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Original Article

Relationship Between Severity of Multiple Sclerosis and Fear of Falling Mediated by Cognitive and Physical Factors

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Abstract

Background & Aims: Multiple sclerosis (MS) patients are exposed to various health threats, including fear of falling (FOF), which restricts their daily life activities and cause isolationism and lower social participation. The present study aimed to investigate the relationship between the severity of MS and FOF through the mediating role of cognitive and physical factors in patients with MS.

Materials and Methods: This was a correlational study based on path analysis. The statistical population consisted of all patients with MS who visited the neurology centers of hospitals in Sari, Iran, 200 of whom were selected as the sample using convenience sampling. The research instruments included the Falls Efficacy Scale-International (FES-I), MS Severity Scale, Cognitive Factors Questionnaire, and the MOS 36-item Short-Form Health Survey (SF-36).

Results: The results indicated that there was a negative and significant relationship between FOF and cognitive and physical factors and also a positive and significant relationship between FOF and the severity of MS ($P<0.01$). In addition, the results corroborated the negative and significant relationship between the severity of MS and physical factors ($P<0.01$). However, the direct relationship between the severity of MS and cognitive factors were excluded from the model because it was not established. The study findings confirmed the relationship between FOF and the severity of MS mediated by cognitive and physical factors ($P<0.001$).

Conclusion: According to the results FOF was found to be much higher among patients with higher MS severity. The severity of MS had a positive relationship with FOF in the patients. Moreover, cognitive and physical factors had a mediating role in the relationship between the severity of MS and FOF.

Keywords: Accidental falls, Patient acuity, Cognitive training, Multiple sclerosis

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1. Introduction

Multiple sclerosis (MS) is the most common neurological inflammatory disease affecting young adults, as the mean age of patients diagnosed with this disease is about 30 years [1]. MS is a chronic, progressive disease of the central nervous system. In this disease, the immune system attacks the protective sheath (myelin) that covers nerve fibers and causes communication problems between the brain and the rest of the body. Eventually, the disease can cause permanent damage or deterioration of the nerves. The latest data indicate that there about 80 000 patients with MS in Iran; therefore, Iran is considered among the top 10 countries around the world in MS prevalence [2].

There are different types of MS, each of which causes symptoms in a different way. One of the types of relapsing-remitting MS (RRMS) is in the form of successive periods of relapse and remission of the disease. In this type of MS, there is a period of remission between both relapses [3,4]. MS has very diverse symptoms and presentation. These problems are mainly cognitive and psychological disorders (memory impairment, anxiety, depression, sense of guilt), visual disorders (optic neuritis, blurred vision, and diplopia), difficulty in speaking (dysarthria) and swallowing, lethargy and fatigue, spasticity, sensory disorders (tingling and murmurs), cerebellum and balance disorders, and urination and defecation disorders [5,6]. Janalipour et al [7] showed that patients with MS experienced higher levels of mental disorders, such as depression, stress, and anxiety than healthy individuals did. These symptoms may result from the direct effect of inflammation and demyelination of the nerves and/or from unpredictable psychological effects of this disease. Studies have shown that about 50-60% of patients with MS suffer from depression and about 37-40% from anxiety, which can greatly affect their quality of life [8]. These mental disorders are associated with social function disorder, suicidal ideation, disease recurrence, and reduced quality of life in patients with MS [9]. Since patients with MS suffer from a wide range of nervous system problems, they may need to receive rehabilitation services during their pharmacological treatment [10,11].

MS patients' ability to maintain their balance is related to muscle strength and spasticity. Their walking speed is also affected by several factors such as muscle strength and balance, muscle tone, and environmental conditions [12]. Moreover, patients with MS can walk at a normal speed if

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they strengthen their muscles and maintain their balance. Inability to control balance, as one of the most common symptoms of MS, along with other factors, increases the risk of falling in such patients and prevents them from running their daily activities [13]. Payette et al [14] showed that there was a significant relationship between fear of falling (FOF) and anxiety. The development of a program for preventing falls requires assessing various aspects of mobility impairments and accurately identifying the factors increasing the risk of falling [15,16]. Considering the high prevalence of MS, addressing balance problems and factors influencing them in patients with MS can play an important role not only in preventing the common complications of falling but also in helping them undergo rehabilitation interventions successfully [17,18].

MS can simultaneously affect both cognitive and physical components that help people to maintain their balance and walk normally. No studies have investigated a set of physical and cognitive factors together in order to find the most important predictor of successful walking in patients with MS. It is hence necessary to identify the factors that greatly affect FOF in patients with MS and also to determine their effect size, because such studies can serve as a basis for making many strategic decisions. Therefore, based on the above considerations, the present study aimed to investigate the relationship between the severity of MS and FOF through the mediating role of cognitive and physical factors in patients with MS.

2. Materials and Methods

2.1. Design and participants

This was a correlational study based on path analysis. The statistical population consisted of all patients with MS who visited the neurology centers of hospitals in Sari, Iran, 200 of whom were selected as the sample using convenience sampling. The inclusion criteria were having a history of MS, not suffering from any serious physical illness, and not having undergone any psychotherapy intervention within one month before the study, and completing informed consent forms. The exclusion criteria were unwillingness to take part in the study, affliction with a physical disease, and failure to answer the questions in the questionnaires. All ethical considerations were observed in this study; an informed consent form was obtained from the participants and they were assured that they could freely leave the study whenever they desired. The sampling process began after making the necessary coordination with the Research Department and obtaining the necessary permits. In addition, the data were confidentially analyzed by the researcher.

2.2. Instruments

The Falls Efficacy Scale-International (FES-I): The FES-I is a 16-item tool that measures the level of concern about falling during 16 social and physical activities based on a 4-point Likert scale (1 = not at all concerned to 4 = very concerned). The minimum and maximum scores on this scale are 16 and 64, and scores of 16-19, 20-27, and 28-64 indicate low, moderate, and high FOF, respectively [19,20]. This scale was developed and validated by Yardley et al [21]. Cronbach's alpha coefficient for the scale was 0.70 [22]. In the present study, the reliability of this scale based on Cronbach's alpha was equal to 0.80.

Cognitive Factors Questionnaire: This 30-item questionnaire was developed by Nejati [23] to measure cognitive factors in 7 separate areas: memory (items 1-6), selective attention and inhibitory control (items 7-12), decision-making (items 13-17), planning (items 18-20), sustained attention (items 21-23), social cognition (items 24-26), and cognitive flexibility (items 27-30). The items are scored based on a 5-point Likert scale (1: never to 5: almost always). Cronbach's alpha coefficient for the scale was 0.83 [23]. In this study, the reliability of this questionnaire based on Cronbach's alpha was equal to 0.78.

The MOS 36-item Short-Form Health Survey (SF-36): This 36-item self-reporting questionnaire was developed by Ware and Sherbourne [24] to examine the quality of life and health in 8 areas: physical function, limitations of role-playing due to physical health status, limitations of role-playing due to emotional problems, energy and vitality, emotional health, social function, pain, and general health. The total score on this tool ranges between 0 and 100, and scores below 45, 45-60, 60-75, and over 75 indicate very poor, poor, good, and desirable quality of life, respectively. Cronbach's alpha coefficient for the scale was 0.90 [25]. In this study, the reliability of this questionnaire was 0.84 based on Cronbach's alpha.

MS Severity Scale: This scale was measured by a neurologist and given to the researcher. The severity of MS is measured on a scale ranging from 0 to 5 based on the following factors: normal functioning without any restriction in activities or lifestyle, type of MS, duration of disease, disease severity, health, and balance. Scores 0, 1, 2, 3, 4, and 5 represent mild, very low grade, low grade, moderate, severe and very severe MS, respectively. The validity of this scale was confirmed by its developers [26].

2.3. Statistical analyses

The data was analyzed through structural equation modeling (SEM) using SPSS and AMOS software version 25.

3. Results

The participants included 200 patients with RRMS with age range of 20-50 years. The mean duration of the disease in the participants was 5.49 ± 2.12 years. The demographic variables of the patients are presented in Table 1.

Table 2 presents the mean, standard deviation (SD), and

Pearson correlation coefficients of the research variables. The initial suggested model to describe the relationship between the variables is shown in Figure 1.

The results in Table 3 demonstrate that the initial model has to be modified based on the root mean square error of approximation (RMSEA = 0.155). To correct the model, the insignificant relationship between severity of MS to cognitive factors was removed. There was a root-mean-square error (RMSEA = 0.017) in the final model, indicating that the model fits well. Figure 2 shows the final modified model.

Table 4 shows the results of estimating path coefficients for testing direct hypotheses. The results showed there was a direct relationship between the severity of MS and FOF (β = 0.60; P = 0.001), and between FOF and cognitive factors (β = 0.68; P = 0.001) in the patients with MS. There was a negative relationship between the severity of MS and physical factors (β = -0.72; P = 0.012), and between FOF and physical factors (β = -0.55; P = 0.002) in the patients with MS. There was no significant relationship between the severity of MS and cognitive factors in the patients (Table 4).

The Bootstrapping method was used to evaluate the significance of intermediary relationships. The results showed there was a significant indirect path from severity of MS to FOF through the mediating role of physical factors in the patients with MS (P = 0.001). The indirect path from severity of MS to FOF through the mediating role of cognitive factors was not significant (Table 5).

Table 1. Demographic variables of the patients

Variables		n	%
Age (y)	20-30	59	29.50
	30-40	123	61.50
	40-50	18	9.00
Gender	Male	83	51.50
	Female	117	58.50
Education	Middle school	49	24.50
	High school	65	32.50
	College education	86	43.00
Mean ± SD duration of the disease (y)		5.49 ± 2.12	

Table 2. Mean ± SD, and Pearson correlation coefficients of the research variables

Variables	Mean ± SD	1	2	3	4
Severity of MS	2.36 ± 0.89	1			
Physical factors	52.76 ± 23.42	-0.33*	1		
Cognitive factors	42.93 ± 17.67	-0.39*	0.51*	1	
Fear of falling	33.75 ± 10.22	0.42*	-0.37*	0.29*	1

* P < 0.05.

4. Discussion

This study aimed to investigate the relationship between the severity of MS and FOF through the mediating role of cognitive and physical factors in patients with MS in Sari in 2021. The results showed that there was a positive relationship between the severity of MS and FOF, and between FOF and cognitive factors in the patients with MS. According to the results of the present study, there was a negative relationship between the severity of MS and physical factors, and between FOF and physical factors in the patients with MS. There was no significant relationship between the severity of MS and cognitive factors in the patients. The results indicated that physical

Table 3. Fit indicators of the initial and final models

Fit indicators	χ^2	df	(χ^2/df)	IFI	TLI	CFI	NFI	RMSEA
Initial model	2.14	1	2.14	0.52	0.44	0.56	0.67	0.155
Final model	4.32	2	2.16	0.91	0.93	0.92	0.93	0.017

IFI: Incremental Fit Index; TLI: Tucker–Lewis index; CFI: Comparative Fit Index; NFI: Normed Fit Index; RMSEA: Root Mean Square Error of Approximation.

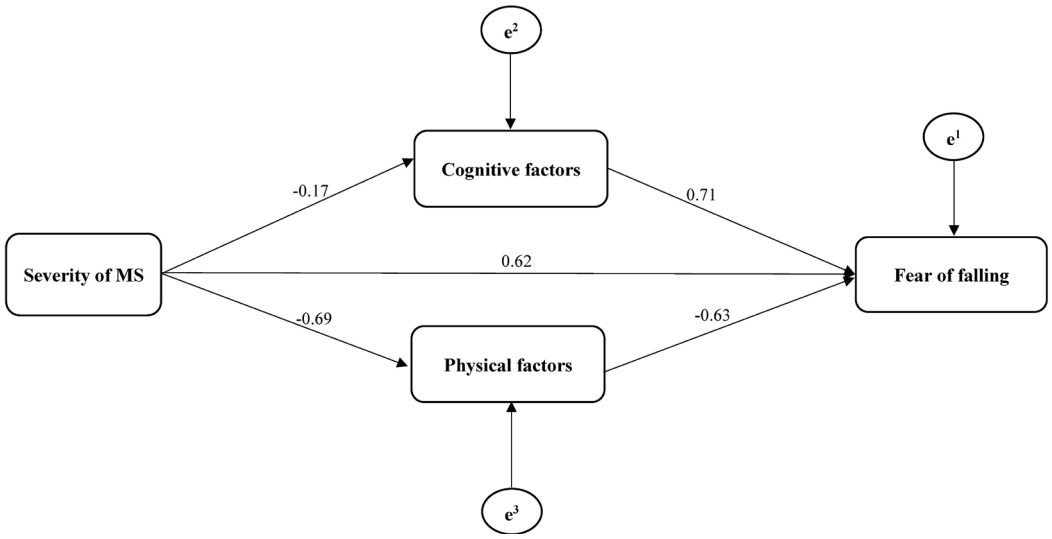

Figure 1. The initial model of the mediating role of cognitive and physical factors in the relationship between severity of MS and fear of falling

Table 4. Direct effects between research variables in the initial and final modified models

Path	Initial model		Final modified model	
	β	*P*	β	*P*
Severity of MS to fear of falling	0.62	0.001	0.60	0.001
Severity of MS to cognitive factors	-0.17	0.215	-	-
Severity of MS to physical factors	-0.69	0.001	-0.72	0.012
Fear of falling to cognitive factors	0.71	0.003	0.68	0.001
Fear of falling to physical factors	-0.63	0.011	-0.55	0.002

Table 5. Results of analysis of indirect and intermediary paths in the final modified models

Predictor variable	Mediator Variable	Criterion variable	Initial model		Final modified model	
			β	P	β	P
Severity of MS	Cognitive factors	Fear of falling	-0.029	0.319	-0.029	0.319
Severity of MS	Physical factors	Fear of falling	0.119	0.001	0.128	0.001

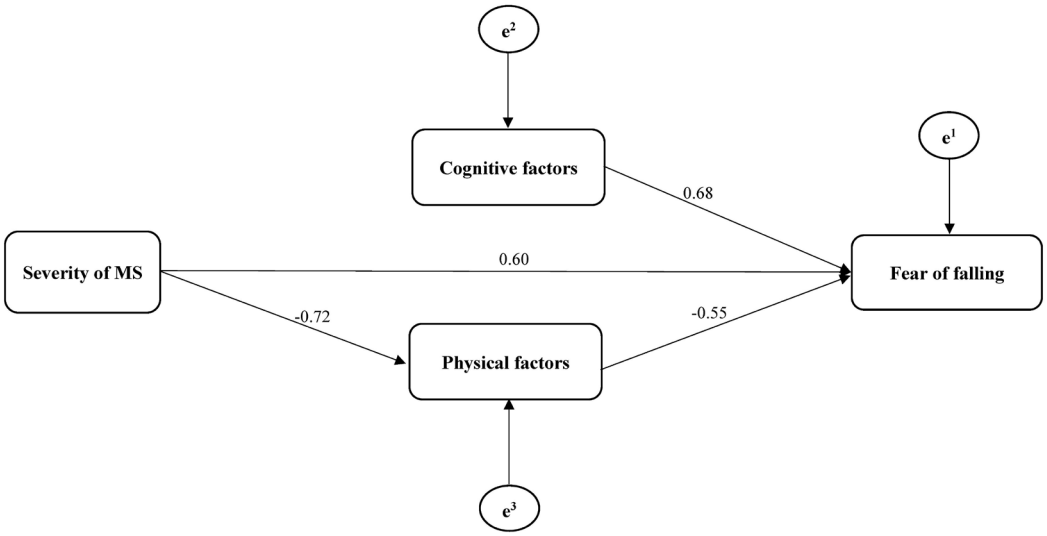

Figure 2. The final modified model of the mediating role of cognitive and physical factors in the relationship between severity of MS and fear of falling

factors had a mediating role in the relationship of severity of MS and FOF in the patients with MS. This finding is consistent with the research results of previous study [27,28].

Balance impairment, falling, and walking limitations in patients with MS can influence their performance in everyday life and social activities [29]. Falling is one of the main problems of the care systems around the world, as the World Health Organization (WHO) introduced FOF as the third leading cause of chronic disability. Many studies have shown that patients with MS experience higher levels of FOF due to their physical conditions [27,28,30]. To explain the study findings, it can be stated that cognitive activity can even be an ordinary conversation that occurs frequently in everyday life. Studies have shown that the speed of movement decreases while talking and the risk of falling increases in patients with MS without dementia, as the risk of falling increases with the increase in the speed of talking. It has been also shown that the mobility performance of such patients decreases as they focus more on talking, compared to the situation in which they equally focus on both activities. Impairment of cognitive functions such as memory, selective attention, inhibitory control, decision-making, planning, sustained attention, social cognition, and cognitive flexibility increases FOF in patients with MS [31].

FOF is defined as a mental condition that limits physical activities. The high level of FOF that patients with MS experience may result in excessive care, mobility restrictions and lack of independence, which ultimately impair their motor functions. It can be hence stated that FOF is a psychological variable that can increase physical weakness and decrease physical activity of inactive patients with MS [27]. Moreover, experiencing frequent falls can make patients with MS limit their physical activities due to FOF. In fact, FOF is inversely related to physical activity, i.e., patients with MS with a higher level of FOF are less likely to engage in physical activities.

About half of patients with MS may experience some sort of changes in their cognitive abilities during the

course of the disease. Cognitive problems in patients with MS usually affect memory, complex attention, information processing speed, and executive functions. Although patients with MS may experience mild to severe changes in their cognitive abilities, even mild changes can negatively influence their personal and professional life. In addition to brain lesions, other factors such as side effects of medications, sleep deprivation, depression, anxiety, stress, and fatigue can cause cognitive problems in patients with MS. It can be argued that the medicines patients with MS take can exacerbate their cognitive problems [31]. However, this result can be attributed to the nonsignificant relationship between the severity of MS and cognitive factors. For example, a study at a different time and place may reveal a significant relationship between the severity of MS and cognitive factors. Moreover, the factors affecting this relationship may originate from different philosophical and cultural contexts. The lower severity of MS in the study population and reduced consumption of drugs can also affect this relationship.

MS is one of the most common neurological diseases among young adults that damages the central nervous system and causes symptoms such as muscle weakness and spasms, fatigue, and balance and sensory disorders. Stressful responses to disease diagnosis, uncertain prognosis and outcome of the disease, side effects of drugs, the inflammatory neurological process of the disease, and psychological-biological and structural changes in the brain are among the factors reducing physical activity by patients with MS [32]. In fact, it can be stated that the higher the severity of the disease, the lower the level of physical activity of patients with MS and the less their ability to perform daily activities

Considering the high prevalence of psychological problems in patients with MS, investigating the role of effective factors in the occurrence of psychological problems can be a useful step in helping these patients and reducing their psychological problems. It is crucial to identify the variables that affect the FOF among patients with MS as it could be helpful in many strategic decisions. One of the innovations of the present study is to investigate the FOF in patients with MS and its relationship with some other characteristics such as the severity of MS and cognitive and physical factors in these patients. The present study seeks to help patients with MS control MS progress, have promising life and mitigate physical and psychological symptoms.

This study faced some limitations. For example, since it was conducted on patients with MS in Sari, Mazandaran Province, the results should be cautiously generalized to patients with MS in other provinces and regions of Iran. In addition, the research data were collected through questionnaires; the unconscious data obtained from questionnaires are prone to distortion and may jeopardize the research findings. Another limitation of this study was the lack of access to the Expanded Disability Status Scale to determine the severity of MS.

5. Conclusion

Considering the importance of developing a model of FOF, the study findings can provide a basis for future studies to investigate stress-induced problems and behavioral disorders, such as depression, and develop appropriate psychological interventions. It is also recommended to develop the necessary plans for reducing FOF in patients with MS.

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Competing Interests

All the authors declare that they have no conflict of interest.

Ethical Approval

The study was approved by the Ethical Committee of Islamic Azad University- Tonekabon Branch (code: IR.IAU.TON.REC.1400.028).

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