Turk J Phys Med Rehab 2025;71(1):92-101
DOI: 10.5606/tftrd.2024.14001
Available online at www.turkishjournalpmr.com

Original Article

Postural stability and fall risk in systemic sclerosis patients

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ABSTRACT

Objectives: This study aims to objectively assess the fall risk and postural balance status of systemic sclerosis (SS) patients and investigate its association with various clinical findings.

Patients and methods: The cross-sectional study was conducted between July 2020 and September 2020. The study included 14 patients (12 females, 2 males; mean age: 48.4±12.3 years; range, 21 to 63 years) diagnosed with SS and a control group of 20 healthy volunteers (17 females, 3 males; mean age: 46.8±9.0 years; range, 25 to 60 years). Demographic and clinical data of the participants were noted. Results of anti-nuclear antibodies and anti-Scl-70 antibodies were recorded. The fall index, indicating fall risk, was determined using a posturography device, and postural stability measurements were performed. The Falls Efficacy Scale-International was used to evaluate fall activity. The modified Rodnan skin score was used to assess the degree of cutaneous involvement in SS.

Results: Fall index results were higher in the SS group ($p<0.05$). The rate of falls in the past year among SS patients was 7.1%. The SS group showed deviations from the normal population in the postural measurement when eyes closed on a solid surface in normal position with the stability index, eyes closed on a pillow with the stability index, and eyes closed on a solid surface with the head tilted 30° forward with the weight distribution index ($p<0.05$). Fear of falling scores were higher in diffuse-type SS compared to limited-type SS ($p<0.01$). No differences were observed in other parameters.

Conclusion: This study revealed impaired postural balance and increased fall risk in SS patients compared to the normal population. Evaluation of postural balance and fall risk in SS patients should be done in the early period, and necessary treatments should be applied.

Keywords: Balance, fall, posture, stability, systemic sclerosis.

Systemic sclerosis (SS) is a rheumatic disease characterized by excessive collagen accumulation and vascular changes in various organs.[1] The most defining feature of the disease is skin fibrosis (scleroderma). There are two forms of scleroderma: localized and generalized. Systemic sclerosis is used synonymously with generalized scleroderma. Inflammatory, vascular, and fibrotic changes in SS can affect internal organs, such as the lungs, gastrointestinal system, and kidneys. Therefore, the disease is referred to as SS.[2] Systemic sclerosis is divided into two subtypes, limited cutaneous and diffuse cutaneous, based on the degree of skin involvement and certain clinical and laboratory features.[2] Although there are suspicions regarding autoimmune mechanisms and genetic and environmental factors, the etiology of SS is not yet well understood.[1] Studies indicate a prevalence rate of 10 cases per 100,000 individuals.[1,3] Systemic sclerosis most commonly affects females between the ages of 30 and 50.[4]

Posture can be defined as the three-dimensional spatial arrangement determined by the joints between body structures.[1,5] Postural balance refers to the ability to maintain the body's center of mass on the support base.[1,6] Postural balance is a complex mechanism provided by the joint work of vestibular, visual, musculoskeletal, and somatosensory systems.[2,7] Any impairment in these systems affects postural control.[2,7] Weak balance increases the risk of falling.[8] Falling can be defined as an undesired change in position resulting in a lower level or on the ground.[9,10] Its consequences can include disability, injury, and even death.

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Received: October 16, 2023 **Accepted:** March 13, 2024 **Published online:** December 06, 2024

Cite this article as: Sarıhan K, Kul A. Postural stability and fall risk in systemic sclerosis patients. Turk J Phys Med Rehab 2025;71(1):92-101. doi: 10.5606/tftrd.2024.14001.

Many systems that may be important in balance functions may be affected in SS patients. Pulmonary arterial hypertension and interstitial lung disease can be observed in 70 to 90% of SS patients. More than 80% of SS patients show musculoskeletal involvement, including myositis, myopathy, joint contracture, tenosynovitis, and polyarthritis.[1,2] Weakness, muscle atrophy, skin sclerosis, and joint dysfunction can occur as a result of skin and musculoskeletal involvement.[1,2,11] Neurological involvement in SS has been reported to be between 0.8 and 5.6%.[12] Among these, various degrees of muscle involvement, trigeminal neuralgia, and peripheral neuropathies can be mentioned.[12] In addition to musculoskeletal and lung involvement in SS, steroid use and chronic inflammation are also considered risk factors for decreased muscle strength and functional limitations.[2]

Inflammatory rheumatic diseases disrupt postural stability and increase the risk of falling through various mechanisms.[7,13] Rheumatic diseases are considered the second strongest risk factor for falls that result in mortality and morbidity in elderly women.[14] Factors such as arthritis, pain, medication side effects, fatigue, movement limitations, decreased lower extremity muscle strength, and postural problems are known to increase the risk of falling in individuals with rheumatoid disease.[2]

In SS patients, pain, muscle weakness, decreased physical activity, neurological involvement, arthritis, contractures, and medication side effects can affect postural stability and fall risk.[1,2,15-18] There are very few studies in the literature on this topic in SS patients.[1,2,15] In this study, our aim was to objectively assess the fall risk and postural balance status of SS patients using a posturography device and to investigate their relationship with various clinical findings, including fear of falling.

PATIENTS AND METHODS

For this cross-sectional study, patients who presented to the physical medicine and rehabilitation and rheumatology outpatient clinics of the Atatürk University Faculty of Medicine between July 2020 and September 2020 were consecutively included. Due to the rarity of SS and exclusion criteria, 14 SS patients (12 females, 2 males; mean age: 48.4±12.3 years; range, 21 to 63 years) were included in the study. While 14 patients met the inclusion criteria, three patients refused to participate in the study, three patients had physical impairments that affected their mobility, one patient had a history of spinal orthopedic surgery, one patient had a history of neurological disease, and two patients had severe cardiovascular and respiratory system diseases and were therefore excluded. As a control group, 20 healthy volunteers (17 females, 3 males; mean age: 46.7±9.0 years; range, 25 to 60 years) from the hospital employees were recruited. The inclusion criteria for the study were having a diagnosis of SS under follow-up according to the 2013 American College of Rheumatology diagnostic criteria and being between 18 and 70 years of age. The exclusion criteria included having a history of neurological disease, having rheumatic and degenerative comorbidities that could cause balance problems, having severe cardiovascular and respiratory system diseases, having a history of significant trauma to the lower extremities and spine, having a history of orthopedic surgery involving the lower extremities and spine, having a history of malignancy, being pregnant or breastfeeding, being in the morbidly obese patient group, and being an emergency case. A written informed consent was obtained from each patient. The study protocol was approved by the Atatürk University Faculty of Medicine Clinical Research Ethics Committee (date: 28.05.2020, no: B.30.2.ATA.0.01.00/223). The study was conducted in accordance with the principles of the Declaration of Helsinki.

The participants were initially asked to fill out a patient follow-up form, which included demographic and clinical data. Serum samples were tested for ANA using immunofluorescence and for anti-Scl-70 antibodies using double immunodiffusion, and the results were recorded.

Fall risks were determined using a posturography device, and measurements of postural stability were conducted.[19] The Falls Efficacy Scale-International (FES-I) was applied to assess the evaluation of fall activity among participants.[20] This scale was developed to measure the level of anxiety about falling. It consists of 16 items scored on a 4-point Likert scale, providing a total score ranging from 16 (no concern) to 64 (high concern). The reliability and validity study of the Turkish version of FES-I was conducted by Ulus et al.[20]

The modified Rodnan skin score (mRSS) was used to determine the severity of skin involvement in SS patients.[21,22] This scoring system utilizes 17 different body areas, including the face, anterior

chest, abdomen, upper arms, forearms, hands, fingers, thighs, legs, and feet. A score ranging from 0 to 3 is assigned to each area, with a total score ranging from 0 to 51. A higher score indicates more severe skin involvement. A score of 0 represents normal skin, where the examiner appreciates fine wrinkles but no skin thickening. A score of 1 represents mild skin thickening, where the examiner can easily make skin folds between two fingers; fine wrinkles are acceptable. A score of 2 represents moderate skin thickening, where the examiner has difficulty making skin folds and describes the absence of wrinkles. Finally, a score of 3 represents severe skin thickening, where there is an inability to make a skin fold between the examined two fingers and describes significant skin thickening. All skin scoring assessments were performed by the same physical medicine and rehabilitation specialist.

The Tetrax Posturography System (Sunlight Medical Ltd., Ramat Gan, Israel) was used for posture assessments.[19] Posturographic evaluation in the Tetrax system consisted of a detailed examination that allowed for the calculation of the balance and

TABLE 1
Demographic and clinical characteristics of the SS group and control group

Parameter	Groups		n	%	Mean±SD	*p*
Age (year)	Case		14		48.4±12.2	0.649
	Control		20		46.7±9.0	
Height (cm)	Case		14		158.5±4.2	0.049*
	Control		20		163.1±7.5	
BMI (kg/m^2)	Case		14		25.9±5.5	0.264
	Control		20		27.7±3.6	
FES-1	Case		14		28.0±7.7	0.090
	Control		20		23.3±7.5	
FI	Case		14		55.0±34.3	0.012*
	Control		20		32.6±13.3	
History of falling	Case	Negative	13	92.9	-	0.412
		Positive	1	7.1		
	Control	Negative	20	100		
		Positive	0	0		
Sex	Case	Female	12	85.7	-	1.0
		Male	2	14.3		
	Control	Female	17	85.0		
		Male	3	15.0		
Marital status	Case	Single	2	14.3	-	1.0
		Married	12	85.7		
	Control	Single	2	10.0		
		Married	18	90.0		
Smoking	Case	Negative	12	85.7	-	0.141
		Positive	2	14.3		
	Control	Negative	12	60		
		Positive	8	40		
Alcohol	Case	Negative	14	100	-	1.0
		Positive	0	0		
	Control	Negative	19	97.1		
		Positive	1	2.9		

SS: Systemic sclerosis; SD: Standard deviation; BMI: Body mass index; FES-1: Falls Efficacy Scale-International; FI: Fall index; * p<0.05.

fall index (FI). Changes in the center of gravity were evaluated in the stability index (SI). The weight distribution index (WDI) was calculated from the data obtained from the footplate and compared the distribution of weight between the left and right feet, heels, and toes. Independent wave signals collected from the four platforms of the device were compared in eight different positions to perform postural performance analysis. These eight different positions were as follows: eyes open on a pillow (PO); eyes closed on a pillow (PC); eyes open on a solid surface in normal position (NO); eyes closed on a solid surface in normal position (NC); eyes closed on a solid surface with the head turned to the right (HR); eyes closed on a solid surface with the head turned to the left (HL); eyes closed on a solid surface with the head tilted 30° backward (HB); eyes closed on a solid surface with the head tilted 30° forward (HF). The Tetrax device was used to calculate the FI based on these parameters, reflecting the patient's fall risk. Based on the determined FI, patients were categorized into three groups: minimum fall risk (0-36), moderate fall risk (37-58), and high fall risk (59-100).[9,19]

Statistical analysis

G*Power version 3.1 (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany) was used to calculate the sample size. Data from a study assessing fall risk in patients with fibromyalgia syndrome were used.[7] With a mean of 29.1±16.9 in Group 1 and a mean of 45.7 in Group 2, it was calculated that 16 participants were needed for each group with a 95% confidence level and 80% power. Due to the reasons mentioned above, 14 participants were included in the patient group. According to the study data, the post hoc power calculated for the primary outcome was 78%.

Data were analyzed using IBM SPSS version 23.0 software (IBM Corp., Armonk, NY, USA). Descriptive statistics were performed. Numerical data were expressed as mean ± standard deviation (SD). Categorical data were given as frequency (percentage). The normal distribution of numerical variables was assessed using the Shapiro-Wilk test. The relationship between categorical variables was analyzed using the chi-square test and Fisher exact test, while the relationship with numerical variables was examined using the independent samples t-test. The correlation between numerical variables was evaluated using Pearson's correlation analysis. A p-value <0.05 was considered statistically significant.

RESULTS

The clinical and demographic characteristics of the SS and control groups are presented in Table 1. The height measurements were higher in the control group, and the FI results were higher in the SS group (p=0.049). There were no significant differences

TABLE 2
Postural stability measurements of the SS and control groups

Parameters	Groups	n	Mean±SD	*p*
NO-SI	Case	14	16.7±2.8	0.723
	Control	20	18.3±14.3	
NC-SI	Case	14	21.5±5.2	0.047*
	Control	20	20.1±4.7	
PO-SI	Case	14	20.1±4.3	0.072*
	Control	20	16.5±4.3	
PC-SI	Case	14	29.9±4.8	0.040
	Control	20	25.9±5.8	
HR-SI	Case	14	22.0±5.0	0.881
	Control	20	22.2±4.8	
HL-SI	Case	14	23.3±6.2	0.184
	Control	20	20.9±3.5	
HB-SI	Case	14	22.4±4.4	0.826
	Control	20	22.0±5.0	
HF-SI	Case	14	22.1±6.1	0.673
	Control	20	21.2±5.6	
NO-WDI	Case	14	6.6±3.0	0.544
	Control	20	5.9±2.8	
NC-WDI	Case	14	6.2±2.6	0.281
	Control	20	5.0±2.9	
PO-WDI	Case	14	8.2±4.9	0.153
	Control	20	6.0±2.9	
PC-WDI	Case	14	6.8±4.2	0.442
	Control	20	5.7±2.9	
HR-WDI	Case	14	7.2±2.8	0.314
	Control	20	5.7±4.2	
HL-WDI	Case	14	6.0±2.6	0.364
	Control	20	5.1±2.6	
HB-WDI	Case	14	6.9±2.4	0.377
	Control	20	5.9±2.8	
HF-WDI	Case	14	7.2±1.9	0.032*
	Control	20	4.9±2.8	

SS: Systemic sclerosis; SD: Standard deviation; NO: Normal position, eyes open, on a solid surface; SI: Stability index; NC: Normal position, eyes closed; PO: Eyes open, on a pillow; PC: Eyes closed, on a pillow; HR: Head turned to the right, eyes closed; HL: Head turned to the left, eyes closed; HB: Eyes closed, head tilted 30° backward; HF: Eyes closed, head tilted 30° forward; WDI: Weight distribution index; * p<0.05.

between the groups in other evaluated parameters (p>0.05).

The postural stability measurements of the control and SS groups are presented in Table 2. The NC-SI, PC-SI, and HF-WDI values were higher in the SS group compared to the control group (p=0.047, p=0.040, and p=0.032, respectively). There were no significant differences between the two groups in other parameters (p>0.05).

The clinical characteristics of the SS group are presented in Table 3. In the SS group, the mean disease duration was 10.6±7.7, the mean mRSS was 18.9±8.2, and the mean age at disease onset was 37.7±12.7. Among the SS group, 85.7% had Raynaud's phenomenon, 78.6% had gastrointestinal symptoms, 57.1% reported shortness of breath, 57.1% had no comorbidities, 50% had diffuse-type SS, 78.6% tested positive for ANA, 57.1% tested negative for anti-Scl-70 antibody, 64.3% were not receiving steroid treatment, 64.3% were not using calcium channel blockers, and 92.9% were not taking angiotensin-converting enzyme inhibitors.

The relationship between certain clinical characteristics, fall risk, and fear of falling within the SS group is presented in Table 4. The FES-I scores were higher in individuals with diffuse-type SS (p<0.01). There were no significant differences in other examined parameters (p>0.05).

The relationship between certain clinical features, fall risk, and FES-I score in the SS group was evaluated. There was no significant statistical relationship between age, height, body mass index, duration of disease, initiation age, mRSS, FES-I and FI (p>0.05).

TABLE 3
Clinical characteristics of the SS group

Parameters		n	%	Mean±SD
Duration of the disease (year)		14		10.6±7.7
Age of disease initiation		14		37.7±12.7
Modified Rodnan Score		14		18.9±8.2
Raynaud's phenomenon	Negative	2	14.3	-
	Positive	12	85.7	
Gastrointestinal system symptom	Negative	3	21.4	-
	Positive	11	78.6	
Shortness of breath	Negative	6	42.9	-
	Positive	8	57.1	
Additional disease	Negative	8	57.1	-
	Positive	6	42.9	
Type of the SS	Localized	7	50	-
	Diffuse	7	50	
Anti-nuclear antibody	Negative	3	21.4	-
	Positive	11	78.6	
Anti SCL-70	Negative	8	57.1	-
	Positive	6	42.9	
Steroid treatment	Negative	9	64.3	-
	Positive	5	35.7	
Calcium channel blocker treatment	Negative	9	64.3	-
	Positive	5	35.7	
ACE-inhibitor treatment	Negative	13	92.9	-
	Positive	1	7.1	

SS: Systemic sclerosis; SD: Standard deviation; ACE: Angiotensin-converting enzyme.

TABLE 4
Relationship between certain clinical characteristics, fall risk, and fear of falling within the SS group (n=14)

Parameters		n	FES-I Mean±SD	*p*	Mean±SD†	*p*
Sex	Female	12	29.0±7.9	0.255	54.1±33.1	0.834
	Male	2	22.0±2.8		60.0±56.5	
Raynaud's phenomenon	Negative	2	22.0±4.2	0.255	43.0±49.4	0.614
	Positive	12	29.0±7.9		57.0±33.7	
Gastrointestinal system symptom	Negative	3	23.6±7.2	0.295	78.0±38.1	0.202
	Positive	11	29.1±7.8		48.7±32.2	
Shortness of breath	Negative	6	25.0±7.7	0.226	40.0±34.0	0.165
	Positive	8	30.2±7.4		66.2±32.0	
Additional disease	Negative	8	29.2±8.4	0.510	62.2±33.5	0.383
	Positive	6	26.3±7.1		45.3±36.0	
Smoking	Negative	12	29.0±7.9	0.255	54.1±33.1	0.834
	Positive	2	22.0±2.8		60.0±56.5	
Type of SS	Localized	7	22.5±4.8	0.004*	57.7±36.9	0.780
	Diffuse	7	33.4±6.2		52.2±34.2	
ANA	Negative	3	25.0±10.3	0.474	59.3±40.0	0.816
	Positive	11	28.8±7.3		53.8±34.7	
Anti SCL-70	Negative	8	27.1±6.5	0.647	57.0±33.4	0.813
	Positive	6	29.1±9.7		52.3±38.5	
Steroid treatment	Negative	9	26.8±8.9	0.496	64.2±36.9	0.188
	Positive	5	30.0±5.4		38.4±23.8	
Calcium channel blocker treatment	Negative	9	27.8±9.4	0.946	56.2±36.1	0.866
	Positive	5	28.2±4.4		52.8±34.7	

SS: Systemic sclerosis; FES-I: Falls Efficacy Scale-International; SD: Standard deviation; ANA: Anti-nuclear antibody; † FI: Fall index; * p<0.05.

DISCUSSION

In our study, it was determined that patients with SS had a higher risk of falls and showed deficits in various postural balance parameters, and individuals with diffuse-type SS had a higher fear of falling. The increased fall risk in these patients appears to be more influenced by the disease rather than its other characteristics.

When standing and walking, individuals use oscillations to maintain their balance. This is called postural sway. Healthy individuals are naturally accustomed to swaying back and forth. However, various health problems can cause individuals to sway abnormally and exhibit other balance issues. These body oscillations can be evaluated using posturography devices.[19] Various methods are used to assess balance functions, ranging from simple clinical tests to measurements using computer-based complex devices.

Inflammatory rheumatic diseases disrupt postural stability and increase the risk of falls through various mechanisms.[7,13] Rheumatic diseases are considered the second strongest risk factor for falls that result in mortality and morbidity in elderly women.[14] Factors such as pain, arthritis, medication side effects, fatigue, movement limitations, decreased lower extremity muscle strength, and postural problems are known to increase the risk of falls in individuals with rheumatoid disease.[2] Studies conducted in patients with rheumatoid arthritis (RA), systemic lupus erythematosus (SLE), familial Mediterranean fever (FMF), and fibromyalgia syndrome have found an increased risk of falls compared to the general population.[7,9,23,24] A study conducted in SS patients

also identified an increased risk of falls compared to the general population.[2] Consistent with other studies in the literature on fall risk in rheumatic diseases, our study also found an increased risk of falls in SS patients.

One of the methods used for assessing fall risk is posturography devices.[7,19] There were no studies in the literature that objectively assessed fall risk using posturography devices in patients with SS. Fall risk assessed with posturography in RA patients was found to be 58.42±28.31.[23] The risk of falling in SLE patients was determined as 59.3±29.5.[9] In our study, the risk of falling in SS patients was found to be 55.0±34.3. According to the device's user guide, this value was within the moderate fall risk group.[19] Our study revealed a moderate level of fall risk in SS patients, similar to other rheumatic diseases.

In diseases such as osteoarthritis, ankylosing spondylitis, and RA, the incidence of falls increases regardless of age.[2,7,25,26] Rheumatic diseases are considered the second strongest independent risk factor for severe falls.[14] Depending on the methodology used for fall evaluation, the incidence of falls in RA patients has been reported in a wide range (10 to 50%).[9,27] The fall rate in SLE patients in the past year was found to be 15%.[9] In one study, the frequency of falls in SS patients in the past year was reported to be 30%.[2] In our study, this rate was 7.1%. This may be due to the small number of participants and strict exclusion criteria set by us. The reason for the different fall rates in previous studies may be differences in the definition of falls.

In our study, posturography devices were used for postural balance measurement. Higher values of the SI in the postural balance parameters indicate a higher degree of postural instability, while low SI scores indicate better balance and stability.[19,28] High WDI values indicate pathology, while values close to 0 indicate maximum postural stability.[19,28] In our study, differences were found in the NC-SI, PC-SI, and HF-WDI values in the SS group compared to the healthy population. In the NC-SI parameter, visual pathways are disabled as the eyes are closed.[19] The detection of differences in NC-SI indicates a greater impact on the vestibular and somatosensory systems.[19] In PC-SI, the eyes are closed, and the feet are on a pillow.[19] Therefore, visual pathways and the somatosensory system are disabled. The detection of differences in PC-SI indicates an impact on the vestibular system.[19] In the HF-WDI parameter, the eyes are closed, and the head is tilted 30° over the chin.[19] Therefore, visual pathways and the vestibular system are disabled.[19] The detection of differences in HF-WDI mainly indicates the impact on the musculoskeletal system and somatosensory system.[19] As a result, it was determined that SS patients have various deficits in postural balance, and the cause of this is the combined impact of the vestibular, somatosensory, and musculoskeletal systems.

Postural instability, due to its association with functional impairment and increased risk of falls, is considered one of the most significant complications in many rheumatoid, pulmonary, and neurological diseases.[2,29,30] Decreased postural stability has been reported in patients with ankylosing spondylitis.[31] Similarly, losses in postural balance have been observed in patients with FMF.[19] There are limited studies evaluating postural balance in SS and the results are controversial.[1,2,15] Giacomini et al.[15] identified postural abnormalities in the SS group. Lima et al.,[1] on the other hand, reported no significant differences in postural balance variables between the SS and control groups. In our study, consistent with the literature in general, differences were found in some postural balance parameters in the SS group. However, the exclusion criteria and measurement methods used in studies conducted in this regard vary, warranting further studies.

Patients with SS experience shortness of breath due to interstitial lung disease, pulmonary arterial hypertension, and widespread fibrosis, leading to movement restrictions.[2,32] Involvement of the respiratory system can disrupt postural balance parameters through factors such as stiffening of chest muscles due to increased respiratory demand, reduced oxygen supply to muscles, disturbance of metabolic acidosis-alkalosis balance, and decreased respiratory muscle strength due to fibrosis.[2,33] A previous study found an association between respiratory system involvement, postural balance loss, and increased risk of falls in SS patients.[2] This study identified a significant relationship between diffusion capacity, dyspnea severity, and fall risk.[2] In our study, SS patients with complaints of shortness of breath were found to have a mathematically significantly higher risk of falls compared to those without shortness of breath. However, this finding was not statistically significant, which may be due to the small sample size. The relationship and potential mechanisms between lung involvement and postural balance are unclear, and further research is needed.

Although some previous studies in RA have found an association between disease activity or its components and fall risk, most studies have not demonstrated such a relationship.[9,34,35] No association has been found between disease activity and fall risk in SLE patients.[9] A study conducted in patients with fibromyalgia syndrome also found no relationship between disease activity and fall risk.[7] Similarly, a study in FMF patients found no association between disease activity and fall risk.[24] In our study, no relationship was observed between the mRSS and other disease components with fall risk and postural balance scores. Our study revealed that the increase in fall risk in SS patients is not associated with disease duration, suggesting that there was no relationship between disease activity and fall risk and postural balance.

Medication use can be a factor to consider in relation to falls. Previous studies in RA have shown that various medications, such as antidepressants, sedatives, antihypertensives, glucocorticoids, and diuretics, can increase the risk of falls.[9,27,34] However, another study found that steroid intake did not affect fall risk outcomes in RA patients.[36] In our study, no relationship was observed between the use of steroids and calcium channel blockers with fall risk. Since previous data is based on different diseases, medications, and fall risk assessments, it may be challenging to interpret these results alongside our study. However, according to our study data, no relationship was found between the use of steroids and calcium channel blockers and the risk of falling in SS patients. Since steroid use may increase the risk of falling depending on the dose, it may not have affected the risk of falling in our patients as a result of low dosage.

A study in FMF patients identified a positive correlation between fear of falling and fall risk.[24] Two separate studies in RA and SLE patients did not find an association between fear of falling and fall risk.[9,37] In our study, no relationship was found between fear of falling and fall risk. There is limited literature on this topic, and further research is needed to reach a definitive conclusion.

Fear of falling is an important parameter that can also affect functionality.[13] Increased fear of falling has been identified in SLE patients compared to the general population.[9] A study in RA patients also found increased fear of falling compared to the general population.[23] We did not come across any studies on fear of falling in SS patients in the literature. In our study, fear of falling was significantly higher in SS patients compared to the general population. However, it was not statistically significant. In addition, our study found that patients with SS had higher fear of falling. The reason for obtaining different results from other studies in the literature may be due to our strict exclusion criteria and small sample size. The similar fall risks between diffuse and limited types of SS and the higher fear of falling in diffuse-type patients may be related to psychiatric processes that could be influenced by visible skin involvement.

There are some limitations to this study. The number of participants may be considered a limiting factor that does not allow subgroup analysis. Nonetheless, due to the insufficient literature on fall risk and postural balance in SS patients, this study provides important results that could lead to further clinical studies. This is the first study to objectively evaluate fall risk using a posturography device in patients with SS. Furthermore, it is the first study to evaluate fear of falling in SS patients. Finally, by setting strict exclusion criteria, the presence of subclinical fall risk could also be determined.

In conclusion, this study has demonstrated that SS patients have increased fall risk and impaired postural balance compared to the general population. Additionally, fear of falling was higher in patients with diffuse SS. According to these results, early evaluation of postural balance and fall risk in SS patients is important for functional independence. Necessary treatment strategies need to be included in rehabilitation programs.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Idea/concept, design, control/supervision, critical review, analysis and/or interpretation: K.S., A.K.; Materials, data collection and/or processing, literature review, writing the article, references and fundings: K.S.

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

Funding: The authors received no financial support for the research and/or authorship of this article.

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