Ankara Med J, 2017;(4):235-44
DOI: 1017098/amj.364155

Which Factors Affect the Functional Situation and Quality of Life in Patients with Ankylosing Spondylitis?

Ankilozan Spondilit Hastalarında Yaşam Kalitesini ve Fonksiyonel Durumu Hangi Faktörler Etkiler?

Gülcan Gürer[1], Gülnur Taşçı Bozbaş[1], Ayşe İyiyapıcı Ünübol[2], Tiraje Tuncer[3], Bülent Bütün[3]

[1]Aydın Adnan Menderes University, Department of Physical Medicine and Rehabilitation
[2]Aydın Private Medinova Hospital, Clinic of Physical Therapy and Rehabilitation
[3]Antalya Akdeniz University, Department of Physical Medicine and Rehabilitation

Abstract
Objectives: This study was performed to determine the possible predictive factors affecting the functional situation and quality of life in patients with ankylosing spondylitis (AS).
Materials and Methods: A total of 88 volunteer Turkish patients with AS were included in the study. We evaluated the Bath AS Functional Index (BASFI), Bath AS Disease Activity Index (BASDAI), Bath AS Metrology Index (BASMI) and AS Quality of Life Questionnaire (ASQoL) in patients. The ages, genders, levels of education, morning stiffness duration, smoking statuses, statues of doing the home exercises instructed were interrogated and mobility measurements of patients were performed and all of these values were recorded.
Results: BASFI was found to be correlated with smoking (p=0.019), morning stiffness (p=0.001), BMI (p=0.020), exercise (p=0.002), BASMI (p<0.001) and BASDAI (p<0.001). According to the categorical regression, BASDAI (Beta=0.574, p<0.001) was independently associated with the BASFI score. ASQoL was found to have correlation with the level of education (p=0.030), smoking (p=0.049), morning stiffness (p=0.004) and exercise (p=0.007), BASDAI (p<0.001) and BASFI (p<0.001). It was found that the effect of BASFI was significant on the ASQoL(p=0.007).
Conclusion: Even though the duration of the disease appears to be an unchangeable factor, smoking, duration of morning stiffness, the compliance with home-based exercise program and mobility measurements appear to be relatively changeable factors. Therefore, we believe that specialists who follow patients with AS can influence quality of life and functions of the patients by educating and inspiring them at every visit.
Key words: Ankylosing spondylitis, Bath Ankylosing Spondylitis Metrology Index, Bath Ankylosing Spondylitis Functional Index, Bath Ankylosing Spondylitis Disease Activity Index, Ankylosing Spondylitis Quality of Life Questionnaire

Öz
Giriş: Bu çalışma, Ankilozan spondilit (AS) hastalarında fonksiyonel durumu ve yaşam kalitesini etkileyen olası faktörleri belirlemek amacıyla yapıldı.
Materyal ve Metot: Çalışmaya AS'li toplam 88 adet gönüllü Türk hasta dahil edildi. Hastalarda Bath AS Fonksiyonel İndeks (BASFI), Bath AS Hastalık Aktivite İndeksi (BASDAI), Bath AS Metrology İndeksi (BASMI) ve AS Yaşam Kalitesi Anketi (ASQoL) değerlendirildi. Yaş, cinsiyet, eğitim düzeyi, sabah tutukluğu süresi, sigara içme durumu, evde egzersiz yapma durumları sorgulandı ve mobilite ölçümleri yapıldı ve bunlar kaydedildi.
Bulgular: BASFI skoru sigara içme (p=0,019), egzersiz (p=0,002), sabah tutukluğu (p=0,001), vücud kütle indeksi (p=0,020), BASMI (p<0,001) ve BASDAI (p<0,001) ile korele bulundu. Kategorik regresyon analizine göre ise BASDAI BASFI skoru ile ilişkili bulundu (β:0.574, p<0,001). ASQoL ise sabah tutukluğu (p=0,004), eğitim durumu (p=0,030), sigara içme (p=0,049), egzersiz (p=0,007), BASDAI (p<0,001) ve BASFI (p<0,001) korele bulundu. ASQoL üzerinde BASFI'nin belirgin etkisi olduğu saptandı (p=0,007).
Sonuç: Hastalık süresi değiştirilemediği halde, sigara içme, sabah tutukluğunun süresi, evde egzersiz programına uyum ve hareketlilik ölçümleri nispeten değiştirilebilir faktörler gibi gözükmektedir. Bu nedenle, AS'li hastaları takip eden hekimlerin her ziyarette, bu konularda eğitim vererek ve bunu vurgulayarak hastaların yaşam kalitelerini ve fonksiyonlarını etkileyebileceklerine inanıyoruz

Anahtar kelimeler: Ankilozan spondilit, Bath Ankilozan Spondilit Metroloji Indeksi, Bath Ankilozan Spondilit Fonksiyonel İndeks, Bath Ankilozan Spondilit Hastalık Aktivite İndeksi, Ankilozan Spondilit Yaşam Kalitesi Anketi

Correspondence / Yazışma Adresi:
Dr. Gülnur Taşçı Bozbaş
Adnan Menderes University, Department of Physical Medicine and Rehabilitation, Aydın
e-mail: gulnurtb@yahoo.com
Date of submission: 30.06.2017
Date of admission: 17.11.2017

Introduction

Ankylosing spondylitis (AS) is a chronic inflammatory rheumatological disease characterized by spinal inflammation, usually in the form of sacroiliitis and spondylitis which may lead to syndesmophyte formation and ankylosis in the further course of the disease.[1] AS most commonly begins in the second and third decade of life as persistent inflammatory back pain that can already be associated with significant loss of function, work disability and impaired quality of life early in the disease.[2-5]

In studies conducted previously, risk factors affecting the functional status and quality of life in patients with AS have been evaluated. Age, duration of symptoms, pain severity, stiffness, peripheral arthritis, total hip arthroplasty, smoking habit of patient, having history of more physically demanding jobs and lower levels of education have been demonstrated as risk factors for functional limitations and quality of life in patients with AS.[4,6-13] In other rheumatic diseases, level of education has been found to be possibly associated as a risk factor.[14-16]

In this study, we planned to determine the possible risk factors affecting functional situation and quality of life in Turkish patients with AS.

Materials and Methods

For this study, firstly, power analysis was performed. At least 20 patients should be evaluated to carry out this study based on the study of Bodur et, as the correlation coefficient between BASFI and BASDAI will be 0.655, alpha 5% and statistically power 90%. In our study, the number of patients were assigned as 89.

Eigthy-nine Turkish AS patients diagnosed with AS according to the Modified 1984 New York Criteria who were admitted to the Rheumatology Outpatient Clinics of Akdeniz University and Adnan Menderes University were included in the study. The Institutional Ethics Committee approved the study, and all participants provided their written informed consent to participate in the study. Yet, one patient, who did not want to participate, was excluded from the study. Thus, a total of 88 volunteer Turkish AS patients consisting of 24 females (27.3%) and 64 males (72.7%) with their age ranging from 21 to 81 were enrolled in the study.

Demographic information of the patients was obtained, their heights and weights were measured and these values were recorded. Then body mass indices (BMIs) of the patients were calculated by dividing the body weight as kilograms by the square of height in meters. Levels of education of the patients were investigated and recorded (0: illiterate, 1: literate, 2: primary school graduate, 3: secondary school graduate, 4: high school graduate, 5: university graduate). Diagnosis dates of the patients, drug(s) they

used, their duration of morning stiffness (as minutes) were investigated and recorded. Patients with diagnosis of AS who were admitted to the Rheumatology Outpatient Clinics are routinely instructed with a home-based exercise program. Exercises recommended are; breathing and posture exercises, and range of motion/stretching exercises for all joints. Patients were inquired about the extent they do these recommended exercises, and they were rated as 0 (not doing the exercises), 1 (doing irregularly or occasionally), 2 (doing regularly every day), and the results were recorded.

Smoking habits of the patients were also evaluated. Those who have smoked at least one cigarette a day for a period of longer than 6 months during their lifetime were included in the smoking group. Whether the individuals in this group were currently smoking and how many cigarettes a day and for how many years they have smoked were determined. "Packs/year" term was calculated by multiplying the number of cigarettes (as packs) smoked daily by smoking period (as years).

Indices have been developed to measure the activation status, functional status, spinal mobility values and quality of life of patients with AS. Bath AS Disease Activity Index (BASDAI), developed for evaluating disease activity, consists of 6 visual analog scale (VAS) measurements comprising of fatigue, spinal and peripheral joint pain, severity and morning stiffness.[17] Bath AS Functional Index (BASFI), developed for functional evaluation, was determined to have been superior regarding sensitivity to the change to the Dougados Functional Index (DFI) which was developed for the same purpose.[18] Bath AS metrology index (BASMI) was developed by evaluating 20 different clinical assessment methods and selecting 5 among them having the property of the highest validity, reliability, repeatability, and sensitivity to the change.[19] Developed to assess the quality of life of patients with AS, Ankylosing Spondylitis Quality of Life Questionnaire (ASQoL) has been demonstrated to be a valid and reliable tool that can be used both in clinical practice and in scientific research.[20]

To evaluate the functional status, disease activity, spinal mobility and quality of life of the patients, BASFI, BASDAI, BASMI and ASQoL scales were used respectively. All indices were assessed by the same physician. Turkish versions of BASFI, BASDAI and ASQoL were used. The reliability of the Turkish versions of BASFI, BASDAI, and ASQoL has been confirmed.[21-24]

BASMI is a combined index comprising five assessments of spinal mobility in AS patients. The index includes the assessments of lateral lumbar flexion, tragus-to-wall distance, lumbar flexion, intermalleolar distance and cervical rotation.[25] These measurements have been found to be clinically practical and reliable in reflecting axial status.[1] In our study, measurements of tragus-to-wall distance, modified Schober, cervical rotations (mean of the sum of right and left rotations was taken), lumbar lateral flexion difference (mean of the sum of right and left lateral flexion differences was taken), intermalleolar distance were performed by the same physician on all patients to obtain BASMI score. Apart from these mobility assessments performed, occiput-to-wall distance, chin-to-sternum distance, chest expansion, thoracic Schober, lumbar Schober, hand-to-ground distance and intermalleolar distance were measured.

As the laboratory values of the patients; erythrocyte sedimentation rate (using Standard Westegren Method) and serum C-reactive protein (CRP) levels were measured.

Statistical analysis was performed by using SPSS 18.0 (SPSS Inc., Il., USA) software package. Results for continuous variables were presented as maximum, minimum and mean ± standard deviation (SD). Compliance with the normal distribution of quantitative data was examined with the Shapiro-Wilk Test. The correlations between the quantitative variables were analyzed using Spearman's correlation test. The categorical regression analyzes were constructed to evaluate associations between identified variables. A p-value of <0.05 was considered as significant.

Results

Sixty-four male and 24 female volunteer Turkish patients with AS, with ages ranging from 21 to 81 were included in the study. Minimum, maximum, and mean and standard deviation (SD) of all values found for the patients are shown in Table 1.

Table 1. Characteristics of the patient population

	Min-max	**Mean ± SD**
Age (year)	21-81	40.31 ± 10.60
BMI (kg/m²)	17.94-39.79	25.96 ± 3.85
Duration of disease (year)	0.5-35	8.93 ± 8.56
Morning stiffness (minute)	0-360	38.07 ± 62.60
Smoking (packs/year)	0-65	7.13 ± 11.49
ESR (mm/h)	1.03-90	33.17 ± 20.73
CRP (mg/l)	0.01-35	2.63 ± 5.02
BASMI	5-14	7.58 ± 2.48
BASDAI	0-9.5	4.05 ± 2.42
BASFI	0-9.3	3.22 ± 2.48
ASQoL	0-18	9.20 ± 5.69

BMI: Body mass index; ESR: Erythrocyte sedimentation rate; CRP: C-reactive protein; BASMI: Bath Ankylosing Spondylitis Metrology Index; BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; BASFI: Bath Ankylosing Spondylitis Functional Index; ASQoL: Ankylosing Spondylitis Quality of Life Questionnaire

The frequency and percent of the education levels and drugs that the patients were used for AS were presented in Table 2.

Correlations of BASMI, BASFI and ASQoL with age, gender, BMI, educational level, duration of disease, morning stiffness, smoking and home-based exercise status were examined. BASMI was found to have correlation with the age ($r=0.39$, $p<0.001$), and duration of disease ($r=0.42$, $p<0.01$). BASFI was found to be correlated with smoking ($r=0.254$, $p=0.02$), morning stiffness ($r=0.346$, $p=0.001$), BMI ($r=0.251$, $p=0.020$), and exercise ($r=-0.333$, $p=0.002$); and ASQoL with the level of education ($r=-0.23$, $p=0.03$), smoking ($r=0.21$, $p=0.049$), morning stiffness ($r=0.30$, $p=0.004$) and exercise ($r=-0.28$, $p=0.007$).

Table 2. Education levels, drug(s) used and exercise status of the patients

	N (%)
Education	
Literate	4 (4.9)
Primary school	32 (36.4)
Secondary school	4 (4.5)
High-school	27 (30.7)
University	21 (23.9)
Drug	
No drug intake	13 (14.8%)
NSAID	18 (20.5%)
Sulphasalazine	20 (22.7%)
Methotrexate	1 (1.1%)
Sulphasalazine+methotrexate	3 (3.4%)
Sulphasalazine+NSAID	14 (15.9%)
Infiliximab	2 (2.3%)
Etanercept	8 (9.1%)
Adalimumab	4 (4.5%)
Adalimumab+sulphasalazine	2 (2.3%)
Etanercept+sulphasalazine	1 (1.1%)
Sulphasalazine+steroid	1 (1.1%)
Subcutan methotrexate+NSAID	1 (1.1%)
Exercise	
None	46 (40.48%)
Irregularly	10 (8.8%)
Regularly	32 (28.16%)

Correlations of BASMI, BASFI and ASQoL with ESR and CRP levels were examined and did not give any correlation ($p>0.05$).

Correlations of BASDAI, BASFI and ASQoL with mobility assessment values were examined. BASFI was correlated with chin-to-sternum distance ($r=0.342$, $p=0.001$), Schober ($r=-0.287$, $p=0.007$), modified Schober ($r=-0.239$, $p=0.027$), thoracic Schober ($r=-0.331$, $p=0.002$), chest expansion ($r=-0.331$, $p=0.002$), intermalleolar distance ($r=-0.286$, $p=0.008$), lateral flexion ($r=-0.335$, $p=0.002$) assessments. ASQoL and BASDAI were not in any way correlated with mobility assessments.
Correlations of Bath AS measurement indices (BASDAI, BASMI and BASFI) and ASQoL scale with each other were examined. While a correlation was found between BASFI with BASMI ($r=0.400$, $p<0.001$), BASDAI ($r=0.634$, $p<0.001$) and ASQoL ($r=0.754$, $p<0.001$), a correlation was again determined between BASDAI and ASQoL ($r=0.674$, $p<0.001$).

Categorical regression models were constructed to evaluate the relations among identified variables.

In the first model, while BASFI score was the dependent variable, morning stiffness, smoking, exercise, BMI, BASDI and BASMI were the independent variables. These

variables were explained 71.5% of the variance of the BASFI score (p<0.001). BASDAI (Beta=0.574, p<0.001) was independently associated with the BASFI score. The results of this model were demonstrated in Table 3.

Table 3. Categorical regression analyses with the BASFI score as dependent variable and morning stiffness, smoking, exercise, BMI, BASDAI and BASMI as independent variables

Variable	**BASFI**			
	Standardized Coefficients		**p**	**R^2**
	Beta	**Std.Err**		
Morning stiffness	0.026	0.115	0.824	0.715
Smoking	0.152	0.222	0.502	
Exercise	0.044	0.224	0.848	
BMI	0.255	0.256	0.331	
BASDAI	**0.574**	**0.120**	**<0.001****	
BASMI	0.214	0.223	0.349	

*P<0.05; **P<0.001, R square: 71.5%. (BASFI: Bath Ankylosing Spondylitis Functional Index; BASMI: Bath Ankylosing Spondylitis Metrology Index; BASDAI: Bath Ankylosing Spondylitis Disease Activity Index; BMI: Body mass index)

In the second regression model, ASQoL was the dependent variable and morning stiffness, smoking, exercise, education, BASDAI and BASFI were the independent variables (Table 4). The variance of ASQoL was 64.1% and p value was 0.004. It was found that the effect of BASFI was significant on the ASQoL (p=0.007).

Table 4. Categorical regression analyses with the ASQoL score as dependent variable and morning stiffness, smoking, exercise, education, BASDAI and BASFI as independent variables

Variable	**ASQoL**			
	Standardized Coefficients		**p**	**R^2**
	Beta	**Std.Err**		
Morning stiffness	-0.032	0.155	0.840	0.641
Smoking	-0.095	0.288	0.745	
Exercise	-0.059	0.210	0.782	
Education	-0.176	0.291	0.553	
BASDAI	-0.026	0.247	0.917	
BASFI	**0.825**	**0.270**	**0.007***	

*P<0.05; **P<0.001, R square: 64.1%. (ASQoL: Ankylosing Spondylitis Quality of Life Questionnaire; BASDAI: Bath Ankylosing Spondylitis; BASFI: Bath Ankylosing Spondylitis Functional Index; Disease Activity Index; BASMI: Bath Ankylosing Spondylitis Metrology Index)

In the other model, the dependent variable was BASMI and independent variables were duration of disease, age and BASFI. This model explained 43.1% of the variance of the BASMI score (p<0.001). These results were presented in Table 5.

Table 5. Categorical regression analyses with the BASMI as dependent variable and duration of disease, age and BASDAI as independent variables

Variable	**BASMI**			
	Standardized Coefficients		**p**	**R^2**
	Beta	**Std.Err**		
Age	0.132	0.087	0.134	0.431
Duration of disease	0.416	0.103	**<0.001****	
BASDAI	0.366	0.086	**<0.001****	

*P<0.05; **P<0.001, R square: 43.1% (BASMI: Bath Ankylosing Spondylitis Metrology Index)

Discussion

In the present study, there was a positive correlation between the duration of morning stiffness and BASFI and ASQoL. The functions and quality of life worsened with the increasing duration of morning stiffness. According to this result, we see the importance of treating the morning stiffness of the patient with AS. By eliminating morning stiffness, we both enable the patient to perform his/her daily activities better and improve his/her quality of life. These results were found to be consistent with previous studies.[4,6-13,25] A positive relation was found between duration of the disease and BASMI in patients with AS. As the duration of disease increased, the extent of its effect on the patient increased and it affected the patient's mobility negatively.

Patients were inquired about the presence of smoking habit, and it was calculated and recorded as packs/year, if present. Mobility and functional levels of AS patients were affected negatively as the level of smoking habit increased. As a result, we see the importance of smoking habit in patients with AS. Therefore, suggestions with regard to quitting smoking are indications of the improvement both in the performance of daily activities and in the mobility of the patients. Averns et al have found in a study they conducted that, when lumbar Schober test, hand-to-ground distance and occiput-to-wall distance of smokers and non-smokers were compared, these mobility assessments were significantly limited in smokers.[26] Similarly, in a study they conducted in patients with AS, Ward et al have found that limitation in functional and daily activities in patients who were current smokers was greater compared to those who had quit smoking or who had never smoked.[27] These results were found to be consistent with our study.

In a few studies, benefits of exercise on the severity of symptoms, mobility, functional and cardiovascular capacity, and psychological status in patients with AS were reported.[28-34] Bodur et al. studied the quality of life and related variables in nine-hundred and sixty-two patients with AS.[13] In conclusion, they have found in patients with AS that, the most significant variables associated with quality of life were BASDAI, BASFI, fatigue and pain. Analay et al. investigated the effectiveness of

intensive group exercise in 45 AS patients and found that group exercise in hospital could have been more effective than home-based exercises at reducing impairment associated with ankylosing spondylitis.[32] However, Karapolat et al. compared the impact of group-based exercise programme and a home-based exercise programme on Bath Ankylosing Spondylitis Indices, depression and quality of life in patients with AS. No statistically significant changes were detected in both exercise groups in the mentioned study.[31] Group and home-based exercise programmes are efficient in improving symptoms and mobility and had an important effect on quality of life in patients with AS. Durmus et al. studied the effects of home-based exercise programs on quality of life, fatigue, and depression in patients with AS.[33] Forty three patients were included in this study. They found that home-based exercise programs are very effective in improving quality of life and reducing fatigue. Because of these advantages, home-based exercise program should be advised for the management of AS in addition to medical treatments. For this reason, exercise is a cornerstone in the treatment of AS. In the presented study, the status of doing home-based exercise instructed to patients was found to be correlated with BASFI. We see here again that exercises corrected the functions in patients with AS. According to this result, patients should be inquired about doing their exercises, and should be recommended to do them regularly.

In our study, we examined the correlation of Bath AS measurement indices with mobility measurement values. A significant correlation was found between BASFI and the measurements. As a result, the greater the joint motion limitation of the patient is the more limitation there is with respect to performing daily activities. We also examined the correlation between BASDAI with each of the mobility measurements, but could not find any association. Haywood et al. have found in a study they have conducted with 150 patients with AS that; there was a correlation between spinal mobility and BASDAI.[34] According to our study, limitation in the mobility of the patients is not correlated with disease activity. Fallahi et al. found the correlation between spinal mobility and ASQoL.[35] According to our study, we did not find any relation when we examined the correlation of ASQoL with mobility measurements.

By testing the relations between BASDAI and BASFI, we found BASFI scores to be associated with BASDAI. In the conclusion, as the mobility assessments of the patients were limited and disease activities of them increased, their functions were affected negatively. Furthermore, the AS patients' quality of life (ASQoL) was found to be associated with the functional level (BASFI) of the patients in this study. According to these results, as the patient's function was limited and disease activity was increased, quality of life was impaired more in patients with AS.

Finally, negative relation was found between the education levels of the patients and ASQoL scores in this study. Conclusively, quality of life was found to be better in patients who had higher education levels. Ward et al. found negative relations between education levels and functional limitations in AS patients.[9] Fallahi et al. showed that quality of life in AS was worse in patients with lower educational status.[35] They defined that; in patients with AS, functional limitations were less severe among those with higher levels of education. The patients with higher levels of education can have more information about AS and thus, they can follow the recommendations of physicians better and cope better with the disease-related difficulties.

According to the results of our study, duration of morning stiffness, adherence to the home-based exercise programs, smoking habit, range of motion of joints are associated with functions, activities and quality of life of patients with AS. The disease activity appears to have effects on functions, activities, whereas functional status affects quality of life. The duration of morning stiffness, performing a home-based exercise program regularly, quitting smoking and eliminating or minimizing joint motion limitation and activity of disease are changeable factors, and patients can improve their functions and quality of life by means of realizing these. Therefore, we believe that specialists who follow patients with AS can influence the quality of life and functions of their patients by providing effective treatments and educating and inspiring them in this way at every visit.

References

1. van Weely SF, Kneepkens EL, Nurmohamed MT, Dekker J, van der Horst-Bruinsma IE. Continuous improvement of physical functioning in Ankylosing Spondylitis patients by TNF inhibitors: 3-year follow-up and predictors. Arthritis Care Res (Hoboken) 2016;68:1522-9.
2. Dagfinrud H, Mengshoel AM, Hagan KB, Loge JH, Kvien TK. Health status of patients with ankylosing spondylitis: a comparison with the general population. Ann Rheum Dis; 2004;63:1605-10.
3. Bostan EE, Borman P, Bodur H. Functional disability and quality of life in patients with ankylosing spondylitis. Rheumatol Int 2003;23:121-6.
4. Zink A, Braun J, Listing J, Wollenhaupt J. Disability and handicap in rheumatoid arthritis and ankylosing spondylitis: Results from the German rheumatological database. J Rheumatol 2000;27:613-22.
5. Malinowski K, Kawalec P. The Association between Disease Activity and Quality of Life among Patients with Ankylosing Spondylitis in Polish Population. Value Health 2015;18(7):A653
6. Ward MM. Predictors of the progression of functional disability in patients with ankylosing spondylitis J Rheumatol 2002;29(7):1420-5.
7. Ariza-Ariza R, Hernandez-Cruz B, Navarro-Sarabia F. Physical function and health-related quality of life of Spanish patients with ankylosing spondylitis Arthritis Rheum 2003;49:483-7.
8. Chung HY, Machado P, van der Heijde D, D'Agostino MA, Dougados M. Smokers in early axial spondyloarthritis have earlier disease onset, more disease activity, inflammation and damage, and poorer function and health-related quality of life: results from the DESIR cohort . Ann Rheum Dis 2012;71(6):809-16.
9. Ward MM, Weisman MH, Davis JC Jr, Reveille JD. Risk factors for functional limitations in patients with long-standing ankylosing spondylitis. Arthritis Rheum 2005;15(5):710-7.
10. Taylor AL, Balakrishnan C, Calin A. Reference centile charts for measures of disease activity, functional impairment, and metrology in ankylosing spondylitis. Arthritis Rheum 1998;41:1119-25.
11. Falkenbach A, Franke A, van Tubergen A, van der Linden S. Assessment of functional ability in younger and older patients with ankylosing spondylitis: performance of the Bath Ankylosing Spondylitis Functional Index. Am J Phys Med Rehabil 2002;81:416-20.
12. Falkenbach A, Franke A, van der Linden S. Factors associated with body function and disability in patients with ankylosing spondylitis: a cross-sectional study. J Rheumatol 2003;30:2186-92.
13. Bodur H, Ataman S, Rezvani A, et al. Quality of life and related variables in patients with ankylosing spondylitis. Qual Life Res 2011;20(4):543-9.
14. Fried LP, Guralnik JM. Disability in older adults: evidence regarding significance, etiology, and risk. J Am Geriatr Soc 1997;45:92-100.
15. Gabriel SE. The epidemiology of rheumatoid arthritis. Rheum Dis Clin North Am 2001;27:269-81.
16. Mikuls TR, Saag KG. Comorbidity in rheumatoid arthritis. Rheum Dis Clin North Am 2001;27:283-303.

17. Garrett S, Jenkinson T, Kennedy LG, Whitelock H, Gaisford P, Calin A. A new approach to defining disease status in ankylosing spondylitis: the Bath Ankylosing Spondylitis Disease Activity Index. J Rheumatol 1994;21(12):2286-91.
18. Calin A, Garrett S, Whitelock H, et al. A new approach to defining functional ability in ankylosing spondylitis: the development of the Bath Ankylosing Spondylitis Functional Index. J Rheumatol 1994;21(12):2281-85.
19. Jenkinson TR, Mallorie PA, Whitelock HC, Kennedy LG, Garrett SL, Calin A. Defining spinal mobility in ankylosing spondylitis (AS). The Bath AS Metrology Index. J Rheumatol 1994;21(9):1694-8.
20. Doward LC, Spoorenberg A, Cook SA, et al. Development of the ASQoL: a quality of life instrument specific to ankylosing spondylitis. Ann Rheum Dis 2003;62(1):20-6.
21. Akkoc Y, Karatepe AG, Akar S, Kirazli Y, Akkoc N. A Turkish version of the Bath Ankylosing Spondylitis Disease Activity Index: reliability and validity. Rheumatol Int 2005;25(4):280-4.
22. Karatepe AG, Akkoc Y, Akar S, Kirazli Y, Akkoc N. The Turkish versions of the Bath Ankylosing Spondylitis and Dougados Functional Indices: reliability and validity. Rheumatol Int 2005;25:612-8.
23. Yanik B, Gursel YK, Kutlay S, Ay S, Elhan AH. Adaptation of the Bath Ankylosing Spondylitis Functional Index to the Turkish population, its reliability and validity: functional assessment in AS. Clin Rheumatol 2005;24(1):41-7.
24. Duruöz T, Doward L, Cerrahoglu L, et al. Translation and validation of the Turkısh version of the Ankylosıng Spondylıtıs Qualıty Of Lıfe (ASQoL) Questionnaire. Rheumatol Int 201;33(11):2717-22.
25. Yılmaz O, Tutoğlu A, Garip Y, Ozcan E, Bodur H. Health-related quality of life in Turkish patients with ankylosing spondylitis: impact of peripheral involvement on quality of life in terms of disease activity, functional status, severity of pain, and social and emotional functioning. Rheumatol Int 2013;33(5):1159-63.
26. Averns HL, Oxtoby J, Taylor HG. Smoking and outcome in ankylosing spondylitis. Scand J Rheumatol 1996;25(3):138-42.
27. Ward MM, Weisman MH, Davis JC Jr. Risk factors for functional limitations in patients with long-standing ankylosing spondylitis. Arthritis Rheum 2005;53(5):710-7.
28. Dagfinrud H, Kvien TK, Hagen KB. The Cochrane review of physiotherapy interventions for ankylosing spondylitis. J Rheumatol 2005;32:1899-906.
29. Analay Y, Ozcan E, Karan A, Diracoglu D, Aydin R. The effectiveness of intensive group exercise on patients with ankylosing spondylitis. Clin Rehabil 2003;17:631-6.
30. Ince G, Sarpel T, Durgun B, Erdogan S. Effects of multimodal exercise program for people with ankylosing spondylitis. Phys Ther 2006;86:924-35.
31. Karapolat H, Akkoc Y, Sari I, et al. Comparison of group-based exercise versus home-based exercise in patients with ankylosing spondylitis: effects on Bath Ankylosing Spondylitis Indices, quality of life and depression. Clin Rheumatol 2008;27(6):695-700.
32. Analay Y, Ozcan E, Karan A, Diracoglu D, Aydin R. The effectiveness of intensive group exercise on patients with ankylosing spondylitis. Clin Rehabil 2003;17(6):631-6.
33. Durmus D, Alayli G, Cil E, Canturk F. Effects of a home-based exercise program on quality of life, fatigue, and depression in patients with ankylosing spondylitis. Rheumatol Int 2009;29(6):673-7.
34. Haywood KL, Garratt AM, Jordan K, Dziedzic K, Dawes PT. Spinal mobility in ankylosing spondylitis: reliability, validity and responsiveness. Rheumatology (Oxford) 2004;43(6):750-7.
35. Fallahi S, Jamshidi AR, Bidad K, Qorbani M, Mahmoudi M. Evaluating the reliability of Persian version of ankylosing spondylitis quality of life (ASQoL) questionnaire and related clinical and demographic parameters in patients with ankylosing spondylitis. Rheumatol Int 2014;34(6):803-9.