faktör fiziksel fonksiyon olarak belirlendi. **Sonuç:** Romatizmal hastalıklarda pulmoner fonksiyonlar olumsuz etkilenebilir. Kas iskelet sistemindeki kısıtlılıkların pulmoner sistem üzerindeki negatif etkileri ve fonksiyonel iyilik halinin olumlu yansımaları fiziksel aktivitenin yararını ortaya koymakta ve özellikle düşük aerobik kapasiteli RA hastalarında aerobik egzersizlerin önemini vurgulamaktadır.

Anahtar Kelimeler: Ankilozan spondilit; romatoid artrit; pulmoner fonksiyon; aerobik kapasite; yaşam kalitesi

Ankylosing spondylitis (AS) and rheumatoid arthritis (RA) are chronic, systemic inflammatory diseases with uncertain etiology. AS mainly affects axial skeleton and sakroiliac joints as well as peripheral joints. Typical disease characteristics are inflammatory back pain and reduced spinal mobility, which may lead to structural and functional impairment. Extraarticular manifestations in AS include uveitis, bowel disease, cardiovascular diseases (CVDs) and pulmonary abnormalities.[1,2] Pulmonary involvement, primarily represented by intestinal lung disease or restricted lung function, is often associated with bony ankylosing of the thoracic vertebrae, costovertebral, costosternal, and manubriosternal joints results in limitation of chest wall expansion.[3]

RA particularly affects joints and results in possible deformity, and limited pyhsical function. The symptoms of RA may be unpredictable due to the alleviation or exacerbation of the disease, which may have a significant effect on the patients' daily lives.[4] The disease is associated with increased mortality especially in relation to the CVDs due to underlying inflammatory process.[5] Patients with RA avoid physical activity due to primary effect of disease, pain and fatigue. Physical inactivity is known to have harmful effects on cardiovascular and pulmonary systems by decreasing muscle strength, blood volume, and aerobic capacity.[6-8] Restrictive or obstructive pulmonary involment can individuated by pulmonary function tests (PFT). Aerobic capacity can be tested by different exercise tests which evaluate pyhsical working capacity of individuals, is valuable for activity counseling, exercise prescription, or disability asessment.[9,10]

The objectives of this study were to compare pulmonary functions and aerobic capacities of healthy controls with AS and RA patients, and to determine the effects of disease-specific evaluation parameters including mobility, disease activity, and functional disability as well as quality of life on pulmonary functions and aerobic capacity.

MATERIAL AND METHODS

This cross-sectional study was carried out with 87 participants in our clinic between January 2015 and April 2016. There were 36 patients with AS, 27 with RA, and 24 healthy subjects as control group. All patients met case criteria for their respective diagnoses.[5,11]

This study included subjects aged between 18-65 years who were clinically and laboratory stable (had not undergone drug changes in the last 6 months). The patients who underwent surgery, used corticosteroids and performed regular exercise in the last six months, had co-existent cardiac or pulmonary disease (like asthma, chronic bronchitis, or emphysema), systemic organ involvement, or had disease activity that prevent performing exercise on the treadmill were excluded.

The protocol was explained to all participants, and informed consent was obtained at the beginning of the study. The ethics committee of the Institute approved the study protocol, and all procedures were performed in compliance with the Helsinki Declaration.

Demographic data concerning age, gender, disease duration, working and marital situations, body mass index (BMI), and smoking status were recorded for both patients and controls.

The Bath Ankylosing Spondylitis Disease Activity Index (BASDAI), the Bath Ankylosing Spondylitis Functional Index (BASFI), and the Bath Ankylosing Spondylitis Metrology Index (BASMI) were used to assess disease activity, disease-related functioning and spinal mobility, respectively.[12-14] In addition, chest expansion was measured, and patients were divided into two groups with chest expansion below 4 cm or above.

Disease Activity Score-28 (DAS-28) was used to assess clinical disease activity of patients with RA.[15] Stanford Health Assessment Questionnaire (HAQ) was used to assess functional disability.[16] Participants' quality of life was evaluated by SF-36 Health Survey (SF-36).[17]

Six-minute walking test (6-MWT) was performed as follow: participants walked up and down a 30-m hallway for a period of six minutes at their own pace. Patients were permitted to stop and rest and were instructed to continue walking as soon as they felt able to do so. The distance walked by each subject was recorded in meters.[18]

A computerized spirometry was used to determine the subjects' pulmonary functions; the forced expiratory volume in one second (FEV1), forced vital capacity (FVC) and FEV1/FVC values.

Exercise tolerance test (ETT) was performed to all participants in order to determine aerobic capacity on treadmill ergospirometry system (Care Fusion Type Master Screen-CPX) with Bruce protocol. Before exercise testing, each subject was familiarized with the testing procedure and treadmill. All participants were instructed to refrain from ingesting food or caffeine or using tobacco products within three hours. A nose clip was applied and the subjects allowed to breathe through a mouthpiece. The mouthpiece has a valve system to allow inspired air to enter and expired air to be expelled through separate channels. This system was connected to breath- by- breath gas analyzing system and calibration with known gas concentration and volumes before each test. A 12 channel electrocardiography (ECG) was performed at rest and during ETT. Blood pressure readings were taken at the baseline and at the end of the test. The exercise was stopped if the patient developed chest pain or any limiting symptoms (dizziness, leg fatigue, etc.), or in the event of ECG changes, such as runs of three or more successive ventricular extrasystoles or more than six ventriculary extrasystoles in one minute, ST depression >3 mm, and excessive increase (>230 mmHg) or significant drop (>30 mmHg) in systolic blood pressure. At the end of the test, we asked all participants for their reasons to stop exercise. Peak oxygen consumption (VO2 peak), peak heart rate (HR peak) and peak respiratory exchange ratio (RER) which is the carbon dioxide ratio production to VO2, were defined as the highest values achieved during test. Anaerobic threshold (AT), the VO2 at which aerobic metabolism is significantly supplemented by anaerobic metabolism, was determined using the V-slope method.[19]

STATISTICAL ANALYSIS

The data were analyzed using the SPSS for Windows 20.0 software package. The Shapiro-Wilks test was used to investigate whether the continuous variables are distributed according to the normal distribution. The descriptive statistics were shown in the form of mean±standard deviation for the continuous variables, and % for the nominal variables. The significance of the difference between the groups in terms of the non-normally distributed continuous variables was examined using the Mann-Whitney U test in the two-group comparisons and Kruskal Wallis test in the three-group comparisons. The Fisher's Exact test was used for the nominal variables. The relationships of FEV1, FVC, FEV1/FVC, VO2 peak and 6-MWT with the other parameters in the patient groups were examined with the Pearson's correlation test for the nominal variables and Spearman's correlation test for the continuous variables. Multiple logistic regression analysis was applied for the correlations that were found to be significant. Factors that may affect FEV1, FVC and VO2 peak were recorded as beta (b) coefficient, 95% coefficient interval (CI) and p-value, and the effect of one unit decrease was evaluated for these parameters. Results of $p<0.05$ were considered statistically significant.

RESULTS

Demographic characteristics of patients with AS, RA and control group are presented in Table 1. The patients with RA were significantly older than the other two groups. Disease duration was 10.77±7.56 years for AS and 10.66±8.65 years for RA. Chest expansion was <4 cm in 9 (25%) and ≥4 cm in 27 (75%) patients.

PFT and ETT results of AS, RA patients and the control group are demonstrated in Table 2. FEV1 and FVC values were significantly higher in the control group than patient groups (AS, p=0.048, p=0.011; RA, p=0.008, p=0.015, respectively). FEV1/FVC ratio was significantly higher in AS group than RA (p<0.001) and control group (p<0.001). VO2 peak values in the control group were significantly higher than AS (p=0.042) and RA (p<0.001) patients as well as in AS group than RA group (p=0.007). The control group had significantly better results than both patient groups for 6-MWT which was due to the difference between control group and RA patients (p=0.009).

TABLE 1: Demographic characteristics of patients with AS, RA and control groups.

	AS group mean±SD, N (%)	RA group mean±SD, N (%)	Control group mean±SD, N (%)	p value
Age (years)	40.3±9.86	51.71±9.97	41.5±11.58	<0.001
Gender				
Female	18 (50)	19 (70.4)	13 (54.2)	0.211
Male	18 (50)	4 (29.6)	11 (45.8)	
Working status				
Work	20 (55.6)	10 (37.0)	18 (75)	0.949
Non-work	16 (44.4)	17 (63)	6 (25)	
Marital status				
Married	32 (88.9)	19 (70.4)	17 (70.8)	0.142
Single	4 (11.1)	8 (29.6)	7 (29.2)	
BMI (kg/m^2)				
Normal	20 (55.6)	7 (25.9)	13 (54.2)	
Overweight	10 (27.8)	14 (51.9)	6 (25.0)	0.114
Obese	6 (16.7)	6 (22.2)	5 (20.0)	
Smoking status				
Current smoke	12 (33.3)	6 (22.2)	8 (33.3)	
Ex-smoke	6 (16.7)	7 (25.9)	3 (12.5)	0.782
Non-smoke	18 (50)	14 (5.9)	13 (54.2)	

AS: Ankylosing spondilitis; RA: Rheumatoid artrihitis; SD: Standard deviation; BMI: Body mass index; A value of p<0.05 was considered statistically significant.

TABLE 2: Pulmonary function and exercise tolarence tests results.

PFT-ETT	AS group mean±SD	RA group mean±SD	Control group mean±SD	p value
FEV 1 (L)	2.86±0.80	2.67±0.65	3.31±1.21	**0.026**
FVC (L)	3.23±1.05	3.22±0.99	3.95±1.11	**0.020**
FEV 1/FVC (%)	89.69±9.40	81.13±9.21	80.63±7.37	**<0.001**
VO2 peak (mL/kg/min)	24.38±6.11	20.31±5.05	27.57±6.38	**<0.001**
6 MWT (m)	558.00±83.53	515.03±100.35	579.25±70.29	**0.025**

PFT: Pulmonary function tests; ETT: Exercise tolerance test; AS: Ankylosing spondilitis; RA: Rheumatoid artrihitis; SD: Standard deviation; 6 MWT; 6 minute walking test; FEV 1, forced expiratory volume in one second; FVC, functional vital capacity; A value of p<0.05 was considered statistically significant.

Correlations of demographic and clinical data with PFT and ETT in AS and RA patients are presented in Table 3. Overweight RA patients had higher VO2 peak values than obese RA patients (p=0.013). FEV1 (p=0.014, r=0.406) and FVC (p=0.035, r=0.352) values were higher in AS patients who had ≥4 cm chest expansion.

Correlations between PFT, ETT results and quality of life in AS and RA patients are demonstrated in Table 4.

In the light of correlation analysis, multiple logistic regression models were constructed for FEV1, FVC and VO2 peak values (Tables 5-7).

DISCUSSION

The results for pulmonary functions and aerobic capacity showed better outcomes in healthy controls compared to AS and RA patients, as well as in AS than those with RA. Age was determined to be an effective parameter on pulmonary functions in AS patients and on exercise capacity in RA patients. Spinal mobility and thoracic expansion were associated with pulmonary functions, and functional status was associated with aerobic capacity in AS. The only common factor associated with pulmonary functions and aerobic capacity in patients with RA was physical function.

TABLE 3: Correlations of demographic data and clinical features with pulmonary function and exercise tolerance tests.

		FEV1 p (r)	FVC p (r)	FEV1/FVC p (r)	6-MWT p (r)	VO2 peak p (r)
AS	Age	**0.005 (-0.456)**	**0.008 (-0.435)**	0.517 (0.112)	0.338 (0.164)	**0.046 (-0.334)**
	Disease duration	0.547 (-0.104)	0.387 (-0.149)	0.803 (0.043)	0.485 (0.120)	0.540 (-0.105)
	Gender	0.342 (0.163)	0.358 (0.158)	0.437 (-0.134)	0.087 (0.289)	0.350 (0.160)
	BASDAI	0.840 (0.035)	0.624 (0.084)	0.222 (-0.209)	0.253 (-0.196)	0.643 (-0.080)
	BASFI	0.747 (-0.056)	0.647 (-0.079)	0.942 (0.013)	0.209 (-0.215)	**0.020 (-0.387)**
	BASMI	**0.012 (-0.414)**	**0.003 (-0.483)**	0.243 (0.200)	0.335 (-0.165)	0.187 (-0.225)
RA	Age	0.111 (-0.308)	0.098 (-0.319)	0.510 (-0.130)	0.062 (-0.358)	**0.007 (-0.496)**
	Disease duration	0.026 (-0.421)	**0.014 (-0.457)**	0.788 (-0.053)	**0.013 (-0.463)**	0.052 (-0.371)
	DAS 28	**0.037 (-0.396)**	0.181 (-0.260)	0.321 (-0.195)	0.122 (-0.299)	**0.041 (-0.389)**
	HAQ	0.293 (-0.206)	0.326 (-0.192)	**0.036 (-0.399)**	0.339 (-0.188)	**0.040 (-0.390)**

AS: Ankylosing spondilitis; RA: Rheumatoid artrihitis; 6 MWT: 6 minute walking test; FEV1: Forced expiratory volume in 1 second; FVC: functional vital capacity; BASDAI: Bath Ankylosing Spondylitis Disease Activity Index, BASFI: Bath Ankylosing Spondylitis Functional Index; BASMI: Bath Ankylosing Spondylitis Metrology Index; DAS-28: Disease activity score-28; HAQ: Health Assessment Questionnaire; A value of $p<0.05$ was considered statistically significant.

TABLE 4: Correlations of pulmonary function and exercise tolerance tests results with quality of life.

		FEV1 p (r)	FVC p (r)	FEV1/FVC p (r)	6 MWT p (r)	VO2 peak p (r)
Physical functioning	AS	0.540 (0.106)	0.630 (0.083)	0.902 (0.021)	**0.010 (0.426)**	0.378 (0.137)
	RA	**0.020 (0.436)**	**0.047 (0.378)**	0.272 (0.218)	**0.009 (0.485)**	**<0.001(0.637)**
Role- physical	AS	0.247 (0.198)	0.470 (0.124)	0.434 (0.134)	**0.011 (0.420)**	0.245 (0.199)
	RA	0.102 (0.316)	0.219 (0.240)	**0.047 (0.379)**	0.225 (0.237)	**0.012 (0.466)**
Role-emotional	AS	0.234 (-0.203)	0.369 (-0.154)	0.948 (0.011)	0.616 (0.086)	0.457 (0.128)
	RA	0.791 (0.068)	0.786 (-0.054)	0.290 (0.207)	0.648 (-0.090)	0.702 (0.076)
Vitality	AS	0.586 (0.094)	0.681 (0.071)	0.729 (0.060)	**0.003 (0.478)**	0.132 (0.256)
	RA	0.846 (0.038)	0.472 (-0.142)	**<0.001 (0.637)**	0.920 (-0.020)	0.145 (0.283)
Mental health	AS	0.549 (-0.103)	0.421 (-0.318)	0.768 (0.051)	0.067 (0.309)	0.487 (0.120)
	RA	0.731 (0.068)	0.661 (-0.087)	**0.025 (0.424)**	0.986 (0.003)	0.456 (0.147)
Social functioning	AS	0.648 (-0.079)	0.747 (-0.056)	0.629 (-0.083)	0.379 (0.151)	0.577 (0.096)
	RA	0.103 (0.314)	0.261 (0.220)	0.114 (0.305)	0.068 (0.350)	**0.017 (0.447**
Bodily pain	AS	0.929 (-0.015)	0.938 (0.013)	0.942 (0.013)	**0.001 (0.517)**	0.331 (0.167)
	RA	0.895 (0.026)	0.497 (0.134)	0.059 (0.362)	0.141 (0.286)	**0.014 (0.460**
General health	AS	0.841 (0.041)	0.794 (-0.045)	0.464 (0.126)	0.295 (0.175)	0.615 (-0.087)
	RA	0.464 (0.144)	0.667 (0.085)	0.059 (0.362)	0.166 (0.269)	**0.002 (0.565**

AS: Ankylosing spondilitis; RA: Rheumatoid artrhitis; 6 MWT: 6 minute walking test; FEV1: Forced expiratory volume in one second; FVC: Functional vital capacity; A value of $p<0.05$ was considered statistically significant.

No difference was found in terms of gender, work and marital status, BMI and smoking status among the three groups. The mean age of the RA group was 51.71 years similarly to the studies in the literature, and significantly higher than the other two groups.[20-22] RA patients in our study group were older patients. Symptoms of AS often appear gradually, with the peak age of between 20-30 years, and as the disease progress invade other body systems.[23] Additionally, as age progresses, joint involvement increases. Therefore, we could not include patients with older AS as they had systemic diseases or joint limitations that prevented them from testing on the treadmill.

In our study, pulmonary functions and aerobic capacity values were better in healthy control group than the RA and AS patients. A study similarly demonstrated higher FEV1 and FVC values in

TABLE 5: Multiple logistic regression analysis of FEV 1 in AS and RA patients.

		FEV 1		
		β	95 % CI	p
AS	Age	-0.456	(-0.062)-(-0.012)	**0.005**
	BASMI	-0.414	(-0.275)-(-0.036)	**0.012**
	Chest expansion	0.406	(0.048)-(0.397)	**0.014**
RA	Gender	0.418	(0.074)-(1.110)	**0.027**
	Disease duration	-0.358	(-0.056)-(0.001)	**0.061**
	SF-36-Physical functioning	0.411	(0.001)-(0.025)	**0.030**
	DAS-28	-0.395	(-0.574)-(-0.018)	**0.038**

FEV 1: Forced expiratory volume in one second; AS: Ankylosing spondilitis; RA: Rheumatoid artrihitis; BASMI: Bath Ankylosing Spondylitis Metrology Index; SF-36, Health Survey-36; DAS-28, Disease activity score-28; A value of p<0.05 was considered statistically significant.

TABLE 6: Multiple logistic regression analysis of FVC in AS and RA patients.

		FVC		
		β	95 % CI	p
AS	Age	-0.435	(-0.080)-(-0.013)	**0.008**
	BASMI	0.483	(-0.390)-(-0.088)	**0.003**
	Chest expansion	0.352	(0.063)-(1.628)	**0.035**
RA	Gender	0.387	(0.033)-(1.639)	**0.042**
	Disease duration	-0.428	(-0.092)-(-0.007)	**0.023**
	SF-36-Physical functioning	0.402	(0.002)-(0.037)	**0.034**

FVC: Functional vital capacity; AS: Ankylosing spondilitis; RA: Rheumatoid artrihitis; BASMI: Bath ankylosing spondylitis metrology index; SF-36, health survey- 36; A value of p<0.05 was considered statistically significant.

TABLE 7: Multiple logistic regression analysis of VO2 peak values in AS and RA patients.

		VO2 peak		
		β	95 % CI	P
AS	BASFI	-0.387	(-2.347)-(-0.216)	**0.020**
RA	Age	-0.425	(-0.401)-(-0.031)	**0.024**
	SF-36-Physical functioning	0.613	(0.072)-(0.229)	**0.001**
	SF-36-Role-physical	0.482	(0.034)-(0.218)	**0.009**
	SF-36-Social functioning	0.445	(0.021)-(0.202)	**0.018**
	SF-36-Pain	0.475	(0.022)-(0.152)	**0.011**
	SF-36-General health	0.530	(0.050)-(0.233)	**0.004**
	DAS-28	-0.335	(-4.170)-(0.261)	0.081
	HAQ	-0.371	(-6.131)-(0.033)	0.052

AS: Ankylosing spondilitis; RA: Rheumatoid artrihitis; BASFI: Bath Ankylosing Spondylitis Functional Index; SF-36, Health Survey- 36; DAS-28, Disease activity score-28; HAQ, Health Assessment Questionnaire; A value of p<0.05 was considered statistically significant.

control group compared to the AS patients.[24] The underlying inflammation and secondary organ involvements in rheumatic diseases are thought to reduce pulmonary functions and aerobic capacity, which is also reflected in the results of our study.

In the AS group, there was a negative correlation between age and FEV1 and FVC. Additionally, multiple logistic regression analysis showed that each one-year increment in age caused a decrease of 0.456 L in FEV1 and 0.435 L in FVC. Age has been shown to affect aerobic capacity in AS and RA. There are many studies demonstrating the effect of age on aerobic capacity in the literature.[24-33] Similarity of the mean ages of the groups is important when considering the age effect. The higher mean age of the RA group may have caused the V02 peak values to be lower.

The mean duration of disease of the AS patients included in the study was about 11 years, and it was observed that there was no correlation between duration of disease and pulmonary functions. Similarly, no correlation was detected between duration of disease and pulmonary functions in two studies in which the durations of diseases were 7.1 and 8.4 years.[29,30] A negative correlation was found between spinal mobility and pulmonary functions; each one-unit increment in BASMI resulted a decrease of 4.1% in FVC.[25] This finding suggests that pulmonary functions are affected by mobility rather than duration of disease. FEV 1 and FVC values were higher in the group with thoracic expansion of ≥4 cm. A study which was investigated the relationship between vital capacity and thoracic expansion reported that vital capacity decreased with reduced thoracic expansion.[26] Postural deformities such as pectoral shortening and increased dorsal kyphosis developed due to joint ankylosis contribute to reduced thoracic expansion which can directly cause respiratory problems.[29]

A study that examined pulmonary involvement in patients with RA reported that high DAS-28 values were associated with abnormal PFT results.[31] Although FEV1 was found statistically effective factor on disease activity, this result was not clinically significant since our patients were clinically stable. However, pulmonary involvement should be remembered in cases of increased clinical activity and deteriorated PFT.

This study demonstrated a negative correlation between BASFI and VO2 peak values. However, a study showed a correlation between thoracic expansion and VO2 peak but not with BASFI.[24] Decreased functional capacity causes limitations during activities; this can lead to reduced aerobic capacity.

In a clinical trial, VO2 peak values were significantly different between AS patients with low and high disease activity.[33] While no correlation was found between BASDAI and aerobic capacity, a negative correlation was determined between DAS-28 and aerobic capacity. A study that examined disease activity, quality of life, fatigue, pain and physical condition reported that low physical condition and high levels of pain result in reduced quality of life; high disease activity, reduced functionality and increased fatigue.[34] It can be mentioned that patients with high disease activity feel more pain and fatigue and therefore show less functionality leading to reduced exercise capacity.

To our best knowledge, although there are many studies that compare AS or RA patients with healthy controls, this is the first study which compare the three with each other according to pulmonary functions and vital capacity. Despite the developments in pharmacological treatments, the functional losses due to rheumatic diseases and the resulting deterioration in quality of life and social integration difficulties can not be avoided. In this study, the effects of mobility and functional disability on pulmonary tests and aerobic capacity were assessed in patients with stable disease activity, and the importance of physical activity and aerobic exercises to improve functional status was established. Suggestions for aerobic exercises against increasing cardiovascular risk and inflammation have been flourishing in recent years.[35] Drug therapy suppresses the disease activity and helps the patient adapt to the exercise program. Therefore by this study we recommended that before starting the exercise program to be applied in inflammatory rheumatic diseases, the patient should be assessed according to the suggested scales in terms of disease parameters and exercise capacity, and the exercise protocols should be created in this direction.

The most important limitation of this study was the small number of patients. Inclusion criteria that allowed patients with stable disease and without cardiopulmonary diseases limited the number of patients. Another limitation is different mean ages of patient groups. Since RA is seen at older ages, the mean age of this group was higher.

Pulmonary functions and aerobic capacity may be adversely affected in rheumatic diseases. Negative effects of the musculoskeletal system limitations and positive reflections of functional wellness on the pulmonary system shows the importance of physical activity in rheumatic diseases and demonstrates that aerobic exercises should be underlined especially in RA patients with low aerobic capacity.

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