Research Paper

Relationship Between Multiple Sclerosis Severity and Fear of Falling With Mediating Roles of Disability, Cognitive Factors, and Physical Factors Among Patients With MS

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ABSTRACT

Background: Fear of falling (FoF) is a permanent concern and may limit daily activities and diminish confidence in balance abilities leading to muscular deterioration, a sedentary lifestyle, and reduced quality of life. The present study aimed to investigate the relationship between multiple sclerosis severity and FoF with mediating roles of disability, cognitive factors, and physical factors among patients with multiple sclerosis (MS).

Methods: This research 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. A total of 200 MS patients were selected as the sample using multistage random sampling. Two hospitals were selected from the hospitals of Sari city and the research sample was selected from the neurology centers of these hospitals. The research instruments included the falls efficacy scale-international, the MS severity scale, the expanded disability status scale, the cognitive factors questionnaire, and the MOS 36-item short-form health survey. The data were analyzed by structural equation modeling in AMOS and SPSS software, version 25.

Results: The results of structural equation modeling demonstrated that the proposed model fitted the data. FoF had positive significant relationships with MS severity and disability. MS severity and FoF had negative significant relationships with physical factors ($P<0.01$). The direct relationship between MS severity and cognitive factors was insignificant and excluded from the model. The study findings confirmed the relationship between MS severity and FoF mediated by disability and physical factors in patients with MS ($P<0.01$).

Conclusion: The frequency of FoF was much higher among patients with higher MS severity. Considering the consequences of the FoF among patients with MS, it is recommended that consultation services be provided to patients with MS at healthcare centers to improve their health and activity and reduce their FoF.

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

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1. Introduction

Multiple sclerosis (MS) is the most common nervous system disease among young adults. The average MS diagnosis age is 30, and most patients have periodic recurrences [1]. The clinical period of MS varies from a constant chronic state to a rapidly progressing disease. Relapsing-remitting MS is the most common type of MS; however, there are other types [2]. Many patients with MS engage in the progressive stage of the disease in one or two decades [3]. Several environmental and genetic factors may change the MS risk; however, the main cause of the disease remains unidentified yet [4, 5]. In Iran, nearly 80,000 patients with MS have been reported. Iran is among the top ten countries in the number of patients with MS [6].

Balance problems are among the most disabling symptoms of MS and appear in nearly 75% of the patients. In addition, balance problems and body control are the most common condition in MS, and patients frequently experience falling [7]. The imbalance in MS disease and loss of coordination of body parts starts from muscles, especially muscle weakness and spasms. Other MS-related factors associated with MS imbalances include blurred vision, problems with sensation in the legs, and vertigo [8]. Falling is one of the biggest problems that result from an imbalance in MS. Some people with MS have a lack of balance when they walk, and the way they walk lacks coordination. Studies have shown that falling is related to dynamic balance disorder in patients with MS [9]. Patients with a history of falling reportedly showed lower performance in balance, standing up, and walking tests. These tests evaluate balance problems during walking and transporting [10]. Fear of falling (FoF) is a permanent concern and may limit daily activities and diminish confidence in balance abilities, leading to muscular deterioration, a sedentary lifestyle, and reduced quality of life. Balance disorders in patients with MS lead to FoF, the tendency to be still and immobile, reduced levels of physical activity, and reduced self-efficacy during essential daily activities [9]. Studies have shown that patients with MS experience more falls compared to the elderly and also compared to those who have had a stroke [7]. As a severe consequence of MS, disability refers to functional, physical, personal, and social problems in one or more aspects concerning environmental factors and health conditions [11, 12]. Scholz et al. [8] reported that patients with MS who have a greater FoF experience more falls and more severe disability; also, walking speed is lower in these patients. Khalil et al. [9] showed that FoF in patients with MS is multifactorial and includes motor and non-motor factors. Mazumder et al. [7] reported that patients with MS fall more, and are more likely to be injured by a fall.

MS causes personality, cognitive, and psychological changes [13]. Many psychological problems have been reported among patients with MS, and 40% to 65% of patients with MS experience some kind of change in cognitive abilities during the course of their disease. Cognitive problems in MS are usually related to memory, complex attention, information processing speed, and executive functions [14]. Changes in cognitive abilities can range from mild to moderate in severity, but even mild degrees affect the patient's personal and professional life. Not all cognitive problems in MS are caused by lesions in the brain, but factors such as side effects of medications, lack of sleep, depression, anxiety, stress, and fatigue also play a role in its occurrence [15]. Grzegorski and Losy [14] reported that cognitive impairment is a common feature of MS that affects 43%-70% of patients. Tajoddini et al. [16] showed that many of the psychological problems experienced by MS patients are partially affected by cognitive, emotional, and social factors. Botchorishvili et al. [15] reported that cognitive impairment is a common symptom of MS with a significant negative impact on the occupational and social functioning of patients. In patients with MS, pain is diagnosed in twice as many women as men [17, 18]. An epidemiological study showed that 17% of male patients with MS and 20% of female patients in Australia suffered from chronic pain [19].

One of the important consequences of MS disease that is evaluated and treated by therapists is movement problems, walking disorders, and balance problems in patients with MS, which causes a decrease in the individual's independence and the patient's stay at home. This disorder eventually prevents MS patients from continuing their work activities and causes them to become depressed and isolated. Most of the studies on patients with MS have focused on the problems related to the physical aspect of MS, and less attention has been paid to the psychological aspects of the disease. Therefore, 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 re-

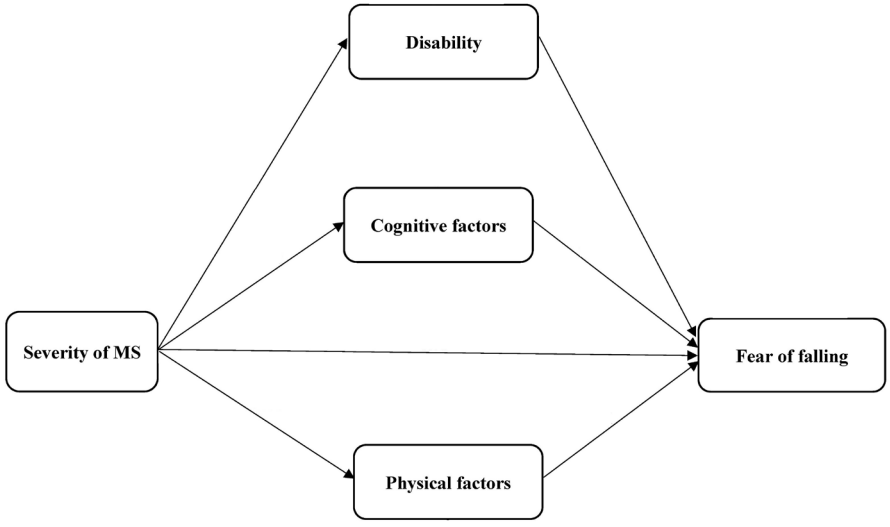

Figure 1. Theoretical model of the research

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lationship with some other characteristics such as disability, 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 a promising life, and mitigate physical and psychological symptoms. Therefore, based on the above considerations, the present study aimed to investigate the relationship between MS severity and FoF with mediating roles of disability, cognitive factors, and physical factors among patients with MS. The theoretical model of the research is presented in Figure 1.

2. Methods

The present research 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. A total of 200 MS patients were selected as the study sample using multistage random sampling. Two hospitals were selected from the hospitals of Sari city and the research sample was selected from the neurology centers of these hospitals. In this study, the sample size was selected based on the research variables. Based on this, 20 samples were considered for each variable [20]. A total of 210 questionnaires were distributed among the participants. After removing 10 incomplete questionnaires, the data from 200 questionnaires were analyzed. The inclusion criteria were having a history of MS, not suffering from any serious physical illness, 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 coordinating with the research department and obtaining the necessary permits. In addition, the data were confidentially analyzed by the researcher.

Instruments

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 four-point Likert scale (1=not at all concerned to 4=very concerned). The minimum and maximum scores on FES-I are 16 and 64, and scores of 16-19, 20-27, and 28-64 indicate low, moderate, and high FoF, respectively [21]. This scale was developed and validated by Yardley et al. [22]. The Cronbach alpha coefficient for FES-I was 0.70 [23]. In the present study, the reliability of this scale based on the Cronbach alpha was 0.80.

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.

Cognitive factors questionnaire

This 30-item questionnaire was developed by Nejati [24] 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). The Cronbach alpha coefficient for the scale was 0.83 [24]. In this study, the Cronbach alpha reliability of this questionnaire was 0.78.

MOS 36-item short-form health survey

This 36-item self-reporting questionnaire was developed by Ware and Sherbourne [25] 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 the very poor, poor, good, and desirable quality of life, respectively. The Cronbach alpha coefficient for the scale was 0.90 [26]. In this study, the Cronbach alpha reliability of this questionnaire was 0.84.

Kurtzke expanded disability status scale

EDSS was used to evaluate the degree of disability of patients with MS. This scale measures the different states and functions of the central nervous system (CNS). This instrument, along with neurological clinical examinations, assesses the function of the pyramidal tracts, the brain, brainstem, cerebellum, and senses to determine the severity of disability in patients. The respondent's total score can range from 0 (normal neurological examination) to 10 (death due to MS). Lower scores indicate less disability, and higher scores reflect severer disability [27]. This scale was used by a neurologist who collaborated with the study before including the patient in the training program, and the results were given to the researcher.

Statistical Analyses

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

3. Results

The demographic data showed that 19.5%, 43.5%, 28%, and 9% of the participants were under 25, 25-35, 35-45, and over 45 years of age, respectively. In addition, 41.5% were male and 58.5% of female. In terms of educational attainment, 29.5%, 13.5%, 44.5%, and 12.5% of the participants had a high school diploma, an associate's degree, a bachelor's degree, and a master's or a higher degree, respectively. Table 1 presents the Mean±SD, and Pearson correlation coefficients of the research variables. All the variables had Variance Inflation Factor (VIF) <10 and tolerance statistics >0.1; therefore, the assumption indicating non-multi-linearity was confirmed. The Kurtosis and Skewness of all the variables fell in the -2 to +2 range, therefore the data normal distribution was confirmed (Table 1).

The results in Table 2 demonstrate that the initial model has to be modified based on the root-mean-square error of approximation (RMSEA=0.147). To correct the model, the insignificant relationship between MS severity to cognitive factors was removed. The RMSEA was equal to 0.023 in the final model, indicating that the model fits well. Figure 2 shows the final modified model.

Table 1. Mean±SD and Pearson correlation coefficients of the research variables

Variables	Mean±SD	Skewness	Kurtosis	1	2	3	4	5
MS severity	2.36±0.89	0.74	0.64	1				
Physical factors	52.76±23.42	0.82	0.59	-0.33*	1			
Cognitive factors	42.93±17.67	0.41	-0.49	-0.39*	0.51*	1		
Fear of falling	33.75±10.22	0.32	-0.29	0.42*	-0.37*	0.29*	1	
Disability	5.67±3.21	-0.25	-0.64	0.27*	-0.44*	-0.36*	0.51*	1

* P<0.05.

Table 2. Fit indicators of the initial and final models

Fit indicators	χ^2	df	χ^2/df	IFI	TLI	CFI	NFI	RMSEA
Initial model	2.32	1	2.32	0.61	0.62	0.53	0.52	0.147
Final model	4.98	2	2.49	0.92	0.91	0.94	0.92	0.023

IFI: incremental fit index; TLI: the Tucker-Lewis index: NFI: normal fit index; RMSEA: root-mean-square error of approximation.

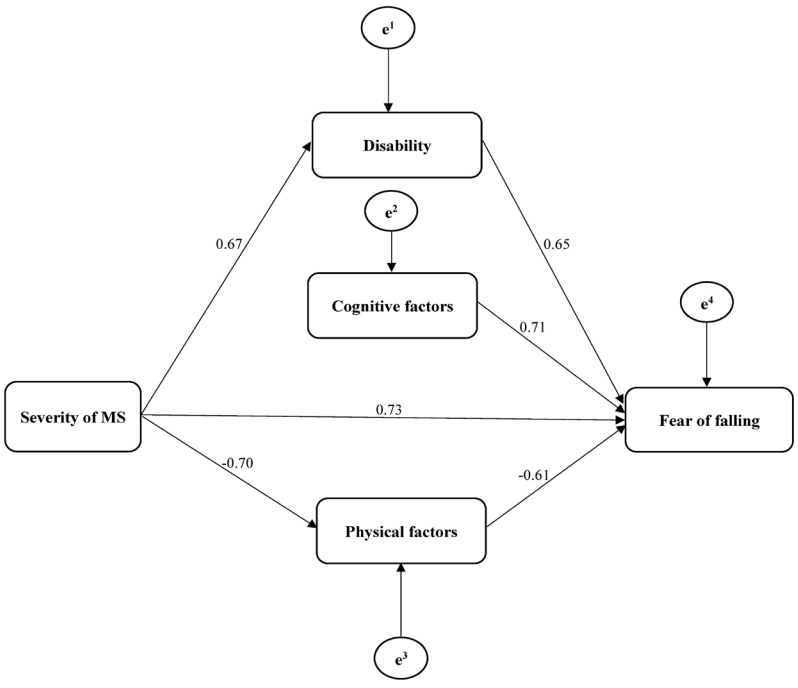

Figure 2. Final modified model of the mediating roles of cognitive factors, physical factors, and disability in the relationship between MS severity and FoF

Table 3. Direct and mediation paths between research variables in the initial and final modified models

Paths	Initial Model		Final Modified Model	
	β	P	β	P
MS severity to fear of falling	0.77	0.001	0.73	0.001
MS severity to disability	0.70	0.004	0.67	0.001
MS severity to cognitive factors	-0.26	0.311	-	-
MS severity to physical factors	-0.73	0.002	-0.70	0.001
Disability to fear of falling	0.69	0.001	0.65	0.006
Cognitive factors to fear of falling	0.76	0.001	0.71	0.003
Physical factors to fear of falling	-0.66	0.001	-0.61	0.001
MS severity to fear of falling through the mediating role of disability	0.121	0.001	0.143	0.001
MS severity to fear of falling through the mediating role of cognitive factors	-0.033	0.238	-	-
MS severity to fear of falling through the mediating role of physical factors	0.127	0.006	0.139	0.006

Table 3 shows the results of estimating path coefficients for testing direct hypotheses. The results showed there was a positive relationship between MS severity and FoF (β=0. 73; P=0.001), between MS severity and disability (β=0.67; P=0.001), between disability and FoF (β=0.65; P=0.006), and between cognitive factors and FoF (β=0. 71; P=0.003) in the patients with MS. There was a negative relationship between MS severity and physical factors (β=-0.70; P=0.001), and between physical factors and FoF (β=-0.61; P=0.001) in the patients with MS. There was no significant relationship between MS severity and cognitive factors in the patients (Table 3).

The Bootstrap method was used to evaluate the significance of mediation relationships. The results showed that there was a significant indirect path from MS severity to FoF through the mediating roles of physical factors and disability in the patients with MS (P<0.01). The indirect path from MS severity to FoF through the mediating role of cognitive factors was not significant (Table 3).

4. Discussion

This study aimed to investigate the relationship between MS severity and FoF with mediating roles of disability, cognitive factors, and physical factors among patients with MS in Sari, in 2021. The results showed there was a positive relationship between MS severity and FoF, between MS severity and disability, between disability and FoF, and between cognitive factors and FoF in the patients with MS. Moreover, there was a negative relationship between MS severity and physical factors, and between physical factors and FoF. There was no significant relationship between MS severity and cognitive factors in the patients. The results indicated that physical factors and disability had mediating roles in the relationship between MS severity and FoF in patients with MS. This finding is consistent with the results of previous studies [7, 11].

MS is a chronic, progressing disease of the CNS. It damages myelin, which is an insulating layer of nerves rapidly transferring information from the brain to other parts of the body [28]. This decelerates or even destroys the transfer of messages from the nervous system, leading to a variety of symptoms, e.g., imbalance, fatigue, vision problems, and numbness of the hands and/or feet. MS is the main cause of non-traumatic disability among adults and the most common progressing neurological disease among youth [29]. Imbalance, falling, and walking limitations among patients with MS can affect a wide range of daily activities at home, in the workplace, and society. Falling is a major problem in the care system [30]. Patients with MS have a high FoF due to their physical conditions.

FoF and its physical and psychological consequences affect patients with MS [31]. Falling leads to the patient being unwantedly on the ground due to reduced consciousness, seizures, paresis, or strokes. The falling of an MS patient may lead to disability, hospitalization, and early death [8]. Falling is a serious problem in the MS community, and its psychological effects may lead to motion abnormalities and reduced quality of life.

Cognitive activities may happen very frequently in daily life [32]. Research has shown that the movement speed during speaking reduces in non-dementia MS, and such individuals are at a higher risk of falling; an increased speaking rate increases the probability of falling [33]. It has also been found that higher concentration on speaking reduces the movement performance of the patient compared to a situation in which the patient pays equal attention to the two activities. Problems in cognitive functions such as memory, selective attention, inhibitory control, decision-making, planning, sustained attention, social recognition, and cognitive flexibility represent a cognitive disorder and worsen the FoF in patients with MS.

FoF is defined as a psychological condition and a physical activity limiter. It may lead to over-caring, movement limitations, and a lack of independence in an MS patient. This, in turn, could result in motor skill deterioration [9]. Thus, FoF is a psychological variable that increases physical weakness and reduces physical activity in patients with MS. Furthermore, a history of falling may affect other activities due to the fear of recurrence. FoF had a significant inverse relationship with physical activity; physical activity declined as the FoF score increased.

MS is a chronic disease of the CNS in which myelin is locally damaged. It is the most common cause of non-traumatic disability among youth. Disability mostly occurs at an age of 20-30; rarely does it begin earlier than 10 or older than 60 [2]. It is a common symptom of patients with MS. Disability, along with other problems, increases the FoF and prevents daily life activities. It can be said that higher MS severity increases disability in daily life.

Almost half of the patients with MS experience changes in cognitive abilities during their disease period. The cognitive problems of MS typically appear in memory, complex attention, data processing rate, and executive functions. Changes in cognitive abilities may be slight or moderate; however, even slight cognitive changes could affect personal life and career. The cognitive problems in MS cannot be entirely attributed to brain damage; other factors, e.g., the side effects of medicines, lack of sleep, depression, anxiety, stress, and tiredness, are also involved. It can be said that patients with MS experience more cognitive problems due to MS medicines [34]. This may explain the insignificance of the relationship between MS severity and cognitive factors. This relationship could become significant in a different region and/or at a different time. Moreover, the components of MS severity and cognitive factors may have been dissimilar or had different philosophical and cultural roots. The participants may also have had lower MS severity or used lower medicines.

MS is a very common neurological disease in young adults [1]. It causes various damages to the CNS and can have symptoms such as muscle weakness or spasms, fatigue, balance problems, and sensory problems. The stressful result of the diagnostic test, unknown prognosis and future, medicine effects, nerve inflammation process, biological and psychological factors, and structural brain changes contribute to the reduction of physical activity in patients with MS [35]. It can be said that higher MS severity leads to lower physical activity in such patients.

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.

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.

Ethical Considerations

Compliance with ethical guidelines

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

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

The authors declare no conflict of interest.

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