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Association of fear of falling with balance, posture, and functionality in patients with ankylosing spondylitis: Comparison with healthy controls

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Abstract

The aim of the study was to compare the fear of falling in patients with ankylosing spondylitis (AS) and healthy controls. The relationship between the fear of falling and spinal mobility, balance parameters, functional capacity, pain, and disease activity was also evaluated in patients. The study sample included 40 AS patients and 50 gender-age-matched healthy controls. Falls Efficacy Scale-International (FES-I), Berg Balance-Scale (BBS), and Short-Physical Performance Battery (SPPB) were evaluated in all participants. In patients, the Bath AS-Metrology Index (BASMI), pain-visual analog scale (VAS), Bath AS-Disease Activity Index (BASDAI), and Bath AS-Functional Index (BASFI) were assessed. The mean ages of the patients and controls were 45.73 ± 9.5 (18-63) and 42.28 ± 8.1 (26-56), respectively. Fear of falling scores were significantly higher, and BBS and SPPB scores were significantly lower in patients than in controls ($p<0.001$). There was a positive correlation between FES-I scores and VAS-pain, BASFI, and BASDAI-scores, and a negative correlation was found between FES-I scores and BBS and SPPB-scores (SPPB $p<0.05$, others $p<0.001$). BASMI scores were negatively correlated with BBS scores ($p<0.05$). In the regression analysis, positive correlation with FES-I was BASFI-scores ($p<0.05$). The results of this study showed that patients with AS may experience fear of falling even if there is no history of falls. Balance, disease activity, and, most importantly, functional capacity should be evaluated to reduce the fear of falling in these patients.

Keywords: ankylosing spondylitis, balance, fear of falling, functionality, mobility

1. Introduction

Ankylosing spondylitis (AS) is a chronic inflammatory disease involving the axial skeleton, the peripheral joints, and the enthesis. (1). The main finding in patients with AS is the limitation of flexion and extension of the lumbar spine as well as chest expansion. Pain and stiffness progress with advancing disease, lumbar lordosis may be lost, exaggerated kyphosis may be observed, and the neck may stoop forward. Flexion contractures of the hips and knees may occur with significant morbidity and disability (2). The relation of severe joint deformities and changes in spinal curvature with poor balance in AS patients has been stated previously (3, 4). It was also reported that poor postural balance and reduced mobility may contribute to the increased fall risk in AS patients (5, 6). Although falls are major public health problems of the aging population, patients with AS are also at risk for falling despite their younger age. Falls are the leading cause of vertebral fractures, which are one of the most common complications in AS and can lead to neurological findings in 47% of patients (7). For this reason, it is of great importance to determine the factors that increase the risk of falling in patients with AS.

Fear of falling is defined as a low perceived self-efficacy in avoiding falls during essential, non-hazardous activities of daily living (8). It is one of the factors that increase the risk of falling and may also occur in a person who has never fallen before (9). It was emphasized that early detection and prevention of fear of falling is an important step in reducing the risk of falling (10). Fear of falling is a common concern for the elderly population. Besides the elderly, a limited number of studies showed that patients with chronic diseases had an increased fear of falling (11-13).

There is a lack of sufficient data on the fear of falling in patients with AS. The aims of this study were to compare the fear of falling in AS patients with healthy controls and to evaluate the association between the fear of falling and spinal mobility, balance parameters, functional capacity, pain, and disease activity in these patients.

2. Materials and methods

2.1. Participants

A case-control study was conducted in the Department of Physical Medicine and Rehabilitation of Medical Faculty of "Ondokuz Mayıs University" between March 2019 and August 2019. Forty patients with AS attending our institution (14) and 50 sex-age-matched controls were enrolled in this study. The controls were recruited from the general population, such as university employees, relatives of patients from outpatient-inpatient clinics, and healthy volunteers. Individuals were excluded if they had any lower extremity operation, had known balance problems, and had medications that might affect their

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balance.

2.2. Measures:

All participants were questioned about age, education level, number of education years completed, medical comorbidities, smoking habits, and a history of falls. Disease duration, family history, and current medications were reported in the patients. The participant's body mass index was calculated. Pain intensity was evaluated with a 10-cm visual analogue scale (VAS) (0= no pain, 10= very severe pain).

Disease-related variables:

Disease activity was measured by the Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) (15). The Bath Ankylosing Spondylitis Functional Index (BASFI) was used to evaluate functional capacity (16). Higher values of these indexes indicate high disease activity and worse function, respectively (17, 18). Spinal mobility of the patients was evaluated by Bath Ankylosing Spondylitis Metrology Index (BASMI). Scores of spinal measurements including wall to tragus distance, lumbar flexion, cervical rotation, lumbar lateral flexion, and intermalleolar distance were calculated. The higher the BASMI score indicates the more severe the patient's limitation of movement due to their AS (19).

Fear of falling:

The level of concern about falls of the participants was evaluated by The Falls Efficacy Scale International (FES-I) (20). It is a self-report questionnaire and assesses concerns relating to basic and more demanding activities, both physical and social. The total score ranges from 16 (absence of concern) to 64 (extreme concern) (21). According to the cut-off value (FES-I score <24 and FES-I score ≥ 24), patients were divided into two groups (20).

Balance:

The Berg Balance Scale (BBS) was originally developed to measure balance in the elderly, but it is commonly used to measure balance in people with varying conditions and disabilities (22, 23). The scale consists of 14 items, scored from 0 to 4; a higher score indicates better balance (24).

Physical performance and balance were assessed by The Short Physical Performance Battery (SPPB) test. It is a composite measure assessing walking speed, standing balance, and sit-to-stand performance. The total score ranges from 0 (bad) to 12 (very good), which is obtained by adding three test scores (25).

2.3. Statistical analyses

The data were analyzed using the IBM SPSS version 22.0 for Windows. The sample size was calculated with PASS 2011 software. A priori power analysis using data from a previous study (26) assessing balance in AS indicated that a sample of 40 patients and 50 controls would have 0.99 power and $p<0.01$ based on modified Schober's test scores. The Normal distribution assumption of the quantitative outcomes was analyzed by the Kolmogorov-Smirnov test, and all data were not normally distributed. Descriptive data were presented as minimum–maximum (median). The sociodemographic characteristics and clinical parameters of the patients and controls were compared by Chi-square test and Mann Whitney-U test, respectively. In the patients, the correlations between the clinical parameters were investigated by using Spearman correlation analysis. Multivariate linear regression analysis was performed to determine if VAS pain, BASFI, BASDAI, BASMI, BBS, and SPPB scores were associated with FES-I scores. *P* values less than 0.05 were considered statistically significant.

3. Results

The mean ages of the patient and control groups were 45.73±9.5 (18-63) and 42.28±8.1 (26-56), respectively. Demographic and clinical characteristics of the participants are shown in table 1. No significant difference was found between the groups regarding the sociodemographic characteristics (except education years and body mass index) ($p>0.05$). Patients' fear of falling scores were significantly higher, and BBS and SPPB scores were significantly lower compared to the controls ($p<0.001$) (Table 1).

The comparison of demographic and clinical parameters in patients according to their FES-I scores is shown in Table 2. Of the patients 26 (65%) had a FES-I score ≥ 24. There was a significant difference between the two groups in terms of VAS-pain, BASDAI, BASFI, BBS, and SPPB scores ($p<0.05$) (Table 2).

Table 3 provides the correlation coefficients between the clinical parameters in patients with AS. There was a strong positive correlation between FES-I scores and BASFI scores ($p<0.001$). FES-I scores were positively correlated with VAS-pain and BASDAI scores ($p<0.001$) and negatively correlated with BBS ($p<0.001$) and SPPB ($p=0.001$) scores (Table 3). BBS scores were positively correlated with SPBB ($p<0.001$) scores and negatively correlated with BASFI, FES-I ($p<0.001$), and BASMI ($p<0.05$) scores (Table 3). Negative correlations were found between SPPB scores and VAS-pain, FES-I ($p<0.05$), and BASFI ($p<0.001$) scores (Table 3).

In multivariate linear regression analysis, the most significant correlation with FES-I scores was BASFI scores ($p= 0.017$) (Table 4)

Table 1. Comparison of demographic and clinical characteristics of the patients with ankylosing spondylitis and controls

Characteristics	Patients (n= 40)	Controls (n= 50)	p
	n (%)	n (%)	
Gender			
Female	13 (32.5)	13 (26)	0.640
Male	27 (67.5)	37 (74)	
Occupation			
Housewife	10 (25)	7 (14)	
Retired	7 (17.5)	8 (16)	0.091
Office worker	15 (37.5)	31(62)	
Other	8 (20)	4 (8)	
Smoking	16 (40)	19 (38)	0.847
Medication use			
NSAIDs	28 (70)	-	-
csDMARD	7 (17.5)		
Biologic DMARDs	26 (65)		
Family history	10 (25)	-	-
	Median (minimum-maximum) 95% CI (Lower Bound- Upper Bound)		
Age	47 (18-63) (42.68-48.77)	44(26-56) (39.98-44.58)	0.067
Years of education	8 (5-18) (7.71-10.54)	11 (5-26) (10.19-13.57)	**0.017**
Body mass index (kg/m^2)	28.3 (18-38.9) (26.57-30.02)	26.2 (20.2-41.5) (25.31-27.14)	**0.027**
Number of falls	0 (0-4) (-0.06-0.36)	0 (0-1) (-0.1-0.13)	0.375
FES-I (16-64)	25.5 (16-47) (25.19-30.81)	17.5 (16-28) (17.53-19.07)	**<0.001**
Berg Balance Scale (0-56)	51.5 (28-56) (48-52.20)	56 (52-56) (55.44- 55.92)	**<0.001**
SPPB (0-12)	9 (1-12) (8.20-9.80)	12 (11-12) (11.90-12.02)	**<0.001**
Disease duration (years)	9 (1-35) (9.17-16.00)	-	-
ESR (mm/h)	31.5 (1-78) (27.40-41.59)	-	-
CRP (mg/l)	5.5 (2.2-96) (6.02-16.92)	-	-
VAS pain (0-10)	7 (0-10) (4.48-6.82)	-	-
BASDAI (0-10)	6.2 (0-10) (4.47-6.22)	-	-
BASFI (0-10)	3.7 (0-9.4) (3.15-4.94)	-	-
BASMI (0-10)	1.5 (0-9) (1.83-3.67)	-	-

NSAIDs non-steroidal anti-inflammatory drugs, csDMARDs conventional synthetic disease-modifying anti-rheumatic drugs, FES-I Falls Efficacy Scale International, SPPB Short Physical Performance Battery, ESR Erythrocyte Sedimentation Rate, CRP C-Reactive Protein, VAS visual analogue scale, BASDAI Bath Ankylosing Spondylitis Disease Activity Index, BASFI Bath Ankylosing Spondylitis Functional Index, BASMI Bath AS metrology index

Table 2. Comparison of the demographic and clinical parameters in the patients with ankylosing spondylitis according to fear of falling

Characteristics	FES-I < 24 (n=14)	FES-I ≥24 (n=26)	p
	n (%)	n (%)	
Gender			
Female	2 (14.3)	11 (42.3)	0.071
Male	12 (85.7)	15 (57.7)	
CS DMARDs use	4 (28.6)	3 (11.5)	0.176
Biologic DMARDs use	8 (57.1)	18 (69.2)	0.445
	Median (minimum-maximum) 95% CI (Lower Bound- Upper Bound)		
Age	47.5 (28-57) (40.29-50.57)	47 (18-63) (41.84-49.93)	0.887
Years of education	10.5 (5-18) (7.52-13.19)	5 (5-15) (6.81-10.11)	0.167
Body mass index (kg/m^2)	28.23 (18-33) (24.48-29.54)	29.8 (19.8-38.9) (26.63-31.35)	0.320
Number of falls	0 (0-1) (-0.08-0.23)	0 (0-4) (-0,13-0.53)	0.926
Disease duration (years)	12.5 (1-35) (8.12-21.09)	7 (1-33) (7,29-15.71)	0.387
ESR (mm/h)	32.5 (6-78) (21.24-47.33)	31 (1-73) (25.56-43.67)	0.876
CRP (mg/l)	5.8 (2.2-96) (1.16-31.83)	5.2 (2.3-34) (5.52-11.99)	0.842
VAS pain (0-10)	1.5 (0-10) (0.75-4.97)	8 (0-10) (6.06-8.25)	**0.002**
BASDAI (0-10)	3.5 (0-8.4) (1.91-4.90)	6.9 (1-10) (5.49-7.29)	**0.001**
BASFI (0-10)	1.5 (0-5.7) (0.84-2.85)	5.4 (0.7-9.4) (4.20-6.25)	**<0.001**
BASMI (0-10)	1.5 (0-7) (1.0-3.86)	1.5 (0-9) (1.68-4.17)	0.805
Berg Balance Scale (0-56)	54 (45-56) (51.54-55.32)	50 (28-56) (45.40-51.22)	**0.017**
SPPB (0-12)	11 (7-12) (9.67-11.62)	9 (1-12) (7.13-9.10)	**0.001**

FES-I Falls Efficacy Scale International, ESR Erythrocyte Sedimentation Rate, CRP C-Reactive Protein, VAS visual analogue scale, BASDAI Bath Ankylosing Spondylitis Disease Activity Index, BASFI Bath Ankylosing Spondylitis Functional Index, BASMI Bath AS metrology index, SPPB Short Physical Performance Battery

Table 3 Correlation coefficients between the clinical parameters in patients with ankylosing spondylitis

	FES-I	BBS	SPPB
Age	-0.132	0.141	-0.044
Disease duration	-0.216	-0.199	-0.104
VAS-pain	**0.553****	-0.264	**-0.314***
ESR	-0.006	0.188	0.219
CRP	0.026	-0.073	0.010
Body mass index	0.146	0.124	-0.086
Number of falls	0.101	-0.145	0.096
BASDAI	**0.595****	-0.187	-0.215
BASFI	**0.693****	**-0.617****	**-0,542****
BASMI	-0.070	**-0.518****	-0.193
FES-I	-	**-0.451***	**-0.516***
BBS	**-**	-	**0.554****
SPPB	**-0.516***	**0.554****	**-**

FES-I Falls Efficacy Scale International, BBS Berg Balance Scale, SPPB Short Physical Performance Battery, VAS visual analogue scale, ESR Erythrocyte Sedimentation Rate, CRP C-Reactive Protein, BASDAI Bath Ankylosing Spondylitis Disease Activity Index, BASFI Bath Ankylosing Spondylitis Functional Index, BASMI Bath AS metrology index
*p<0.05, **p<0.001

Table 4. Multiple regression analysis with FES-I as dependent variable and VAS pain, BASDAI, BASFI, BASMI, BBS, SPPB as independent variables

	Fear of falling (FES-I)				
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	*β*	*t*	*p*
Pain (VAS)	0.270	0.450	0.112	0.598	0.554
Function (BASFI)	1.502	0.598	0.478	2.509	**0.017**
Disease activity (BASDAI)	0.299	0.646	0.093	0.462	0.647
Spinal mobility (BASMI)	-0.743	0.456	-0.242	-1.630	0.113
Balance (BBS)	-0.321	0.282	-0.233	-1.108	0.276
Physical performance (SPPB)	-0.122	0.676	-0.035	-0.180	0.858

FES-I Falls Efficacy Scale International, VAS visual analogue scale, BASFI Bath Ankylosing Spondylitis Functional Index, BASDAI Bath Ankylosing Spondylitis Disease Activity Index, BASMI Bath AS metrology index, BBS Berg Balance Scale, SPPB Short Physical Performance Battery

4. Discussion

In the present study, the fear of falling in AS patients was higher than in controls. Fear of falling was associated with poor balance, increased pain, and disease activity in AS patients, and disease activity in AS patients, and the main determinant of fear of falling was found to be a functional limitation.

The fact that the prevalence of falls was 32.9-34.7 % in AS patients highlights the importance of fall prevention in these patients (5). The determination of the risk factors for falls is one of the important steps for fall prevention. Previously, disease-related factors such as reduced mobility, impaired balance, and active disease have been shown as risks for falls in patients with AS (3, 5-7, 27). Fear of falling has been described as a patient-related factor that increases fall risk, and little is known about the fear of falling in patients with AS (5). In a study by Dursun et al., fear of falling has been evaluated by a single item (as “yes” or “no”) and they found that AS patients with a history of falls had more fear of falling (27). The assessment of fear of falling intensity and concern about different activities are not possible with dichotomous outcome (28). In the current study, fear of falling was assessed by FES-I which is widely accepted tool for assessing concern about falling (21). While the number of falls of the AS patients was not different from the control group, the fear of falling scores were significantly higher than the healthy controls. These results show that patients with AS may have a greater fear of falling than healthy controls and this fear may develop in those who have no experience of falling.

Several studies have been published evaluating the effect of AS on postural stability. While in most of these studies, static and dynamic balance was found to be impaired in patients with AS compared to the healthy population (3, 4, 26, 29-33), some authors reported that AS patients had good postural control (34, 35). Postural changes, disease duration and severity, and functionality have been shown to be associated with balance disorders in patients with AS (26, 30-33). In the current study, AS patients with increased pain, decreased function, and mobility had poor balance parameters compared to healthy individuals. Age-related changes in postural stability and balance control have been identified as the main risk factors associated with falls in the elderly (36, 37). Despite their younger age, fall risk increases in AS patients with altered postural control and balance (3, 5, 6, 31). In older people, the mutual correlation between fear of falling and balance was shown previously (37, 38). However, there is no published data about the relation of fear of falling with balance parameters in patients with AS. The results of this study indicate that the balance parameters were significantly lower in patients with fear of falling, and a negative correlation was found between fear of falling and balance parameters. The fear of falling may increase as the balance impaired in AS patients, or the balance may deteriorate in those with a fear of falling. It is difficult to establish the causality of this relationship.

Limitation in spinal mobility is the fundamental finding in AS, and BASMI is a clinically relevant, reliable, reproducible, and valid metrology score for the axial status of patients with AS (19). A significant correlation between the risk of falls and BASMI was shown previously, and it was stated that poor spinal mobility leads to increased fall risk in patients with AS (6, 27). However, the relationship between the fear of falling and spinal mobility is an unknown issue. The expected relationship, based on the previous studies, between fear of falling and spinal mobility could not be shown in this study, and BASMI scores were not different in AS patients with and without fear of falling. Since the AS sample in our study had good mobility with a median BASMI score of 1.5, we might not have found a significant relationship between spinal mobility and fear of falling. Further studies with AS patients who have mobility restriction may define this relationship.

Functional impairment due to AS has negative impact on activities of patient’s daily functioning (39). The functional status and physical performance were reported as predictors for falls, and poor functional status was found to be associated with increased fall risk in AS patients (6, 27). The AS population in this study had lower physical performance scores than the control group. Our expectation was that fear of falling, which had not been studied before, was also associated with poor physical performance. As anticipated, physical performance scores were lower in AS patients with fear of falling compared to those without fear of falling and fear of falling was correlated with poor physical performance. Moreover, BASFI score was the most important determinant for fear of falling in patients with AS. This close relationship between fear of falling and functional performance in patients

with AS suggests that functionality may play an important role in the development of fear of falling.

Older age, female gender, visual and cognitive disorders, depression, poor sleep quality, comorbidities, high body mass index, and low economic resources were associated with fear of falling in the geriatric population (40, 41). In rheumatoid arthritis, another inflammatory disease, increased fear of falling was shown to be associated with pain, disability, depression, and more comorbid conditions (11, 13). AS patients at older age and with advanced disease and longer disease duration are at increased risk of falls (5, 7, 27). On the other hand, the relationship between falls and disease activity is controversial. While Fatemi et al. (7) reported that fall risk increases in severe AS, Dursun et al. (27) did not find any correlation between a number of falls and disease activity. In the current study, pain and disease activity were found to be higher in AS patients with fear of falling than in those without fear of falling, and they were associated with fear of falling scores in patients with AS. It can be said that AS patients with pain and high disease activity are afraid of falling.

It is known that fear of falling is not only a result of falls but also a risk factor for falling (42). Considering the high morbidity and mortality after fractures due to falls, it is important to evaluate the fear of falling and take necessary precautions in the rehabilitation of AS patients. To the best of our knowledge, this is the first study in the literature investigating the factors associated with fear of falling in patients with AS. The assessment of fear of falling involves physical, behavioral, and functional components, and the use of a fall efficacy scale is recommended to provide a continuous self-report measure of fear of falling during daily activities (13, 43).

The main limitation of this study is its cross-sectional design so direction or causality of the correlations could not be inferred. Secondly, if the AS patients had severe deformity that leads to posture disorders, we could detect a relationship between fear of falling and spinal mobility. It is known that the fear of falling is closely related to the emotional status. The emotional status of the patients was not evaluated in our study, and it is one of the limitations. Another parameter that we did not evaluate in our study was whether the participants had regular exercise habits. Exercise is very important in the non-pharmacological treatment of AS. Considering the positive effects of exercise on balance and posture, studies examining the relationship between exercise and fear of falling may be planned. And lastly, balance was not evaluated with objective methods such as dynamic posturography. Although they provide objective data, these measurements are time-consuming and require special equipment. The balance tests used in this study are useful and easy to apply for balance assessment during routine examinations.

According to the results of this study, patients with AS may have a greater fear of falling than healthy individuals. The results showed that increased pain, higher disease activity, balance problems, and functional limitation may be associated with fear of falling in patients with AS. Therefore, controlling disease activity and symptoms, optimizing physical performance, and recommending exercise programs for balance rehabilitation, even if there is no history of falls, may help reduce the fear of falling in patients with AS. Considering the impact of functionality on the fear of falling, the assessment of functional status could be routinely included in the management of patients with AS. Additionally, the exercise program for AS patients should include functional balance exercises as well as mobility. With the introduction of biological agents in the treatment of AS, the spinal mobility of patients with established AS remained stable (44). The results of this study are important in terms of showing that AS patients may have a fear of falling even if their spinal mobility is not impaired.

Ethical Statement

The Medical Research Ethics Committee at Ondokuz Mayıs University (B.30.2.ODM.0.20.08/219) approved the study protocol, and the participants gave their written informed consent. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Conflict of interest

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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Authors' contributions

Concept: H.B., Y.U., Design: H.B., Y.U., Data Collection or Processing: H.B., Analysis or Interpretation: H.B., Y.U., A.B, Literature Search: H.B., Y.U, Writing: Y.U.

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