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Original Research

How Right Are Multiple Sclerosis Patients in Fear of Falling? A Comparative Study

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Abstract

Objectives: The aim of this study was to investigate the factors underlying the fear of falling in Multiple Sclerosis (MS) patients and to determine the share of physical and psychological components in this fear.
Materials and Methods: Patients between the ages of 18-65 years, diagnosed with Relapsing-Remitting form of MS were included in the study. Timed Up and Go Test (TUG) was used to assess gait functions and balance skills of patients during gait, Berg Balance Test (BBT) to assess balance skills in general, Fall Efficacy Scale-International (FES-I) to assess fear of falling, and Expanded Disability Status Scale (EDSS) to assess MS severity of the patients.
Results: Forty-four patients (F:32 M:12) diagnosed with MS, with a mean age of 37.23±9.67 years, were included in our study. There was a statistically significant, positive and moderate correlation between the fear of falling and the number of attacks in the last 1 year (r=0.433, p=0.039), a statistically significant, positive and high-level correlation between fear of falling and falling history in the last 1 year (r=0.912, p=0.001), disability status (r=0.940, p=0.001) and TUG test (r=0.901, p=0.001) and a significant, negative and high-level correlation between fear of falling and balance skills (r=-0.944, p=0.001). According to the regression analysis, while the effects of falling history (p=0.043), BBT (p=0.025), TUG (p=0.004), and EDSS (p=0.007) on FES-1 were significant, the effect of TPLA was insignificant (p>0.05).
Conclusion: Patients with MS are right about their fear of falling in parallel with their disability and balance-gait skills. However, this relationship is bidirectional, and the fear of falling has the potential to increase these limitations even more in MS patients whose functional activities are already restricted or going to be restricted.

Keywords: *Balance, Fear of Falling, Gait, Multiple Sclerosis*

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Introduction

Multiple Sclerosis (MS) is the most common non-traumatic, dysfunctional disease affecting young adults (Kobelt, Thompson, Berg, Gannedahl and Eriksson, 2017). The reason for the increasing incidence and prevalence of MS in both developed and developing countries is not yet known (Browne et al., 2014). MS is a complex disease; many genes moderately increase susceptibility to disease, in addition to several well-defined environmental factors, particularly exposure to vitamin D or ultraviolet B light, Epstein-Barr virus, obesity, and smoking (Ascherio, 2013).

In MS, cognition, muscle strength, muscle tone, sensation, coordination, and gait skills regress, resulting in an increased risk of falling (Cameron and Nilsagard, 2018; Comber, Galvin and Coote, 2017). The frequency of falling increases in individuals with MS, and secondary to this, results such as increased fear of falling, decreased participation in activities, leaving the profession, injury and even death may occur (Hafler, 2004; Luchinetti et al., 2000; Martin, McFarland and McFarlin, 1992; McFarland, 1999; Raine and Scheinberg, 1988). In order to avoid these results, first of all, it is necessary to identify individuals with MS who are at high risk of falling with balance and gait tests.

It has been reported that the fear of falling is higher in MS patients who have experienced falling in the past, and the fear of falling leads patients to avoid participating in activities and gait (Peterson, Cho and Finlayson, 2007). However, there are few studies in the current literature investigating the correlation between fear of falling, disability status, falling history, and the balance-gait skills of MS patients (Khalil et al., 2017, Scholz et al., 2021). Patients with MS are afraid of falling because their balance and gait skills are weak, or is this fear only due to past experiences? This answer should lead to rehabilitation programs can be determined specifically for the patient. While a more physically focused rehabilitation program is planned for patients with poor balance and gait skills, a more psychology-oriented program could be planned for patients who have a fear of falling due to their past experiences of falling.

The aim of this study was to investigate the factors underlying the fear of falling in MS patients and to determine the share of physical and psychological components in this fear.

Material and Methods

Study design and participants

Patients between the ages of 18-65 years, diagnosed with Relapsing-Remitting form of MS and without any additional neurological or orthopedic problems that would affect the

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balance and gait skills were included in the study. Individuals over 65 years of age were not included, since the risk of falling in older individuals increases independently of the disease.

The study was carried out on a voluntary basis and following the Helsinki Criteria in the Fırat University, Faculty of Health Sciences, Department of Physical Therapy and Rehabilitation. The ethical approval was obtained by the Medical Ethics Committee of Fırat University with the number of 2021/09-54 in 16.09.2021.

After the approval of the ethics committee, the patients were evaluated and the data were recorded and statistical analysis was started.

Assessments

Demographic and clinical data of the patients such as age, height, weight, Body Mass Index (BMI), gender, employment, marital status, educational status, falling history in the past one year were obtained, and then assessments were started. Timed Up and Go Test (TUG) was used to assess gait functions and balance skills of patients during gait, Berg Balance Test (BBT) to assess balance skills in general, Fall Efficacy Scale-International (FES-I) to assess fear of falling, and Expanded Disability Status Scale (EDSS) to assess the MS severity of the patients.

Timed up and go test

The TUG is a tool to assess an individual's mobility and requires both static and dynamic balance. This test is a scale of the World Health Organization's International Classification of Functioning, Disability and Health model. Before the test began, the subject sat in a chair. Afterwards, the subject was asked to get up from the chair, walk 3 meters at the speed at which he felt comfortable, turn and sit back in the chair with the "start" command. The time from the start command until the subject was fully seated in the chair was measured in seconds. The test was repeated 2 times and the mean time was recorded (Podsiadlo and Richardson, 1991).

Berg balance test

BBT was performed to assess balance and fall risk. The BBT consists of 14 items, with 0 indicating the lowest level of function and 4 indicating the highest level of function. BBT consists of 14 different tasks. These; standing up from sitting position, standing unsupported with eyes open, sitting unsupported, going from standing to sitting, transfers, standing unsupported with eyes closed, standing unassisted, reaching forward with arms bent 90º while standing, lifting an object from the floor, back from right and left over left shoulder It includes daily functional tasks such as turning to look, turning 360º, stepping alternatively, making an unsupported heel-toe stance, standing on one leg (Berg, Wood-Dauphinee, & Williams, 1995). The maximum score individuals can get from the test is 56, and higher scores indicate better

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balance. The highest score is 56, scores between 0-20 indicate balance disorder, scores between 21-40 indicate acceptable balance, and scores between 41-56 indicate good balance. We used the Turkish version of the scale in our study (Şahin et al., 2008).

Fall efficacy scale-international

FES-I is a scale that evaluates patients' fear of falling during physical and social activities. It is a 16-item questionnaire in which individuals are instructed to rate their fear of falling during an activity on a 4-point Likert scale as 1 not at all concerned and 4 very worried. Item scores are added together to obtain a total, the higher the score, the higher the drop anxiety. The total score is between 16-64 (Yardley et al., 2005). Cut-off points are defined as 16-19 points of low anxiety, 20-27 points of moderate anxiety, and 28-64 points of high anxiety (Delbaere et al., 2010). We used the Turkish version of the scale in our study (Korkmaz, Duray, Hüzmeli, & Şenol, 2019).

Expanded disability status scale

The EDSS was developed to monitor disease stage by assessing the brainstem, sensory, bowel and bladder, visual, cerebral and other cerebellar systems. It evaluates functional systems by examining activities of daily living and movement restrictions and gives information about disability by examining it in 20 steps. In this scale, which consists of 20 steps, the number 0 indicates normal neurologic finding; 10 means death due to MS. Scores on the EDSS increase to correspond with worsening in MS. The first score after 0 is 1, and then clinical worsening is expressed in 0.5-point intervals (Kurtzke, 1983).

Studies have stated that it takes 6 to 23 years for MS patients to achieve an EDSS score of 3 to 4, and it takes 16 to 18 years to reach 6 (Özakbaş, 2008).

Statistical analysis

In the power analysis made in line with the information obtained from the literature (Mazumder, Lambert, Nguyen, Bourdette, and Cameron (2015), it was calculated that 90% power could be obtained at the 95% confidence level when at least 41 patients were included in the study. Data were analyzed with SPSS 25 (IBM SPSS Statistics 25 software (Armonk, NY: IBM Corp.)) package program. Continuous variables are given as mean ± standard deviation and categorical variables as numbers and percentages. Relationships between continuous variables were analyzed by Spearman correlation analysis, since the data did not fit the normal distribution. Linear regression analysis was performed to determine the effect level of the parameters affecting the fear of falling.

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Results

Forty-four patients (F:32 M:12) diagnosed with MS, with a mean age of 37.23±9.67 years, were included in our study. The mean height of the patients was 166.27±7.45 cm, the mean weight was 70.07±13.04 kg, and the mean BMI was 25.31±4.3 kg/cm^2. The demographic data of the patients and the number of falls in the last 1 year are given in Table 1.

Table 1. Demographic and clinical data

Gender	**n**	**%**
Female	32	72.7
Male	12	27.3
Falling History (Last 1 year)	**n**	**%**
0	22	50
1	6	13.6
2	7	15.9
3	6	13.6
4	3	6.8

As can be seen from Table 1, half of the MS patients experienced at least one fall in the last 1 year, and the other half has never fallen. This homogenity is important for the statistics.

The clinical assessment scores of the patients are given in Table 2.

Table 2. Assessment Scores

	Mean±SD	**Min**	**Max**
TUG	10.22±4.12	5.5	18.92
BBT	43.3±8.04	28	56
FES-I	29.32±10.48	16	50
FES-I (fh+)	38.72±6.46	25	50
FES-I (fh-)	19.91±2.75	16	26
EDSS	2.54±1.25	1.0	4.5
TPLA	2.27±1.78	1	8

TUG: Timed Up and Go Test **BBT:** Berg Balance Test
FES-I: Fall Efficacy Scale-International **fh+:** Falling History (+) **fh-:** Falling History (-)
EDSS: Expanded Disability Status Scale **TPLA:** Time Past from Last Attack (years)

According to Table 2, the patient population with MS included in this study has a moderate fall concern. Supporting this data, mean balance scores are close to the lower limit of the cut point, which is considered as "good balance" (Berg et al., 1995). Another important data seen in this table is that patients with a falling history in the last 1 year have a higher fear of

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falling. According to the FES-I scores, patients with MS who have a falling history are at the "high concern" level, while those without it are at the "low concern" level. The mean EDSS score of these patients, who have experienced a mean of 2 attacks in the last 1 year, is also slightly above 2. This means these patients have minimal disability in 1 functional system (Kurtzke, 1983).

The correlation of the evaluated parameters of patients with MS is examined in Table 3.

Table 3. Correlations

		FES-I	**TPLA**	**Falling History**	**BBT**	**TUG**	**EDSS**
FES-I	**r**	-	0.433*	0.912*	-0.944*	0.901*	0.940*
	p	-	*0.039*	*0.001*	*0.001*	*0.001*	*0.001*
TPLA	**r**	0.433*	-	0.013	-0.126	0.019	0.087
	p	*0.039*	-	*0.933*	*0.415*	*0.903*	*0.102*
Falling	**r**	0.912*	0.013	-	-0.911*	0.913*	0.906*
History	***p***	*0.001*	*0.933*	-	*0.001*	*0.001*	*0.001*
BBT	**r**	-0.944*	-0.126	-0.911*	-	-0.895*	-0.920*
	p	*0.001*	*0.415*	*0.001*	-	*0.001*	*0.001*
TUG	**r**	0.901*	0.019	0.913*	-0.895*	-	0.863*
	p	*0.001*	*0.903*	*0.001*	*0.001*	-	*0.001*
EDSS	***r***	0.940*	0.087	0.906*	-0.920*	0.863*	-
	p	*0.001*	*0.575*	*0.001*	*0.001*	*0.001*	-

FES-I: Fall Efficacy Scale-International **TPLA:** Time Past from Last Attack (years)
EDSS: Expanded Disability Status Scale **BBT:** Berg Balance Test
TUG: Timed Up and Go Test ***: $p<0.05$* *Spearman Correlation Analysis*

According to Table 3, there is a statistically significant, positive and moderate correlation between the fear of falling and the number of attacks in the last 1 year (r=0.433, *p=0.039*). There is a statistically significant, positive and high-level correlation between fear of falling and falling history in the last 1 year (r=0.912, *p=0.001*), disability status (r=0.940, *p=0.001*) and TUG test (r=0.901, *p=0.001*). There is a significant, negative and high-level correlation between fear of falling and balance skills (r=-0.944, *p=0.001*).

There was no statistically significant correlation between the number of attacks in the last 1 year with disability status and balance-gait skills (*p>0.05*). Likewise, there is no significant relationship between the number of attacks in the last 1 year and the falling history in the last 1 year (*p>0.05*).

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There is a statistically significant, negative and high correlation between the falling history in the last 1 year and balance skills (r=-0.911, *p=0.001*). There is a significant, positive and high-level correlation with disability status (r=0.906, *p=0.001*) and the TUG test (r=0.913, *p=0.001*).

The regression analysis examining the effects of independent variables on the dependent variable of FES-1 is given in Table 4.

Table 4. Regression analysis

	R	**R^2**	**Regression Sum of Squares**	**df**	**Mean Square**	**F**	***p***
FES-1	0.975	0.943	4491.784	5	898.357	144.034	*0.001*
	Unstandardized Beta		**Standardized Beta**			**t**	***p***
TPLA	-0.082		-0.014			-0.361	*0.720*
Falling History	2.205		0.285			2.364	*0.043**
BBT	0.336		0.258			2.331	*0.025**
TUG	0.893		0.352			3.067	*0.004**
EDSS	2.532		0.303			2.859	*0.007**

R: Regression **R^2:** R Square **df:** Degrees of Freedom **F:** ANOVA Statistics **t:** Test Statistics
FES-I: Fall Efficacy Scale-International **TPLA:** Time Past from Last Attack (years)
EDSS: Expanded Disability Status Scale **BBT:** Berg Balance Test
TUG: Timed Up and Go Test ****:*** *$p<0.05$* *Linear Regression Analysis*

According to Table 4, while the effects of Falling History (*p=0.043*), BBT (*p=0.025*), TUG (*p=0.004*), and EDSS (*p=0.007*) on FES-1 were significant, the effect of TPLA was insignificant (*p>0.05*).

Discussion

In this study, we conducted to measure the effectiveness of the psychological and physical factors underlying the fear of falling in MS patients, we determined that both psychological factors such as the TPLA and falling history in the last 1 year and physical factors such as balance and gait skills affect the fear of falling in these patients. We also found that there is a high-level correlation between psychological factors and physical factors and that these factors can influence each other.

According to the results of our study, there is a high-level correlation between the fear of falling and the falling history in MS patients. The first conclusion to be drawn from this data is that the falling history triggers the fear of falling in these patients, and the patients are more

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concerned about falling. However, we want to bring a different perspective here and ask the following question; Could the fear of falling also be contributing to the future falling history by increasing the frequency of falling? Considering the high correlation between fear of falling and balance and gait skills, could the increased fear of falling cause weakening of functional skills, just as the weakening of functional skills triggered the fear of falling? Hershkovitz, Malcay, Grinberg, Berkowitz and Kalron (2019) stated that MS patients with fear of falling completed the TUG test in a longer time and the delay here was due to the fear and hesitation in the sitting-to-stand phase. Bernhard et al. (2018), on the other hand, suggested that weakening in balance and walking skills caused the fear of falling, and did not look at this relationship in the opposite direction.

Mazumder, Lambert, Nguyen, Bourdette, and Cameron (2015) evaluated the fear of falling with FES-I in a prospective study involving 58 patients aged 18-50 years with MS diagnosed with EDSS scores ranging from 0 to 6, and the fear of falling could increase the frequency of falling in the future. In the same study, they stated that the history of falling in the last 6 months also increased the fear of falling.

In our study, we found that there was a significant correlation between the fear of falling and the TPLA in the last 1 year and the falling history. On the other hand, there was a high-level correlation between the fear of falling and the disability status and balance-gait skills. The conclusion we can draw from these data is the answer to the question we asked in the title of our study: The fear of falling in MS patients is not baseless, the patients are right to worry about. We believe that patients with poor balance and gait skills, a high level of disability, TPLA and history of falls in the last 1 year are very right in fear of falling.

According to Khalil et al. (2017) investigated the factors underlying the fear of falling in MS patients and found that both motor and non-motor (cognitive, psychological) parameters were associated with fear of falling, but only the effect of motor parameters was significant. They interpreted this as functional activities such as balance skills and walking, although non-motor parameters also had an effect on the fear of falling in MS patients.

In the literature, it has been stated that patients with MS may have a fear of falling even if they do not have a history of falling, and they may limit their activities because of these fears (Matsuda, Shumway-Cook, Ciol, Bombardier and Kartin, 2012). In our study, we found that patients with MS had a low level of anxiety in terms of fear of falling, even if they did not have a history of falling in the last 1 year. From this point of view, it can be concluded that the fear of falling in MS patients has psychological components as well as physical components.

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Another striking result of our study is that there is no significant correlation between the TPLA, disability level, and balance-walking skills. In this regard, the expectation is that the disability level and balance-walking skills of patients with MS who have recently had an attack could be affected. In our study, the first thing that comes to mind as the reason for the contrary to this expectation is that the attacks experienced by the patients were mild and therefore the attacks did not affect the disability level and balance and gait skills. Another interpretation we could bring is that although the attacks affected the disability level and balance-walking skills of the patients, this effect did not reach significant levels. As it is already known, regression of functional skills and disability in MS with the Relapsing-Remitting form occur with the progression of plaques over the years and the overlapping of attacks.

Since there is no study in the current literature investigating the direct effect of attacks on fear of falling in MS patients, the results of our study are the first in this sense. However, there are also studies indirectly reporting that fear of falling may increase due to regression of motor skills, especially balance skills, after attacks (Kalron & Achiron, 2013; Kalron & Allali, 2017; Kalron, Aloni, Givon & Menascu, 2018).

According to the results of our study, the factors affecting the fear of falling in MS patients are gait skills, disability status, falling history and balance skills, respectively. Although the time elapsed after the last attack is related to the fear of falling, its effect is limited. From this point of view, in order to prevent fear of falling in MS patients, gait and balance skills should be improved, disability levels of patients should be reduced and falling should be prevented. Because repetitive falls could bring the fear of falling. When the share of physical and psychological components on the fear of falling was examined, it was seen that the physical parameters were more prominent, therefore, MS patients are right in their fear of falling.

The limitations of our study are that only patients with Relapsing-Remitting MS were included and the included population consisted of only patients with low EDSS scores. Including patients with different types of MS and different disability status and investigating the effects of these parameters on the results can create a stronger study. The strengths of our study are that it brings a different perspective to the existing fear of falling studies in the literature, examines the relationships between psychological and physical factors, and sufficient sample size.

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Conclusion

Patients with MS are right about their fear of falling in parallel with their disability and balance-gait skills. However, this relationship is bidirectional, and the fear of falling has the potential to increase these limitations even more in MS patients whose functional activities are already restricted or going to be restricted. Without ignoring the psychological aspect of the fear of falling, as patients with MS do balance and gait exercises and their disability levels decrease, their fear of falling should decrease in parallel. The falling frequency of patients whose fear of falling decreases should also decrease.

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Conflicts of Interest

The authors declare no conflicts of interest.

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