

Characteristics of Ankylosing spondylitis patients in Kurdistan region of Iraq



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Submission: 02-08-2022

Revision: 29-09-2022

Publication: 01-11-2022

ABSTRACT

Background: Ankylosing spondylitis (AS) affects predominantly the axial skeleton and causes inflammatory low back pain. **Aims and Objectives:** We aimed to explore clinical characteristics of AS patients in Iraqi Kurdistan. **Materials and Methods:** In this cross-sectional study, the patients who attended a rheumatic disease center in Kurdistan Region of Iraq in 2022 were screened for the diagnosis of AS. **Results:** The mean age of the patients was 38.31 (17–65 years old) and most were Middle age and males (93.07%; male: female ratio: 13.43:1). The patients were normal sleepers (61.39%), short sleepers (28.71%), and long sleepers (9.90%). The patients were most physically active through walking. The age at symptoms onset of patients was 22.61 years (7–56 years). The patient's disease was diagnosed at the mean value of 29.56 years. The median gap of diagnosis was 5 years. The patients had different characteristics; peripheral arthritis (56.44%), sacroiliitis (bilateral: 91.09%), tenosynovitis (14.85%), plantar fasciitis (45.54%), achilles tendinitis (17.82%), anterior uveitis (23.76%), positive human leukocyte antigen-B27 (88.40%), and spinal involvement (94.06%). Most patients received treatment (89.11%) including received biological treatment (53.47%) followed by multiple treatments (29.70%) and non-steroidal (4.95%) and only 0.99% (one patient) used physical therapy. The patients with normal sleepers and physically active and without extra-articular manifestations of AS had better disease severity and function compared to short sleepers and nonphysically active. **Conclusion:** A AS patients have escalating disease severity and function patients in this region. The disease severity and function were associated with healthy lifestyles such as sleeping and physical activity.

Key words: Ankylosing spondylitis; Musculoskeletal symptoms; Disease severity; Disease function

INTRODUCTION

Ankylosing spondylitis (AS) is considered a prototype of a group of chronic inflammatory diseases called spondyloarthritides.¹ This disease affects predominantly the axial skeleton and causes inflammatory low back pain. The main joints involved in the AS are sacroiliac joints. Peripheral arthritis, enthesitis, and tenosynovitis are musculoskeletal manifestations of patients with AS.² The following are extra-articular manifestations of AS; uveitis, inflammatory bowel disease, cardiac abnormalities, and apical fibrosis of the lungs.^{3,4}

The diagnosis of AS is usually delayed and this delayed diagnosis is a gap of several years between the onset of symptoms and the actual diagnosis. The delayed diagnosis could be due to a low level of awareness among non-rheumatologists about AS, the high prevalence of chronic low back pain in the population, and the late appearance of radiological evidence of sacroiliitis in the disease course.⁵ The involvement of ankylosing in the spine leads to structural and functional impairments and a decrease in quality of life.⁶

There are few studies conducted on the characteristics of AS in the Middle East.⁷⁻¹¹ For example, a study conducted

Access this article online

Website:

<http://nepjol.info/index.php/AJMS>

DOI: 10.3126/ajms.v13i11.47137

E-ISSN: 2091-0576

P-ISSN: 2467-9100

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in Qatar reported that the mean age of the patients was 25.9 years, and at diagnosis at 32.3 years. The average delay in the diagnosis was 6.4 years. The disease was most prevalent among males (male: female ratio: 5.2:1). Human leukocyte antigen (HLA)-B27 was positive in the majority of patients (80.7%). Different disease features were reported as well.⁷ The mean value of disease severity and function was 3.3 and 2.9, respectively.

Until now, there is only one study about AS in this region. The study aimed to explore the prevalence of HLA-B*27 among the healthy Kurdish population and in patients with AS⁹ along with another conducted in Baghdad.¹²

Aims and objectives

In this study, we aimed to explore the clinical characteristics of AS patients in the Kurdistan Region of Iraq/Duhok governorate.

MATERIALS AND METHODS

Study design and sampling

In this cross-sectional study, the patients who attended the Specialized Centre of Rheumatic Diseases and Medical Rehabilitation were screened for the diagnosis of AS. The patients who were diagnosed with AS by a rheumatologist were included in this study. All patients were screened by a rheumatologist for the eligibility criteria. The patients of both genders without age restriction were eligible for this study irrespective of extra-articular manifestations of AS and sociodemographic aspects. The study was pre-approved by the Institutional Ethics Committee for the final permission. The patients with other rheumatic diseases were not included in this study. The patients who were diagnosed with AS and had other rheumatic diseases were eligible for this study.

Diagnosis and measures

The diagnosis of the study was established by the Spondylo Arthritis International Society (ASAS) classification criteria for axial spondyloarthritis.¹³

Disease severity

The severity of the diseases was assessed using “The Bath AS Disease Activity Index” (BASDAI).¹⁴ The BASDAI scale is used to assess the disease severity in patients with AS. It is a validated diagnostic test. The scale is a quick and simple index to determine the effectiveness of the current drug therapy for patients suffering from AS. The BASDAI has six questions for the five major symptoms of the disease; fatigue, spinal pain, joint pain or swelling, areas of localized tenderness, and morning stiffness duration and severity. The questions are rated between 0

and 10, where 0 means that there is no problem and 10 that the problem is severe. The formula for calculation of BASDAI score is

$$\text{BASDAI score} = (Q1 + Q2 + Q3 + Q4 + (Q5 + Q6)/2)/5,$$

Where Q means the points for each question.

The average of questions 5 and 6 was used because they both relate to the same symptom – morning stiffness. After performing all of the calculations, the total BASDAI score can range from 0 to 10 points. A higher score means worse disease severity.

Disease function

The function of AS was measured using the Bath AS Functional Index (BASFI). The scale is a set of ten questions designed to determine the degree of functional limitation in patients with AS. The first eight questions are about everyday tasks and are dependent on functional anatomy. The functional anatomy is bending, reaching, changing position, standing, turning, and climbing steps with or without rail. The final two questions assess the ability of patients in coping with everyday life. The items are rated between 0 and 10. On this scale, zero means no functional impairments, and 10 means maximal impairment. The scores of questions are added together and divided by 10 to obtain the total score of the function. The mean of the individual scores is calculated to get the overall mean score of the function. A higher score indicates a higher degree of functional limitations.¹⁵

The extra-articular manifestations of AS in the patients diagnosed with AS were recorded in a pre-designed questionnaire. The extra-articular manifestations of AS in the patients were obtained from their medical records registered in the center.

Statistical analysis

Categorical and continuous values were expressed as frequency (percentage) and mean (SD). Descriptive statistics were used to summarize the demographic, epidemiological, radiographic, and other clinical characteristics of the patients. The prevalence of extra-articular manifestations of AS among patients with AS was determined in number and percentage. Disease severity and function of patients with AS among patients with different severity were examined in an independent t-test or analysis of Variance one-way as appropriate. Controlling factors to function and disease of patients with AS were examined in standard least square with effect leverage. The significant level of difference was determined by $P < 0.05$. The statistical calculations were performed in JMP pro 14.3.0.

Ethical approval

The ethical approval of this study was taken from the Research Ethics Committee registered as the reference number 1342022-2-9 on April 13, 2022. The confidentiality of the personal information of the patients was protected throughout the study steps. The right of the patients to participate was protected in the study.

RESULTS

The mean age of the patients was 38.31 and mostly young and middle ages; 40 years and older (45.55%) compared to 25–39 years old (44.55%) and 17–24 years old (9.90%). Most of the patients were males (93.07%). Only seven patients were females (6.93%). The male: female ratio was 13.43:1. Most of the patients were normal sleepers (61.39%) followed by short sleepers (28.71%) and long sleepers (9.90%). We found that most of the patients were physically active through walking (95.05%) for 45–119 min/day (31.68%) and longer (34.65%) and few focused on moderate physical activity (9.90%) for 1–44 min (1.98%) and 45–119 min/day (5.94%) and only four patients did the vigorous physical activity. Close to two-thirds were from urban areas (74.26%) and the majority were Kurdish (99.01%). Only one patient was Chaldean (Table 1).

The age at symptoms onset of patients was 22.61 years between 7 and 56 years. The age at symptoms of most of the patients was between 10 and 39 years. The patients' disease was diagnosed at the mean value of 29.56 years and in different age groups. The age at diagnosis of most patients was after 5 years. The patients had different extra-articular manifestations of AS; peripheral arthritis (56.44%), sacroiliitis (bilateral: 91.09%), tenosynovitis (14.85%), plantar fasciitis (45.54%), achilles tendinitis (17.82%), anterior uveitis (23.76%), HLA-B27 (88.40%), and spinal involvement (94.06%). Most patients received the treatment (89.11%). The patients received different treatments, mostly received biological treatment (53.47%) followed by multiple treatments (29.70%) and non-steroidal (4.95%) and only 0.99% (one patient) used physical therapy. The median gap of diagnosis was 5 years (Table 2).

The study showed that the normal sleepers had a better function of diseases compared to short sleepers, 3.35 versus 5.32 ($P=0.0039$). In addition, those patients who did moderate physical activity had a better function of disease compared to those who did not do moderate physical activity, 1.28 versus 4.32; $P=0.0006$. The function of the disease was improved by increasing the duration of moderate physical activity and vigorous physical activity.

Table 1: General information of the patients with ankylosing spondylitis

General information (n=101)	Frequency distribution, n (%)
Age (17–65 years)	Mean: 38.31 (SD: 11.02)
15–24	10 (9.90)
25–34	31 (30.69)
35–44	31 (30.69)
45–54	22 (21.78)
55–65	7 (6.93)
Gender	
Male	94 (93.07)
Female	7 (6.93)
Sleeping	
Long sleeper	10 (9.90)
Normal sleeper	62 (61.39)
Short sleeper	29 (28.71)
Walking	
No	5 (4.95)
Yes	96 (95.05)
Walking category	
No walking	5 (4.95)
1–44 min	29 (28.71)
45–119 min	32 (31.68)
120 and longer	35 (34.65)
Moderate PA	
No	91 (90.10)
Yes	10 (9.90)
Moderate PA category	
No moderate PA	91 (90.10)
1–44 min	2 (1.98)
45–119 min	6 (5.94)
120 and longer	2 (1.98)
Residency	
Rural	26 (25.74)
Urban	75 (74.26)
Ethnicity	
Kurdish	100 (99.01)
Chaldean	1 (0.99)

PA: Physical activity, SD: Standard deviation

The study showed that the patients who had symptoms at earlier stages of life had better function compared to those patients who had symptoms at older ages. A similar pattern was found for the age at diagnosis (Table 3).

The study showed that the patients with normal sleepers had better disease severity (3.61) compared to short sleepers (6.18) and long sleepers (5.13; $P<0.0001$). In addition, the patients who did moderate physical activity and live in urban areas had better disease severity; 2.65 and 3.97 compared to those patients who did not do moderate physical activity and lived in rural areas; 4.52 and 5.39, respectively. The disease severity was not statistically significant in patients of different gender, walkers, and non-walkers, and at different ages at symptoms and diagnosis (Table 3).

The study showed that the patients without peripheral arthritis had better disease severity and function compared

Table 2: Medical information of patients with ankylosing spondylitis

Medical information (n=101)	Frequency distribution, n (%)
Age at symptoms (7–56 years)	22.61 (8.14)
0–9	4 (3.96)
10–19	39 (38.61)
20–29	42 (41.58)
30–39	14 (13.86)
40–49	1 (0.99)
50–59	1 (0.99)
Age diagnosis	29.56 (10.32)
10–14	4 (3.96)
15–19	11 (10.89)
20–24	15 (14.85)
25–29	25 (24.75)
30–34	14 (13.86)
35–39	16 (15.84)
40–44	7 (6.93)
45–49	6 (5.94)
50–54	1 (0.99)
55–59	1 (0.99)
60–64	1 (0.99)
Gap of diagnosis, median (IQR)	5 (7)
Peripheral arthritis	
No/Yes	44/57 (43.56/56.44)
Sacroiliitis	
None	6 (5.94)
Unilateral	3 (2.97)
Bilateral	92 (91.09)
Tenosynovitis	
No/Yes	86/15 (85.15/14.85)
Plantar fasciitis	
No/Yes	55/46 (54.46/45.54)
Achilles tendinitis	
No/Yes	83/18 (82.18/17.82)
Anterior uveitis	
No/Yes	77/24 (76.24/23.76)
HLA-B27	
No	8 (11.60)
Yes	61 (88.40)
Not done	32 (31.68)
Spinal involvement	
No/Yes	6/95 (5.94/94.06)
Treatment	
No treatment	11 (10.89)
Biological	54 (53.47)
Non-steroidal	5 (4.95)
Physical therapy	1 (0.99)
Multi-therapy	30 (29.70)

HLA: Human leukocyte antigen, IQR: Interquartile range

to those patients affected by peripheral arthritis. The patients with spinal involvement had worse disease severity (4.54) compared to the patients without spinal involvement (1.08; $P=0.0008$). The patients with achilles tendinitis had better disease function (2.13) compared to the patients without achilles tendinitis (4.17; $P=0.0042$). However, the patients with spinal involvement had worse disease severity and function compared to those patients without spinal involvement, 4.54 versus 1.08; $P=0.0008$ and 4.19 versus 1.37; $P=0.0125$, respectively (Table 4).

The study showed that worse disease severity is the only factor that predicts the worse disease function in patients with AS. Other factors did not predict the disease function in patients with AS (Table 5 and Figure 1).

The study showed that living in rural areas, short sleeping, and having spinal involvement are the main factors that predict the worse disease severity in patients with AS. Other general and medical factors did not predict the disease severity in patients with AS (Table 6 and Figure 2).

DISCUSSION

This study showed that most of the patients with AS were old males, normal sleepers, and were physically active through walking. The age at symptoms of the patients was wide and the disease was later diagnosed. The patients had different manifestations of AS and the most prevalent ones were bilateral sacroiliitis, peripheral arthritis, plantar fasciitis, HLA-B27, and spinal involvement. The study showed that the patients with normal sleepers, living in urban areas, and doing moderate physical activity had better disease severity and function. In addition, the patients who had symptoms at earlier stages of life and were diagnosed earlier had better disease function. The patients with spinal involvement had worse disease severity and function compared to the patients without spinal involvement. The worse disease severity is the only factor that predicts the worse disease function in patients with AS. However, living in rural areas, short sleeping, and having spinal involvement are the main factors that predict the worse disease severity in patients with AS.

The studies conducted in other regions of the Middle East and the world have shown that most of the patients are young and middle ages and male. For example, a study conducted in Qatar reported that the mean age of the patients with AS was 25.9 years compared to 38.31 years in our study. The male-to-female ratio was 5.2:1 compared to the highly different one in our study; the male: female ratio: was 13.43:1.⁷ A study conducted in Baghdad reported similar findings in terms of age (36.89 years) with a 10.11:1 male: female ratio¹² and that one conducted in the Kurdistan Region of Iraq.⁹ The male: female ratio reported in this study is a little bit different, despite the disease being more prevalent among males compared to females.^{8,10,11,16} The male: female ratio was 2.8:1 in Saudi Arabia,⁸ 8.1:1 in Jordan,¹⁰ and 8.6:1 in Korea.¹⁷

In addition, the disease was diagnosed late in this study. The diagnosis of AS is lately diagnosed in other countries as well.^{7,11} Most patients with AS are males. Another

Table 3: Disease severity and function of patients with ankylosing spondylitis (BASDAI)

Characteristics	BASDAI		BASFI	
	Mean (SD)	P	Mean (SD)	P
BASDAI, range	4.33 (2.49), 0–9.3		4.02 (2.70), 0–9.7	
Gender				
Female	6.07 (0.55)	0.0836	4.24 (2.84)	0.8207
Male	4.25 (2.53)		4.00 (2.71)	
Sleeping				
Short sleeper	6.18 (1.60)	<0.0005	5.32 (2.59)	0.0039
Normal sleeper	3.61 (2.43)		3.35 (2.55)	
Long sleeper	5.13 (1.77)		4.36 (2.72)	
Walking				
No	2.96 (2.20)	0.2082	3.12 (3.34)	0.4489
Yes	4.41 (2.50)		4.06 (2.68)	
Walking				
No walking	2.96 (2.20)	0.2828	3.12 (3.34)	0.5823
1–44 min	4.71 (2.28)		4.19 (2.64)	
45–119 min	4.68 (2.62)		4.41 (2.67)	
120 and longer	3.90 (2.55)		3.65 (2.74)	
Moderate PA				
No	4.52 (2.50)	0.0238	4.32 (2.64)	0.0006
Yes	2.65 (1.80)		1.28 (1.50)	
Moderate PA category				
No	4.52 (2.50)	0.1062	4.32 (2.64)	0.0077
1–44 min	1.75 (0.49)		1.5 (2.12)	
45–119 min	3.3 (1.86)		1.4 (1.67)	
120 and longer	1.6 (2.26)		0.7 (0.99)	
Vigorous PA				
No	4.43 (2.48)	0.0507	4.16 (2.66)	0.0065
Yes	1.95 (1.63)		0.45 (0.53)	
Residency				
Rural	5.39 (2.50)	0.0113	4.65 (2.59)	0.1650
Urban	3.97 (2.40)		3.80 (2.72)	
Age at symptoms				
0–9	2.85 (1.24)	0.3374	0.75 (0.31)	0.0367
10–19	4.39 (2.48)		3.93 (2.71)	
20–29	4.40 (2.49)		4.15 (2.40)	
30–39	4.87 (2.71)		5.23 (3.18)	
40–49	2.4		2	
50–59	0.0		0	
Age diagnosis				
10–14	2.35 (1.69)	0.1312	0.55 (0.48)	0.0332
15–19	3.79 (2.56)		3.2 (2.43)	
20–24	4.31 (2.10)		4.07 (2.91)	
25–29	5.2 (2.22)		4.41 (2.39)	
30–34	3.89 (3.14)		4.16 (3.27)	
35–39	4.5 (2.09)		4.88 (2.30)	
40–44	3.76 (3.04)		4.06 (2.77)	
45–49	3.82 (2.30)		2.68 (1.62)	
50–54	8.1		6.7	
55–59	8.1		9.7	
60–64	0		0	

BASDAI: The Bath Ankylosing Spondylitis Disease Activity Index, BASFI: The Bath Ankylosing Spondylitis Functional Index, PA: Physical activity, The bold numbers show the significant differences.

possible reason for this late diagnosis could be the misdiagnosis or incorrect diagnosis by clinicians. The delay in diagnosis put the patients at a higher risk of disease severity and function. In this study, the patients who were diagnosed lately had worse disease severity and function in this region. Therefore, it is important to diagnose the disease as much as at the early stages. The duration of disease diagnosis is different based on the geographic areas.^{9,11,16} Patients with AS consult a



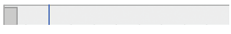
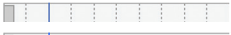
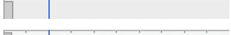
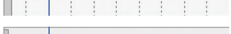
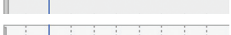
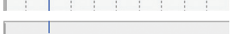
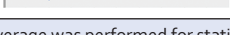
different group of health-care providers due to having extra-articular manifestations of AS from primary care physicians to orthopedic surgeons, to different medical and surgical specialists. The patients may receive unnecessary and often invasive investigations resulting in a delay in diagnosis.¹⁸ A study conducted in India reported that the main factors contributing to delay in diagnosis are incorrect diagnosis as non-specific back, degenerative disc disease, rheumatoid arthritis, and

Table 4: Disease severity of patients with medical information in patients ankylosing spondylitis (BASADI)

Medical information (n=101)	Disease severity (BASADI)		Disease function (BASFI)	
	Mean (SD)	P	Mean (SD)	P
Peripheral arthritis				
No	3.50 (2.39)	0.0027	3.08 (2.25)	0.0019
Yes	4.98 (2.40)		4.74 (2.81)	
Sacroiliitis				
None	2.73 (2.23)	0.1734	4.3 (2.59)	0.8459
Unilateral	3.1 (1.82)		3.2 (3.15)	
Bilateral	4.48 (2.50)		4.03 (2.72)	
Tenosynovitis				
No	4.24 (2.51)	0.3489	3.89 (2.61)	0.2687
Yes	4.89 (2.41)		4.73 (3.17)	
Plantar fasciitis				
No	4.09 (2.63)	0.2764	3.71 (2.57)	0.2138
Yes	4.63 (2.32)		4.38 (2.84)	
Achilles tendinitis				
No	4.49 (2.52)	0.1903	4.17 (2.6)	0.0042
Yes	3.63 (2.29)		2.13 (1.52)	
Anterior uveitis				
No	4.36 (2.54)	0.8445	4.04 (2.70)	0.8957
Yes	4.25 (2.40)		3.95 (2.75)	
HLA-B27				
No	5.79 (2.62)	0.1270	5.55 (2.55)	0.2240
Not done	3.82 (2.44)		4.07 (2.46)	
Yes	4.41 (2.46)		3.79 (2.82)	
Spinal involvement				
No	1.08 (0.96)	0.0008	1.37 (1.89)	0.0125
Yes	4.54 (2.42)		4.19 (2.67)	
Treatment				
No treatment	5.33 (2.41)	0.5950	5.13 (3.30)	0.3250
Biological	4.03 (2.57)		4.03 (2.67)	
Non-steroidal	4.8 (2.53)		4.64 (2.39)	
Physical therapy	3.8		0.30	
Multi-therapy	4.45 (2.43)		3.61 (2.53)	

BASDAI: The Bath Ankylosing Spondylitis Disease Activity Index, BASFI: The Bath Ankylosing Spondylitis Functional Index, HLA: Human leukocyte antigen, SD: Standard deviation, The bold numbers show the significant differences.

Table 5: Controlling factors to function of patients with ankylosing spondylitis

Factors (n=101)	Outcome: Disease function (BASFI)	P
BASDAI score		0.00001
Sleeping		0.19774
Age category		0.20871
Age diagnosis category		0.40510
Treatment		0.47454
Moderate PA category		0.49153
Gender		0.62191
Walking category		0.86773
Residency		0.99829

Standard least square with effect leverage was performed for statistical analyses. The red bold number shows the predictor. BASDAI: The Bath Ankylosing Spondylitis Disease Activity Index, BASFI: The Bath Ankylosing Spondylitis Functional Index, PA: Physical activity

tuberculosis of the spine. This incorrect diagnosis results in prolonged receiving time by patients. Furthermore, the absence of extra-articular manifestations and juvenile age substantially related to diagnostic delay.¹⁸

In agreement with the findings in our study,¹⁸ reported that diagnostic delay is substantially associated with worse disease severity and function as measured by BASDAI and BASFI. The most initial incorrect diagnoses were confirmed among orthopedics (75.9%), followed by general physicians (50%), and rheumatologists (12%). Therefore, the health-care providers need continuous education courses for the correct diagnosis of inflammatory back pain may assist in the early diagnosis of AS.

The disease severity and function of our patients in this region were worse compared to the patients in other regions.^{7,19} Living in rural areas, short sleeping, and spinal involvement were predictors of disease severity and indirectly disease function in this study. The patients who live in rural areas have less opportunity for follow-up services since we have only one center of rheumatologic disease in the Duhok governorate. The spinal involvement may back to the effects of the treatment or late diagnosis of the disease. The spinal involvement may back to the effects of extra-articular manifestations of AS in patients.

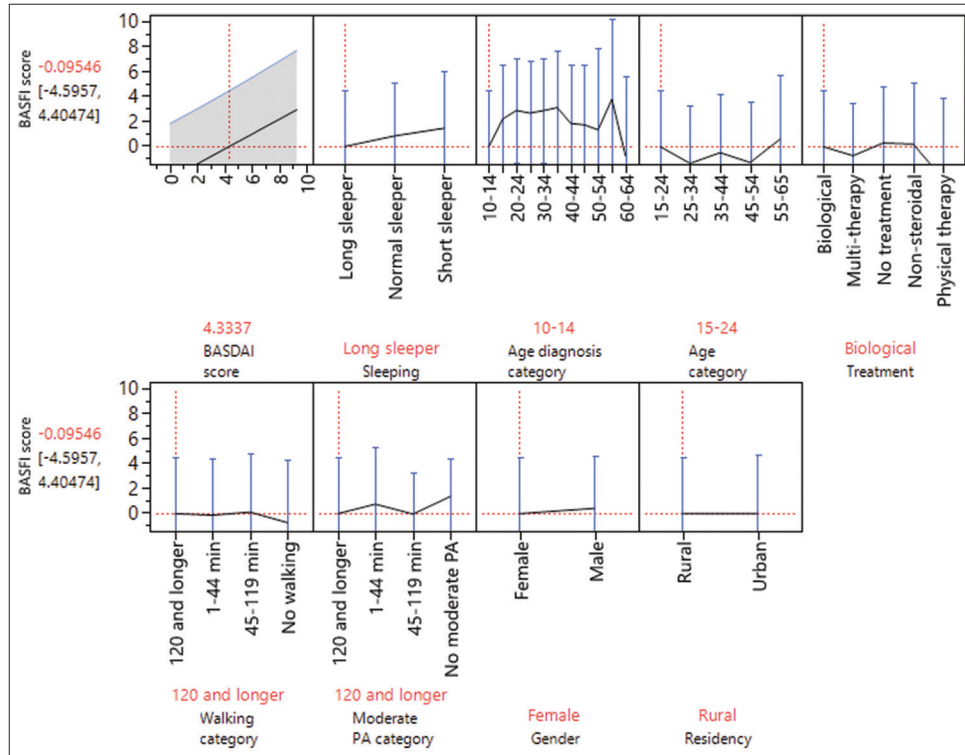


Figure 1: Controlling factors to function of patients with ankylosing spondylitis

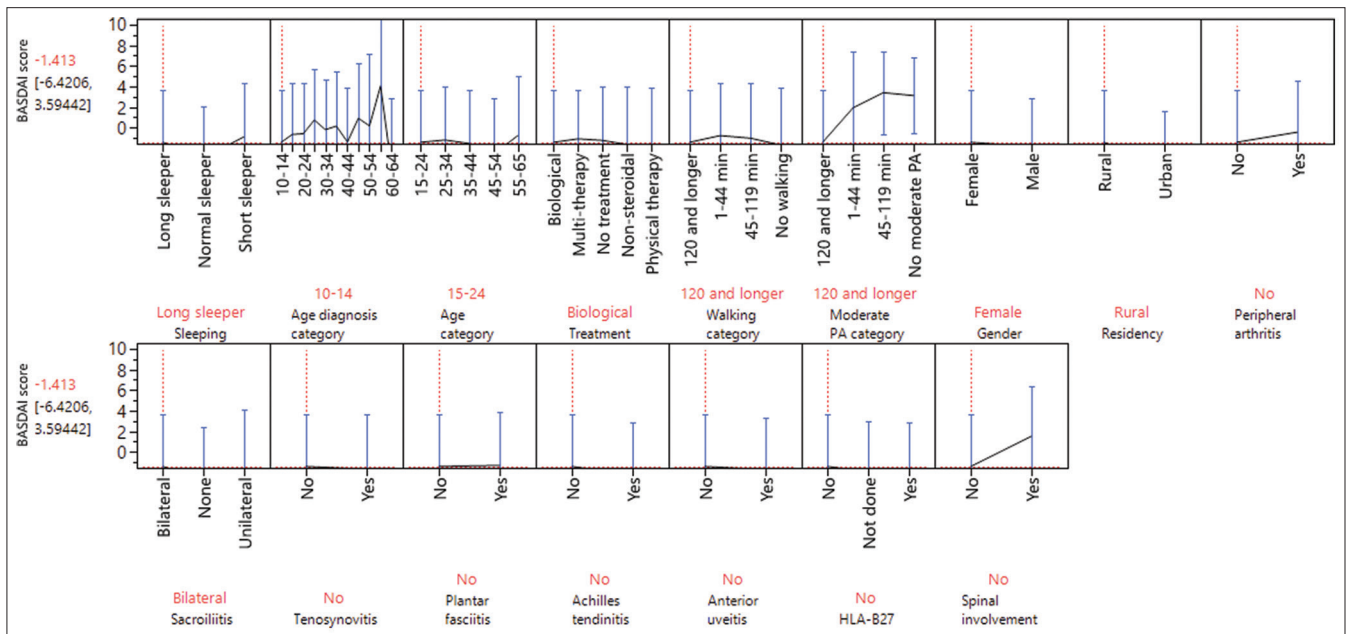


Figure 2: Controlling factors to disease severity in patients with ankylosing spondylitis

The higher prevalence of juvenile-onset and extra-articular manifestations in the form of uveitis, dactylitis, and enthesitis in patients with peripheral arthritis may have a role in further pathogenies. The patients with peripheral arthritis (more than half of the patients in our study) may have had an aggressive form of the disease as indicated by higher ESR levels, worse spinal indices,

higher frequency of enthesitis, and more common whole spine involvement.¹⁹

Limitations of the study

The strong point of this study is that we tried to include as many as possible the patients who were registered in the center. Only a few patients were missed from this study

Table 6: Controlling factors to disease severity in patients with ankylosing spondylitis

Controlling factors (n=101)	Outcome: Disease severity (BASDAI)	P
Residency		0.00023
Sleeping		0.00307
Spinal involvement		0.00648
Moderate PA category		0.05431
Peripheral arthritis		0.06357
Age diagnosis category		0.12913
Achilles tendinitis		0.18802
Age category		0.35491
Sacroiliitis		0.40070
Anterior uveitis		0.56336
Gender		0.64254
Tenosynovitis		0.70478
Walking category		0.71043
HLA-B27		0.82460
Plantar fasciitis		0.84749
Treatment		0.89279

Standard least square with effect leverage was performed for statistical analyses. The red bold numbers show the predictors. BASDAI: The Bath Ankylosing Spondylitis Disease Activity Index, PA: Physical activity, HLA: Human leukocyte antigen

as they were not available despite contacting them several times. This is a cross-sectional study limiting us to make a causal pathway for the disease severity and function. However, it gives a good picture of the prevalence of extra-articular manifestations of AS and the association of disease severity and function with sociomedical information. This gives us a golden way of the management of these patients.

CONCLUSION

This study showed that the scores of disease severity and function of patients with AS are high in this region. The disease of the patients was diagnosed lately. The disease severity and function were associated with healthy lifestyles such as sleeping and physical activity. Living in rural areas, short sleeping, and spinal involvement were predictors of disease severity in patients with AS.

ACKNOWLEDGMENTS

The authors of the study would like to present deep thanks to the patients and administration of the "Specialized centre of rheumatic diseases and medical rehabilitation" in Duhok city in Kurdistan Region. In addition, we would like to present deep thanks and gratitude to Mr Deldar Morad Abdulah for statistical calculations and critical review of the manuscript.

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Source of Funding: None, **Conflicts of Interest:** None.