The importance of quality of life for work outcomes in patients with ankylosing spondylitis: a cross-sectional study

Taser B[1], Ayhan FF[1], Borman P[2]

ACTA REUMATOL PORT. 2017;42:300-309

ABSTRACT

Aims: Work impairment is one of the most important exploration and one of the aims of rheumatologists. We aimed to determine the risk factors for employment state and predictive factors of work outcomes using multi-dimensional measures in patients with ankylosing spondylitis (AS) in this comprehensive study.

Methods: One hundred patients with AS (31 females and 69 males) were included into this study. Demographic properties, local factors, disease activity (BASDAI), functionality (BASFI), spinal mobility (BASMI), radiologic stage (BASRI), quality of life (AS-QoL), cardiopulmonary involvement, exercise stress test and work outcomes were investigated and compared in employed and un-employed patients. The work instability scale (AS-WIS) and work productivity activity impairment scale (WPAI:SpA) were selected as work outcomes. The predictive factors were analyzed using multiple stepwise linear regressions.

Results: Thirty-two patients (mean age: 42,6±11.7) were unemployed and the risk factors for unemployment state were female sex, lower annual income level, and older age. Work disability was detected only in 5% of patients. Decreased chest mobility *(beta: -0.398, p: <0.001)*, low annual income level *(beta:-0.291, p:<0.001)*, higher co-morbidities *(beta:0.237, p:0.004)*, poorer AS-QoL *(beta:0.238, p:0,012)* and poorer AS-WIS score *(beta:0.289, p: 0,004)* were the predictors of work impairment. The predictive factors for work instability were higher work impairment *(beta:0.533, p<0.001)* and poorer AS-QoL *(beta: 0.426, p<0.001)* scores.

Conclusions: Employment state depends on contextual factors including male sex, higher income, and younger age. Socioeconomic factors as well as clinical data such as QoL were predictive for work productivity. Poorer AS-QoL was also a predictive factor for work instability. We suggested effective interventions to improve clinical and economic status in patients with AS.

Key words: ankylosing spondylitis, patient-reported outcomes, work, quality of life, cardiac involvement

1. Rheumatology division, Department of Physical Medicine & Rehabilitation, Ankara Training and Research Hospital, Ankara, Turkey
2. Rheumatology division, Department of Physical Medicine & Rehabilitation, Hacettepe Medical School

INTRODUCTION

Ankylosing spondylitis (AS) is a chronic, inflammatory, progressive, and disabling disease that commonly starts in the early working years of life[1–5] and leads to increased lifetime costs and socioeconomic impacts[5–8]. This work disability (WD) is an important problem, and its economic burden has emerged in the worldwide even if the absent data reported from some geographic regions.

Work problems are reportedly more common in patients with AS than in the general population[6–10]. Work productivity impairment, work instability, and WD are main stages of work outcomes used in patients with AS. These outcomes are affected by a number of local factors primarily due to variations in social security and healthcare systems[6]. A meta-analysis of European and American studies showed WD rates varying from a low of 3% to a high of 50%[9], and unemployment due to WD may be three times higher in patients with AS than in the general population[10]. Losses in work productivity, workforce, and, consequently, work instability develop in the period prior to WD[11,12]. However, AS can be treated before work disablement to mitigate the socioeconomic burden of the disease. If work productivity impairment and work instability are recognized early, the risk of WD can be reduced or eliminated by appropriate clinical and work place interventions.

The Work Productivity and Activity Impairment Scale for AS (WPAI-SpA)[11,13-19] and Work Instability Scale (AS-WIS)[18,19] were developed as outcomes to measure the impact of AS on working conditions and they are the main patient-reported working outcomes used in AS-biologic treatment trials[15-19].

Contextual factors such as age, sex, marital status, smoking state, and work features were recently found to be important considerations when designing and interpreting studies on work outcomes[20,21]. Extra-articular involvement was reported as another significant factor in some studies[6,10], but details of the cardiopulmonary status were ignored in all of these studies despite the importance of this parameter in individuals' health conditions. The results of national surveys in different countries have shown that patients with AS experience major problems in their working life[22–25].

To the best of our knowledge, no study has yet reported the factors affecting all stages of work outcomes in the AS population using official employment statistics and comprehensive evaluations including cardiopulmonary functions.

Because disease-related, cardiopulmonary, contextual, and socio-economic factors contribute to work limitations in patients with AS, comprehensive studies involving employees registered in the regional social security system are also necessary. Therefore, in this work, we aimed to investigate the predictive factors of employment status, work productivity and work instability in patients with AS.

MATERIALS AND METHODS

PATIENTS

Patients were consecutively selected from the rheumatology unit of a tertiary-care hospital in the period of one-year recruitment. The sample size requirements for Rasch analysis are based upon the degree of precision required for estimates of item difficulty and person ability.[18] Patients were included in this study according to the modified New York AS criteria[26]. Patients were excluded if they were below 18 and above 65 years of age because of obvious limitation in their working life. Patients were also excluded if they reported contraindications to exercise stress tests[27]. Demographic and patient-reported health data, including co-morbidities, smoking, alcohol consumption, exercise habits, past medical history, medications, and family history of AS, were recorded. Oral informed consent was obtained from all patients, and the study was carried out in compliance with the Helsinki Declaration. Approval for this research was provided by the Ethical Committee of the Hospital.

QUESTIONNAIRES AND OUTCOMES

Visual analog scales (10 cm-VAS) for pain, morning stiffness (minutes), and patients' and physicians' global scores were recorded. The Bath AS indices of global score (BAS-G), disease activity (BASDAI), function (BASFI), and quality of life (AS-QoL) questionnaire were applied to the patients[28–31]. The indices of Bath AS Metrology (BASMI), radiography (BASRI), and enthesopathy state (Maastricht AS enthesitis score) were also investigated[32–34] in all patients. The same fellow (BT) applied the questionnaires to the patients and performed the BASMI and Mastricht AS enthesitis score.

Secondary causes of AS (e.g., psoriasis, inflammatory bowel disease) and extra-articular involvement (e.g., uveitis, pulmonary and cardiac involvement) were also evaluated.

LABORATORY INVESTIGATION

Blood biochemistry, flow-cytometric complete blood, Westergreen-erythrocyte sedimentation rate (mm/ /hour), nephelometric serum c-reactive protein, and IgA testing were performed on the same day. Microscopic and dipstick urine results were evaluated, and an HLA-B27 genetic mutation study was performed using the PCR technique.

RADIOGRAPHIC EVALUATION

Lateral cervical, AP, and lateral lumbosacral, and AP pelvis radiographs were obtained by digital imaging, and images were evaluated for BASRI scoring[33] by the same radiologist.

CARDIOPULMONARY INVOLVEMENT

Two experienced cardiologist and chest specialist were investigated cardiopulmonary involvement of AS using echocardiography, exercise tolerance test, high resolution computed tomography, and pulmonary function tests. Echocardiography (Echo) to detect ejection fraction (EF), aortic valve insufficiency (AVI), and left ventricle diastolic dysfunction (LVDD) was analyzed. The echocardiographic diagnosis of AVI or LVDD was evaluated as cardiac involvement of AS. Symptom-limited exercise stress tests were applied to the patients to detect aerobic capacity and peak or ma-

ximum MET level considering MET values for occupations. Pulmonary function tests (PFT) and high resolution computed tomography (HRCT) scans were also obtained from the patients to investigate pulmonary involvement of AS.

WORK OUTCOMES

The analysis of employment status was recorded as employee or un-employed, and workers were classified according to their type of the work as blue-collar workers or office workers.

Workers with AS were also asked about their employment history, workforce loss (days) in the last 1 year, work instability, WD, and retirement due to disability. Unemployed patients were also asked about their employment history, WD, and retirement due to disability. Annual income levels were classified in accordance with the 2013 report of the Confederation of Trade Unions[35] as follows: hunger limit, poverty limit, and normal limit.

The WPAI-SpA was used to evaluate work outcomes[11,12]. The WPAI-SpA questionnaire is a self-administered instrument used to assess the impact of AS on work and daily activities during the past 7 days and consists of 6 questions. WPAI outcomes were expressed as impairment percentages, with higher numbers indicating greater impairment and less productivity, i.e., worse outcomes. Absenteeism, presenteeism, overall work impairment and daily activity impairment are the main components of WPAI[11,12]. While absenteeism refer to a phenomenon when persons cannot attend their work (either due to temporary sick leave or permanent worker disability), presenteeism refers to the reduced performance or productivity while at work because of health reasons.

The AS-WIS was used to detect work instability (a mismatch between a worker's abilities and his/her job demands) in employees with AS[18,19]. The instrument is a disease-specific 20-item questionnaire, and answers were applied to define low, moderate, or high risk of work instability (0 = no; 20 = maximum risk of work instability). The cut-off point for low and high levels of work instability risk was 11[18,25].

STATISTICAL ANALYSIS

SPSS Statistics 20.0 (Chicago, IL, USA) was used for all analyzes. Descriptive statistics for numeric (mean ± SD or median [min–max]) and categorical (number, %) variables were summarized. The hypothesis of normal distribution for numerical variables was analyzed via the Kolmogorov–Smirnov test, and similarities of group variances were analyzed via the Levene test. Student's *t* test was used for comparisons of parametric numeric variables, and the Mann–Whitney U test was applied for comparisons of non-parametric numeric variables. The Kruskal–Wallis test was applied to comparisons of numeric variables of more than two groups, and the chi-squared test was used for comparisons of categorical variables. The Spearman correlation test was used to detect possible relationships between numeric variables. After detection of correlated factors for work outcomes, regression analysis was used. Factors affecting employment state, work productivity, and work instability were analyzed using logistic regression and multiple step-wise linear regression with 'forward selection' approach, and statistical significance was determined at $p < 0.05$.

RESULTS

EMPLOYMENT STATE

The AS patients in this study consisted of 68 employees and 32 unemployed persons. Comparisons of demographics, medical history, and socioeconomic variables of the employee and unemployed groups are shown in Table I. The frequency of male sex, the levels of education and annual income were higher in employee group than unemployed group ($p<0.05$).

The clinical, laboratory, and radiographic variables of the employee and unemployed groups are shown in Table II. The clinical, laboratory and radiographic characteristics of both groups were similar ($p > 0.05$). The frequencies of low disease activity (90.6% vs. 82.4%) and high disease activity (9.4% vs. 17.6%) related to BASDAI (cut-off: 4) were not significantly different between groups ($p > 0.05$).

The frequencies of cardiopulmonary involvement (pulmonary function test, HRCT, echocardiography) were similar, but estimated aerobic capacities (peak MET on exercise stress test) differed between groups and are shown in Table III.

The frequencies of psoriasis (3.1% vs. 2.9), inflammatory bowel disease (0.0% vs. 2.9%), and uveitis (28.1% vs. 16.2%) were not different between groups ($p > 0.05$). No difference in the time, type, and dose of pharmacologic treatment was also observed between groups ($p > 0.05$). NSAIDs were the most prescribed treatment (90.6% vs. 95.6%), followed by SSZ (43.8% vs. 39.7%) and anti-TNFs (18.8% vs. 13.2%)

TABLE I. THE COMPARISONS OF DEMOGRAPHICS, MEDICAL HISTORY, AND SOCIOECONOMIC VARIABLES OF THE EMPLOYEE AND UNEMPLOYED GROUPS

	Un-employed (n=32)	Employee (n=68)	p
Age (mean ±SD)	42.6 ±11.7	41.3 ± 9.1	0.541
Duration of AS (years)	9.6 ± 8 (1-34)	8.2 ± 7.8 (1-33)	0.266
Delayed time of diagnosis (years)	3.4 ±2.7 (1-12)	4.6 ± 5.8 (1-27)	0.838
Male sex (n,%)	8. 25%	61. 89.7%	<0.001*
Education level			0.009*
Elementary	26 (%81.3)	39 (57.4%)	
High school	5 (%15.6)	17 (%25)	
University	1 (%3.1)	11 (%16.2)	
PhD	0 (%0)	1 (%1.5)	
Married (n,%)	31 (96.9%)	57 (83.8%)	0.097
Number of child (median [min-max])	2 [0 – 7]	2 [0 – 6]	0.127
Body mass index (mean ±SD)	26.2 ± 4.4	26.6 ± 4.5	0.712
Total co-morbidities (n,%)	6 (%18.8)	7 (%10.3)	0.339
Diabetes mellitus (n,%)	2 (6.3%)	4 (5.9%)	1.000
Hypertension (n,%)	2 (6.3%)	5 (7.4%)	1.000
Coronary artery disease (n,%)	1 (3.1%)	0 (0%)	0.320
History of major surgery (n,%)	16 (50%)	23 (33.8%)	0.184
Smoker (n,%)	11 (34.4%)	36 (52.9%)	0.128
Alcohol intake (n,%)	1 (3.1%)	10 (14.7%)	0.100
Family history of AS (n,%)	12 (37.5%)	12 (17.6%)	0.055
Annual income level			
Hunger limit	13, 40.6%	13, %19.1	
Poverty limit	18, 56.3%	43, 63.2%	0.023*
Normal	1, 3.1%	12, 17.6%	

*statistically significant difference, p<0.05)

in groups. The frequencies of additional medications did not differ (62.5% vs. 51.5%) between groups (p = 0.413). Non-pharmacological treatments, including regular exercise (50.0% vs. 36.8%) and physical therapy (28.1% vs. 36.8%) showed similar frequencies (p > 0.05). However, the employed group performed AS-specific exercises more frequently than the unemployed group (0% vs. 20%; p = 0.009).

In our sample, blue-collar workers outnumbered office workers (72.1% vs. 27.9%). Twelve patients (17.9%) changed jobs to an easier one because of AS. Withdrawal from the labor force due to AS or WD was 5%. Three percent of the patients had retired due to WD from AS. The mean length of sick leave was 8.6 ± 17.3 days (median, 5 days; range, 0–120 days).

Logistic regression analysis showed factors affecting employment status. Male sex (odds ratio: 97.203, %95 CI: 16.755 – 563.906, *p<0,001)*, income level (odds ratio: 22.631, %95 CI: 1.684 – 304.184, *p=0,019)* and age (odds ratio: 0.900, %95 CI: 0,833 – 0,972, *p=0,007)* were the risk factors of unemployed state.

WORK PRODUCTIVITY

The WPAI components were 8% for absenteeism (WPAI-1), 44% for presenteeism (WPAI-2), 47% for overall work impairment (WPAI-3), and 37% for daily activity impairment (WPAI-4). Mean score of AS-WIS was 11,5 ± 5,8 [0–20].

Patients using anti-TNF and medications for co-morbid diseases showed higher scores of presenteeism (p = 0.001, p = 0.002), overall work impairment (p = 0.018, p = 0.002), and daily activity impairment (p = 0.004, p = 0.011) than patients who did not use these medications.

The scores of BASDAI, BASFI, BASMI, and BASRI were moderately related to WPAI-2 (r=0.382, r=0.468,

TABLE II. COMPARISONS OF CLINICAL. LABORATORY. AND RADIOGRAPHIC VARIABLES OF THE UNEMPLOYED AND EMPLOYEE GROUPS

	Un-employed (n=32)	Employee (n=68)	p
Pain-spine (mean ±SD)	2 ± 2.3	2.8 ± 2.1	0.050
Pain at rest (mean ±SD)	1.8 ± 2.1	1.9 ± 2.3	0.865
Pain at night (mean ±SD)	2.1 ± 2.6	2.3 ± 2.5	0.635
Pain-sacroiliac (mean ±SD)	1.7 ± 2	2.3 ± 2.5	0.354
Pain-arthritis (mean ±SD)	0 ± 0	0.2 ± 1.2	0.330
Pain-enthesitis (mean ±SD)	0.8 ± 2.1	0.5 ± 1.6	0.548
Time of morning stiffness (mean ±SD)	8.8 ± 22.8	11.8 ± 23.7	0.360
BAS-G (mean ±SD)	2.5 ± 2.3	3.4 ± 2.1	0.049
BASDAI (mean ±SD)	1.8 ± 1.4	2.2 ± 1.5	0.101
BASFI (mean ±SD)	1.3 ± 1.6	1.7 ± 1.8	0.175
BASMI (mean ±SD)	2.6 ± 2.6	2.3 ± 2.3	0.574
BASRI-total (mean ±SD)	8.1 ± 2.5	8.4 ± 3	0.789
BASRI-hip (mean ±SD)	1.3 ± 1	1.4 ± 0.9	0.597
Patient' global (mean ±SD)	2.9 ± 2.2	3 ± 2	0.865
Physician' global (mean ±SD)	2.6 ± 1.8	2.8 ± 1.9	0.686
MASES (mean ±SD)	0.4 ± 1.3	0.2 ± 0.7	0.455
AS-QoL (mean ±SD)	4.8 ± 4.5	5.0 ± 4.8	0.902
ESR (mm/hr)	16 ± 12.2	14.1 ±10.4	0.582
CRP (mg/dL)	0.7 ± 0.7	1.1 ±1.3	0.055
HLA-B27 (n,%)	22 (68.8%)	43 (63.2%)	0.753

*statistically significant difference, p<0.05

r=0.487, r=0.440, *p<0,001),* WPAI-3 (r=0.361, r=0.441, r=0.459, r=0.421, *p<0,001),* and WPAI-4 (r=0.368, r=0.575, r=0.526, 0.487, *p<0,001).* Patient and physician global scores were also related to WPAI-2 (r=0.365, r=0.482, *p<0.001*), WPAI-3 (r=0.327, r=0.443, *p<0.001*), and WPAI-4 (r=0.427, r=0.491, *p<0.001*). The score of AS-QoL and the length of sick leave (day/year) were related to all WPAI scores (r=0.367, r=0.505, r=0.529, r=0.541, and r=0.465, r=0.414, r=0.460, r=0.483, *p<0,001).* The score of MASES was weakly related to WPAI-2 and WPAI-4 (r=0.244, r=0.320, *p<0.05*). The length of morning stiffness (minutes) and entesopathy-pain score were also weakly related to WPAI-4 (r=0.259, r=0.358, *p<0.05*). Laboratory tests, cardiopulmonary functions, and extra-articular involvement were not related to work productivity (p > 0.05).

WORK INSTABILITY

All WPAI scores were higher in the high work instability group than in the low work instability group (*p<0.001).* Work instability score was high in 39 patients (57.4%) and low in 29 patients (42.6%). Demographic and socioeconomic variables and past medical history did not differ between the high and low work instability groups (p>0.05).

More patients with high work instability reported co-morbid diseases and related medications compared with patients with low work instability (10.3% vs. 0%, p = 0.017 and 36.8% vs. 14.7%, p = 0.03). Sacroiliac pain, patient and physician global scores, and BASDAI, BASFI, BASRI-hip, and AS-QoL scores were higher in the high work instability group than in the low work instability group; the relevant results are shown in Table IV. The frequency of patients with high disease activity (BASDAI ≥ 4) was higher in the high work instability group than in the low work instability group (16.2% vs. 1.5%; p=0.02).

The frequencies of extra-articular involvement, psoriasis (1.5%), inflammatory bowel disease (2.9% vs. 0%), uveitis (8.8% vs. 7.3%), cardiac (16.2% vs. 7.3%), and pulmonary involvement (17.6% vs. 7.3%) were not statistically different between the high and low work instability groups (p>0.05).

TABLE III. THE COMPARISONS OF FREQUENCIES OF CARDIOPULMONARY INVOLVEMENT IN THE EMPLOYEE AND UNEMPLOYED GROUPS

	Un-employed (n=32)	Employee (n=68)	p
Pulmonary involvement	9 (30%)	20 (29.9%)	1
Restrictive lung disease	9 (30%)	18 (26.9%)	0.942
Obstructive lung disease	7 (23.3%)	17 (25.4%)	1
Mixed	7 (23.3%)	13 (19.4%)	0.864
Interstitial lung disease	0 (0%)	5 (7.8%)	0.320
Cardiac involvement	11 (35.5%)	16 (24.6%)	0.387
Ejection fraction	64.2 ± 3.8	62.8 ± 3.7	0.088
Left Ventricle Diastolic Dysfunction	8 (25.8%)	14 (21.5%)	0.837
Aortic Valve Insufficiency	4 (13.3%)	5 (7.7%)	0.457
Peak MET (aerobic capacity)	11.2 ± 2.1	13.7 ± 2.6	<0.001*

*statistically significant difference, p <0.05).

TABLE IV. COMPARISONS OF DISEASE AND WORK PRODUCTIVITY OUTCOMES IN THE LOW AND HIGH WORK INSTABILITY GROUPS

	low work instability (n=29, 42.6%)		high work instability (n=39, 57.4%)		
	mean ±SD	median	mean ±SD	median	p
BASDAI	1.6±1.0	–	2.7±1.7	–	0.001*
BASFI	1.1±1.2	0.9 [0-4.5]	2.2±2	1.2 [0-7]	0.020*
BASMI	1.8±2.1	1 [0-6]	2.7±2.3	3 [0-7]	0.091
BASRI-total	7.8±2.7	7 [4-15]	8.9±3.1	8 [4-16]	0.055
BASRI-S	6.6±2.1	6 [4-11]	7.4±2.3	7 [4-12]	0.112
BASRI-hip	1.1±0.8	1 [0-4]	1.6±1	1 [0-4]	0.041*
MASES	0.1±0.4	0 [0-2]	0.4±0.9	0 [0-3]	0.107
AS-QoL	1.8±2.2	1 [0-7]	7.4±4.8	7 [0-17]	<0.001*
sick leave (days/year)	2.6±3.9	0 [0-10]	13.1±21.7	5 [0-120]	0.004*
WPAI (Work Productivity Activity Impairment)					
WPAI-1	0.7±3	0 [0-16]	13.1±25.8	0 [0-100]	0.006*
WPAI-2	26.2±23.4	30 [0-80]	57.9±23.1	70 [10-100]	<0.001*
WPAI-3	26.8±23.2	30 [0-80]	61.9±24.5	70 [10-100]	<0.001*
WPAI-4	23.1±16.3	20 [0-50]	46.4±20.7	50 [0-100]	<0.001*

*statistically significant difference, p <0.05).

A total of 43 patients were positive for HLA-B27, and the distribution of the positivity did not differ significantly between the high work instability (36.8%) and low work instability (26.5%) groups (p=1). Interstitial lung disease was detected in 5 patients with similar distributions between groups (2.9% vs. 4.4%; p=1). The frequencies of LVDD (14.7% vs. 5.5%), AVI (5.9% vs. 1.5%), and EF (62.9% vs. 62.7%) were also similar between the high and low work instability groups (p>0.05). Estimated aerobic capacity was also similar (14 MET vs. 13.5 MET) between groups (p=0.461).

The type of work (blue-collar workers, 41.2%; office workers, 20.9%), change of work (11.8% vs. 5.9%), withdrawal from labor due to AS (5.9% vs. 0.0%), and retirement due to disability (1.5% vs. 0.0%) were not significantly different between the high and low work

instability groups (p>0.05). WPAI scores and sick leave reports were higher in the high work instability group than in the low work instability group (p<0.05) and are shown in Table IV.

The predictive factors of work productivity and work instability were determined after multiple stepwise linear regression analysis and are shown in Table V. Both disease-related (chest expansion, AS-QoL, co-morbidities) and work-related (change of work, annual income) factors were responsible for impairments in workplace productivity and daily life.

DISCUSSION

We found that female sex, lower income level, and older age were risk factors for unemployment status in patients with AS. Quality of life was the common predictor of the measures of work productivity and work instability in the present study. According to our results, overall work impairment was strongly related to chest mobility, co-morbidities, work instability, and annual income level, in addition to quality of life.

The employment rate was 68% in the present study, and this value was compatible with previous papers reporting a 34%–96% employment rate among patients with AS from different countries[9,22,36,37]. Some studies have reported that patients with AS show a similar[6] or lower employment rate[10,38] than the general population. Eight patients (8%) were unemployed due to WD (5%) or retired (3%) because of AS, which is comparable with the unemployment rate of the general population (10.1%) reported by official employment statistics.[39] In contrast to our results, WD was estimated to be three times greater in patients with AS than in the general population in the Netherlands[10]. Comparison between different studies is difficult because marked differences in patient populations, such as pro-

TABLE V. PREDICTIVE FACTORS OF WORK PRODUCTIVITY ACTIVITY IMPAIRMENT (WPAI) AND WORK INSTABILITY (WIS)

	Factor* (n=68)	Regression coefficient	Standardized (beta) regression coefficient	p	R2
AS-Work Instability Scale	WPAI-3	0.104	0.533	<0.001*	%70.3
	AS-QoL	0.519	0.426	<0.001*	
WPAI-1 (absenteeism)	length of sick leave (day/year)	0.502	0.425	<0.001*	%18.0
WPAI-2 (presenteeism)	chest expansion	-7.985	-0.398	<0.001*	%78.4
	annual income	-13.584	-0.291	<0.001*	
	AS-WIS	16.458	0.289	0.004*	
	AS-QoL	1.400	0.238	0.012*	
	work change	17.318	0.237	0.003*	
	co-morbidities	13.316	0.237	0.004*	
WPAI-3 (overall work impairment)	chest expansion	-10.657	-0.502	<0.001*	%72.5
	AS-WIS	18.117	0.301	0.001*	
	annual income	-14.291	-0.290	<0.001*	
	work change	22.336	0.290	<0.001*	
	AS-QoL	1.724	0.278	0.002*	
	co-morbidities	16.158	0.271	0.001*	
	lateral lumbar spine mobility	1.139	0.198	0.039*	
WPAI-4 (daily activity impairment)	AS-QoL	2.092	0.450	<0.001*	%61.1
	chest mobility	-6.055	-0.381	<0.001*	
	co-morbidities	12.740	0.286	0.001*	
	work change	15.341	0.266	0.002*	
	annual income	-6.747	-0.183	0.032*	

*statistically significant difference, p<0.05

portions of blue-collar workers vs. office workers, proportions of patients with non-AS co-morbidities, and the availability of local employment and benefit systems, exist between studies.

To date, the effect of aerobic capacity has not been investigated in labor studies on AS despite its importance. We found higher level of aerobic capacity in employees than unemployed persons with AS. It is difficult to estimate this result as cause or conclusion because of cross-sectional design of the present study.

Maksymowych *et al*. reported that employed patients generally showed a younger age, male sex, better quality of life, less spinal ankylosis[15]. Similarly, our results showed that male sex, younger age, and high income level were predictors of employment. The same authors also found that quality of life (AS-QoL and SF-36-physical component), functional state (BASFI), health condition (HUI-3), night pain, and back pain were strongly related to non-employment. In a UK study, Healey et al. suggested that advanced age, social deficit, poor physical function, depression, and long disease duration were related to un-employment[40].

Several factors, including advanced age[5,8,15,22,40–42], female sex[8,43], marital status[42], low education level[8,43,44], physical environment and workplace support[41], functional state[17,22,45], spinal fusion[15,43], duration of AS[22], quality of life[15,17], night pain[17], disease activity, pain, and depression[45], psychosocial state[22,43,45] and health state[17], have been suggested as factors influencing employment state.

Stolwijk *et al*. recently reported a number of contextual factors associated with WD, including age with strong evidence, related skills, work accommodations, nature of work, workplace support with moderate evidence, and marital status with poor evidence, in a systematic review of OMERACT worker productivity group[21].

The ratio of work change was 17.9% in the present study; this value is in accordance with the reported rate of 16%–30% in patients with AS[6]. Fabreguet *et al.*[25] reported a similar rate of high work instability in French patients with AS (40%) compared with the 57.4% we found in our results. These researchers further reported relationships between BASDAI, BASFI, and patient global scores and AS-WIS, which are similar to our results. We found that length of sick leave, co-morbidities, WPAI score, VAS-pain, physician global score, finger-to-toe distance (of BASMI), BASRI-hip, AS-QoL, and BASDAI ≥ 4 were moderately related to AS-WIS. AS-QoL, patients' global assessment and overall work impairment were predictors of AS-WIS in this study.

Absenteeism or sick leave was 8% in the present study, which is comparable with the rate of 9% reported by Maksymowych *et al.* from Canada[17]. Absenteeism was related to AS-QoL score and length of sick leave. Multivariable analysis of different studies has shown that carrying heavy loads and more than one peripheral joint involvement[46], BASDAI and depression[40], BASFI[47], pain and HAQ[5] and disability pension[51], contributed to absenteeism. By contrast, the only predictor of absenteeism in our study was the length of sick leave in the last 1 year (R^2 = 18%). The availability of local health care providers and social security systems may be responsible for these differences.

Presenteeism or work productivity loss was 44% in the present study; this value is similar to the rate of 42% reported by Maksymowych *et al*[17]. Presenteeism was related to hip joint involvement, patient and physician global scores, AS-QoL, BASDAI, BASFI, BASRI, and MASES scores, and length of sick leave in the present study. Similar studies have reported that patient and physician global scores[24], high disease activity[17,23,24,39,47], anxiety and depression[40], pain[17,23], quality of life[23,24], and BASFI[17,23,24,47] were risk factors of presenteeism. Presenteeism was significantly related to chest mobility (of BASMI), annual income level, AS-WIS, AS-QoL, work change, co-morbidities, and lateral lumbar mobility (of BASMI) (R^2 = 78.4%) in our study.

Overall, 47% work impairment and 37% daily activity impairment were observed in the present study. Overall work impairment was related to patient and physician global scores, AS-QoL, BASDAI, BASFI, BASRI, and length of sick leave. The predictors of overall work impairment were chest mobility (of BASMI), AS-WIS, annual income level, work change, AS-QoL, co-morbidities, and lateral lumbar mobility (of BASMI) (R^2 = 72.5%).

Daily activity impairment was also related to the length of morning stiffness, enthesitis-pain, patient and physician global scores, AS-QoL, BASDAI, BASFI, BASRI, MASES, and length of sick leave. We found similar predictive factors, including AS-QoL, chest mobility (of BASMI), co-morbidities, work change, and annual income level for daily activity impairment (R^2 = 61.1%).

Cardiopulmonary function may be important for a positive work outcome. We found that the estimated aerobic capacity of employees was higher than that of the unemployed. Aerobic capacity was not investigated in previous studies related to the work outcomes of AS.

Therefore, we could not perform direct comparisons of the role of aerobic capacity in the work outcomes of AS.

The one of the aims of the management of patients with AS is to provide as many working years as possible[47]. Early diagnosis and management of work instability and work productivity impairment may decrease the risk of WD. Quality of life (AS-QoL) was the main predictive factor affecting work instability and work productivity in this study. Gordeev *et al.* similarly suggested that work limitations and lower QoL were significantly associated with probability of sick leave[48]. The AS-QoL questionnaire comprises questions related to all aspects of quality of life including disability, feelings, sleep, social relations, fatigue, pain, working life, and household life. Chest mobility was one of the predictors for work productivity in the present study. Comorbidities, such as hypertension, diabetes mellitus, and depression were also a significant factor influencing work productivity in this study.

To the best of our knowledge, this study is the first to document the factors affecting work outcomes with multi-dimensional measures including contextual outcomes, AS-related outcomes, spinal and extra-spinal involvement, co-morbidities, socioeconomic parameters, and cardiopulmonary functions.

The main limitations of our study are its cross-sectional design, the lack of assessment of psychosocial issues and the small sample size. The other important limitation may be socioeconomic properties of our sample. Our hospital located in the poor region of the city. Therefore our results may not be generalized.

CONCLUSIONS

We found several variables were associated to the employment status especially gender, age and income level, being the quality of life a predictor of work productivity and work instability. Even a new finding not previously reported in the literature was found: the aerobic capacity as factor related to work outcomes in AS. Countries may implement markedly different local healthcare, employment and social security systems for managing the working years of patients with AS.

CORRESPONDENCE TO
Fikriye Figen Ayhan
Turan Gunes Bulvari 118/R Parkoran C3 daire:40 06450
Cankaya-Ankara/Turkiye
E-mail: figenardic@gmail.com

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