



Research Paper: The Effect of Executive Functions on Tolerance and Quality of Life of MS Patients: Path Analysis Pattern



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Running Title Executive Functions and Tolerance and Quality of Life in MS

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ABSTRACT

Background: Multiple Sclerosis (MS) disease is a chronic, debilitating, and often progressive inflammatory disease of the central nervous system that is affected by cognitive and emotional dimensions, and also, this disease affects these dimensions.

Objectives: This study was carried out to determine the effect of executive functions on the tolerance and quality of life of MS patients.

Materials & Methods: In this cross-sectional study, 290 MS patients were selected as the sample size by simple random sampling method from the statistical population consisted of all 687 patients with MS disease in Gorgan's MS Association, Gorgan City, Iran, in 2020. To collect data, we used Nejati's executive functions questionnaire, McGuigan and Hutchinson's quality of life questionnaire, and Simons and Gaher's tolerance scale. Path analysis by SPSS V. 18 and AMOS V. 23 software was used for data processing.

Results: According to the results of path analysis, executive functions affect -0.371 and tolerance -0.257 on the quality of life ($P=0.01$), and in total, that can explain 44% of the variance. Also, tolerance mediates the relationship between executive function and quality of life.

Conclusion: Executive function is related to the quality of life of MS patients by the mediating role of tolerance, in the sense that a higher ability to tolerate increases the constructive effect of executive function on improving the quality of life.

Keywords: Executive functions; Quality of life; Tolerance

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Highlights

- Executive function is related to the quality of life in patients with multiple sclerosis by moderating the role of tolerance.

Introduction

Multiple Sclerosis (MS) is a chronic and sometimes progressive disease of the central nervous system that deteriorates neural system function [1] and usually presents between the ages of 20 and 25 [2]. About 2.5 million people in the world suffer from this disease, and in Iran, the prevalence of MS disease is estimated between 5 and 74 per 100000 people [3]. This disease is one of the most debilitating diseases in youth and causes many problems in the quality of life [4]. MS disease reduces a patient's physical, social, and cognitive functions and ultimately have a negative effect on the quality of life of these patients [5]. In MS patients, the quality of life is affected by the severity of the disease and the duration of the disease, which includes the individual's understanding of the situation, goals, and expectations [6]. Low quality of life can lead to low adaptation and emotional responses in stressful situations [7]. Therefore, the studies of Lanzillo et al. [8] indicate that due to neurological problems in these patients, other problems of the executive function appear in patients and are considered a determining factor. Executive function is one of the most effective processes of cognitive performance [9].

Executive function is a set of superior organizational abilities, including predicting and creating goals and planning that at the neuro-anatomical level are associated with different paths of neural interaction such as the forehead cortex [10]. Better executive function facilitates the use of new assessments and provides a greater cognitive resource to help sustained attention, which leads to better regulation of emotions in daily lives [11]. Neurodevelopmental findings also confirm that tolerance and executive function are indirectly related and work together to analyze information and perform activities [12, 13]. Tolerance is defined as the level of acceptance of emotional pressure in inappropriate situations and events related to illness, anxiety, depression, restlessness, degeneration, etc. [14]. People with mild emotional distress are more likely to complain of cognitive symptoms [15]. Low tolerance is associated with negative beliefs and impulsive and emotional behaviors [16]. In this regard, studies of Sheppard, et al. [1] and Rigikouteh, et al. [2] showed that there is a relationship between executive function with quality of life of MS pa-

tients. Also studies of Brands et al. [14] and Gromisch, et al. [17], showed that there is a relationship between tolerance with quality of life of MS patients. Because of the difficulties caused by MS disease and the impact on the quality of life of people, the importance of paying attention to this disease and the psychological and emotional effects to reduce the disease problems in these people should be determined.

On the other hand, executive functions as a multidimensional variable affect all behaviors of people, which seem to be effective in the emotional responses of people with MS. So far, limited research has been conducted on these variables in MS patients. So this study was carried out to determine the effect of executive functions on the tolerance and quality of life of MS patients.

Materials and Methods

The research method was cross-sectional. The study population consisted of all 687 patients with MS disease in the Gorgan's MS Association, Gorgan City, Iran, in 2020. The sample size was calculated 290 according to the population size, the values obtained from the previous study [9], and with the $\sigma = 20.35$, $d2 = 7.721$, $\alpha = 1.96$, and power = 0.90 inserted into the following equation. People were selected as the sample size by simple random sampling (Formula 1).

$$1. n = \frac{2\sigma(z_{\alpha} \frac{\alpha}{2} + z_{1-\beta})^2}{d^2} = \frac{2(1.50)^2(1.96+20.35)^2}{7.721} = 290.09$$

Research tools

Executive function questionnaire

The executive function questionnaire was designed by Nejati [17]. This questionnaire has 30 items and is scored on a 5-point Likert-type scale. The high score in this questionnaire will indicate the higher level of executive function of individuals (minimum total score of 30 is maximum 150). In Nejati [17] research, the structural and convergent validity was confirmed, and the reliability of the Cronbach α method was 0.83. In the present study, the total reliability of the Cronbach α method was 0.82.

Quality of Life Questionnaire for MS Patients

The quality of life questionnaire for MS patients was designed by McGuigan and Hutchinson [18]. This questionnaire contains 29 items. It is scored on a 5-point Likert-type scale for each item. A higher score indicates a lower overall health quality of life. The construct and content validity of the questionnaire have been confirmed. In Iran, the study of Ayatollahi, Nafissi, Eshraghian, Tarazi [19] confirmed the construct validity and convergence of this questionnaire. The reliability was obtained by the Cronbach α method was 0.70. In the present study, the reliability of the Cronbach α method was 0.73.

Distress Tolerance Scale

The distress tolerance scale was designed by Simons and Gaher [20]. This questionnaire has 15 items. The high score in this questionnaire will indicate the higher level of tolerance of individuals (the minimum total score is 14, and the maximum is 70). It is scored on a 5-point Likert-type scale. Simons and Gaher [20] confirmed its content construct and content validity. The reliability was obtained by the Cronbach α method as 0.82. In Iran, Alavi et al. confirmed the construct and convergent validity, and the reliability was obtained by the Cronbach α method as 0.81. In the present study, the reliability was 0.80, calculated by the Cronbach α method [21].

In the study procedure, after obtaining the necessary permits, a PhD student in psychology, under the supervision of a supervisor, referred to the MS Association and performed the sampling. Timely sampling was performed on meetings and individual referrals of patients to the association in the mornings and in January 2020 for 2 weeks. Before sampling, the subjects were given explanations about the study's purpose and maintaining the materials' confidentiality. At the same time, informed consent was received from the individuals regarding the participation of the samples in the research. Then the questionnaires were obtained from the samples.

The inclusion criteria include people affected by MS disease according to the hospitals or clinics diagnosis in Gorgan City, living in Gorgan City, the onset of the dis-

ease between 2 to 5 years ago, age range between 25 to 40 years old, medium severity of the disease.

The exclusion criteria were reluctance to participate in the study, failure to complete the questionnaires, or withdrawal from the study for any reason. The collected data were analyzed using path analysis by SPSS 18 and Amos 23 software (SPSS V. 18, Amos V. 23, in the USA, California, and Stanford University).

Results

A total of 109 males (37.58%) and 181 females (62.41%) aged 25 to 40 years with a Mean \pm SD age of 33.54 \pm 2.11 years participated in this study. In an analysis, statistical assumptions were examined using the Kolmogorov-Smirnov test, and the normality of the data and the measurement model of the three research variables were confirmed.

Table 1 presents the descriptive indices of variables, including mean, standard deviation, skewness, and kurtosis. Based on Table 1, the significant level of the Kolmogorov-Smirnov statistics of all variables is greater than 0.05. Hence, the default of univariate normality to test the path analysis model holds for all variables.

Table 2 indicates a significant correlation between executive functions, tolerance, and quality of life in subjects. There is a significant negative relationship ($P=0.01$) between executive functions and tolerance with the quality of life. This result means that by increasing executive functions and tolerance, the quality of life decreases in MS patients.

According to Table 3, the indicators proposed by Gefen, Straub, and Boudreau [21] were used to investigate the fitting of the path model in the present study (Figure 1). The value of RMSEA (root mean square error of approximation) is equal to 0.035, so it is less than 0.08 that indicates that the mean square of the model errors is appropriate and the model is acceptable. Besides, the Chi-square value in the degree of freedom (2.421) is be-

Table 1. Descriptive indices of study variables (n=290)

Variable	Mean \pm SD	The Kolmogorov-Smirnov	P
Executive functions	87.37 \pm 11.45	0.996	0.274
Tolerance	31.29 \pm 5.46	0.861	0.449
Quality of Life	87.66 \pm 16.15	0.613	0.847

Table 2. Correlation matrix of the research variables (n=290)

Variable	1	2	3
Executive functions	1		
Tolerance	0.38 **	1	
Quality of life	-0.41**	-0.35**	1

**Significant at the level of 0.01.

Table 3. The goodness of fit indices of the primary tested model and modified model

Test name	Explanations	Acceptable Amounts	Achieved Amount
χ^2/df	Relative Chi-square	>3	2.421
RMSEA	Root mean square error of approximation	>0.08	0.031
GFI	Goodness of fit index	<0.9	0.998
NFI	Normed fit Index	<0.9	0.990
CFI	Comparative fit index	<0.9	0.996
df	18		

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tween 1 and 3, and the amount of Goodness of Fit Index (GFI), Comparative Fit Index (CFI), and Normed Fit Index (NFI) indexes are approximately equal to and greater than 0.9, indicating that the measurement model of the research variables is appropriate. As shown in Table 3, the CFI, Adjusted Goodness-of-Fit Index (AGFI), GFI, and Parsimony Normed Fit Index (PNFI) indices are greater than the values provided by Geffen [21]. The value of RMSEA is less than 0.08, and χ^2/df is less than 3. The fit indices of the modified model are better than the first model; therefore, the model is fit.

According to Table 4, executive functions and tolerance directly affect the quality of life. Specifically, executive functions affect -0.371 on the quality of life, and tolerance -0.257 affects the quality of life (P=0.01).

As shown in Table 5, the two indirect considered paths were significant and confirmed by the bootstrap method at the level of P=0.01 according to the obtained values. According to Figure 1, 44% of the variance in the quality of life can be explained by tolerance and executive functions.

Table 4. Direct effect by maximum likelihood method

Variable	Non-standardized Effect	Standardized Effect	R ²	t	P
Executive functions on quality of life	-0.512	-0.371	0.189	3.362	0.001
Tolerance on quality of life	-0.314	-0.257	0.080	2.462	0.007

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Table 5. The indirect effect of the model by the bootstrap method

Variable	Effect	Lower Bound	Upper Bound	P
Executive functions with quality of life with the mediating role of tolerance	-0.524	-0.549	-0.318	0.001

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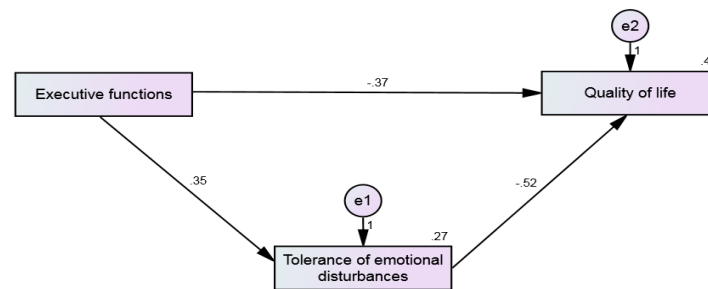



Figure 1. The path model on the effects of executive functions on the quality of life with the mediating role of tolerance

Discussion

The primary purpose of this study was to investigate the effect of executive functions on the tolerance and quality of life of MS patients. According to the results of path analysis, tolerance has a mediating role in the relationship between executive functions and quality of life in MS patients. MS patients with stronger executive functions have better tolerance and quality of life. Also, these results are consistent with the findings of Sangalji et al. [22], who showed that the dimensions of quality of life are under the influence of inability to tolerance, sensitivity to anxiety, and neuropsychological disability in patients with MS. Brands et al. [12] showed that coping strategies with stress have a mediating role in the relationship between tolerance and quality of life in MS patients. Kos et al. [23] showed that the dimensions of pain and fatigue caused by impaired executive function and reduced tolerance, in turn, will affect the quality of life. Grech et al. [9] showed a difference between executive function, tolerance, depression, anxiety, and quality of life in MS patients.

In explaining these results, it can be stated that the goal of the proper functioning of executive functions is to increase rewarding behaviors, which might be internal (such as pleasure or sense of accomplishment) or external (such as social attention) [6]. This increase in rewards first improves the patient's positive emotional tolerance and ultimately improves intimate relationships [24]. The use of appropriate executive function by regulation of behavioral and tolerance and improving proper cognitive and emotional performance caused the MS person to solve their problems and increase their quality of life [2]. Also, MS patients generally use strategies with high emotional tolerance that do not increase anxiety, thus improving their quality of life [25]. In other words, people with improper executive function fail to regulate and tolerate, so negative emotions create the ground for psychological vulnerability in these people [15]. According to the biological view of executive function, when an organism has a better cognitive function, it

has better tolerance for different conditions [26, 27]. These behaviors will be based on appropriate executive functions to stress. A person can always have adaptive behaviors to high tolerance, which is the motivating factor, and ultimately guarantees a better quality of life in the affected person.

This research has some limitations. Given that this study was conducted in Gorgan's MS Association in 2020, caution should be taken in generalizing the results. Causality cannot be inferred from the path analysis. Also, caution should be taken in generalizing the results to other groups and communities because this study has been carried out on MS patients. Also, the limitations of researching the outbreak of Coronavirus Disease (COVID-19) made it difficult to access patients and the sampling process.

Conclusion

This study showed that executive functions affect the tolerance and quality of life of MS patients. MS patients with stronger executive functions have better tolerance and a better quality of life. It is suggested that research in this field be conducted in a wider field and with examples from different and larger communities so that the results can be more generalized. Also, therapists of this disease should always pay special attention to the role of cognitive and emotional factors at the same time. Therapists in the control and treatment of MS, using emotional management training programs, can strengthen executive functions and ultimately improve the quality of life of the patients.

Ethical Considerations

Compliance with ethical guidelines

The present study has been registered under the Ethical Code of IR.IAU.SARI.REC.1398.107 at Azad University of Sari, Sari City, Iran. All ethical principles were considered in this article. The participants were informed about the research purpose and its implementation stages and signed the informed consent. They were also assured about the confidentiality of their information. Moreover,

they were allowed to leave the study whenever they wanted, and if desired, the research results would be available to them.

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Authors contributions

Conceptualization, methodology, and supervision, writing the original draft: Ali Khanekhesi; Resources and funding acquisition: Shohreh Tofighian; Investigation: Kolsom Akbarnataj Bisheh and Ali Khanekhesi; Writing, review, and editing: All authors.

Conflict of interest

The authors have declared no competing interests

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