



A Study on Verbal Fluency of Persian Patients with Three Types of Multiple Sclerosis

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Abstract

Background: Multiple sclerosis (MS) is an acquired autoimmune disease of the brain and spinal cord, resulting in the loss of control, vision, balance, and senses. Among the most important complications of MS in the course of the disease are speech disorders, especially dysarthria, as well as impairment of difficulty and language disorders.

Objectives: Therefore, this research aimed to study the verbal fluency of Persian patients on three types of MS (Relapsing-Remitting, Primary Progressive, and Secondary Progressive).

Methods: The descriptive-analytical approach was employed in this cross-sectional research. Since three types of MS were analyzed in this study, the samples collected using the convenience non-probability sampling technique from the MS patients in Rofeideh Rehabilitation Hospital in Tehran. Based on the inclusion criteria, 24 patients were put in each subgroup, and a total of 72 patients were selected. Besides, the mini-mental state examination (MMSE) was carried out in this research to study the cognitive conditions of the patients. The verbal fluency test has two subtests: semantic and phonological fluency. These two components were analyzed for analyzing lexical knowledge and flexibility. In the data analysis phase, the normal distribution of the data was examined by the Shapiro-Wilk test, and paired t-test, one-way analysis of variance, and Bonferroni non-parametric tests were used to compare the mean values of the variables and analyze the data.

Results: Our findings revealed a mean switching and total verbal fluency of 11.6 (SD = 4.56) and 27.3 (SD = 7), respectively. The different forms of word switching and phonological fluency had no significant relationship with age and gender, but MMSE had a significant positive relationship with all of them ($P < 0.05$). The results from the analysis of variance and Bonferroni test also revealed no significant difference between the mean values on the SP and PP types of MS, but there was a significant difference between all mean values on the RR as well as the PP types ($P < 0.05$). However, the types of PP, SP, and RR did not significantly differ in word switching. Besides, phonological switching and verbal switching varied significantly in patients by academic degree ($P < 0.001$).

Conclusions: The findings from this research revealed that the three types of MS differed significantly at least in lexical switching, phonological fluency, or semantic fluency.

Keywords: Multiple Sclerosis, Verbal Fluency, Phonological Fluency, Semantic Fluency

1. Background

Multiple Sclerosis (MS) is a disabling autoimmune chronic disease with occasional progressive manifestations. In this disease, the immune cells in the central nervous system destroy the myelin membrane covering the axons, resulting in the formation of hard tissues in different parts of the central nervous system and impairment of electrical conductivity in the central nervous system. MS attacks the nerve cells in the brain and nervous system to gradually weaken the limbs, also, defects in cognitive language skills at higher levels of the brain. The risk of development of MS in women is also two or three times higher

than men for unknown reasons (1). According to recent studies, MS has three types: 1) Relapsing-Remitting (RR-MS), 2) Primary Progressive (PP-MS), and 3) Secondary Progressive (SP-MS) (2).

The common symptoms of MS include double vision, muscle weakness, difficulty walking, limb weakness, muscle spasm, fatigue, impatience, loss of sensitivity, numbness, vertigo, speech disorders (dysarthria), defects in cognitive language skills at higher levels of the brain, paralysis of the feet and leg, seizure, cognitive impairment, communication disorders, unstable mood, depression, constipation, and urinary incontinence (3). The clinical symptom

of MS patients includes word-finding difficulties, comprehension, and negotiation, lack of fluency, problems with verbal explanations, difficulties in defining words, narrative discourse disability, problems with starting conversations and interpreting metaphors, and working memory impairment. These cases influence the speed and efficiency of verbal fluency in a patient's speech (4-6). Difficulties in finding words, classifying, naming, recalling names, selecting words, and replacing words are also examples of the inability to produce language content. Although healthy individuals sometimes have difficulties finding words due to fatigue and stress, word-finding problems may signal an important language disorder (7). Search strategies and long-term memory determine the speed of finding words and retrieving and semantic and phonological characteristics of the lexicon (8). A good score on the verbal fluency test is contingent upon the word stock, response speed, the ability to retrieve information from the semantic memory, effective search, working memory, and prevention of errors (9). Expressive language performance is affected by cognitive impairments (10). A study was carried out by Vlaar et al. (2003) to assess the fluency of 35 MS patients based on test-retest reliability and inter-observer reliability. In the phonological fluency (PF), the patients were asked to name all of the words starting with the "F", "A", and "S" phonemes within 60 seconds. In the assessment of semantic fluency (SF), the patients were asked to name animals and fruits within 60 seconds. They reported the standard deviation, mean, and test-retest reliability results for phonological and semantic fluency (11). In addition, in a study by Troyer (2010) on 411 healthy participants aged between 18 and 91 years, normative data were collected on the number of switching and cluster size in verbal fluency tasks. They analyzed the phonological fluency of the "f", "a", and "s" phonemes and the semantic fluency in the "animal" and "supermarket" categories. Their findings revealed the considerable effect of age on the number of correct words in the phonological and semantic fluency tests. Besides, gender had no effect on phonological and semantic fluency, while education influenced the number of words expressed in the phonological and semantic fluency tests (12). Abrahams et al. (2000) also carried out a neuropsychological study and compared the verbal fluency and performance of 23 patients suffering from amyotrophic lateral sclerosis (ALS) with 25 healthy participants. Their findings showed a significant difference between the verbal fluency and performance of the two groups, and they attributed the weak performance of the ALS group to memory damage (13). Ebrahimipour et al. carried out a comparative analysis of phonological and semantic fluency in 30 MS patients and 30 healthy participants, who matched the patient group in terms of gen-

der, age, and education, to quantitatively and qualitatively analyze their verbal fluency. Their findings revealed that verbal fluency, semantic fluency, and phonological fluency were impaired in patients with MS. This damage was manifested as a decrease in the number of correctly articulated words and a decrease in phonological and semantic switching. However, their clustering abilities were not damaged as much as their switching abilities (14). Henry and Beatty (2006) analyzed verbal fluency of 3,673 patients with MS through the phonological and semantic fluency tests, reporting that the increased neural disability and the progressive chronic disease term resulted in more significant phonological and semantic fluency impairments (15). Tombaugh et al. (1999) also normalized verbal fluency of 1,300 participants aged between 16 and 95 years in healthy cognitive conditions. They analyzed the fluency of phonemes "f", "a", and "s" for phonological fluency and analyzed semantic fluency using the "animal" category. Their findings revealed that verbal fluency was influenced by age and education, but education influenced verbal fluency more than age. However, gender did not influence verbal fluency (16). Therefore, given the importance of analyzing the fundamental processes involved in verbal fluency (phonological and semantic fluency) of Persian patients with MS, the present study aimed to study the phonological fluency of phonemes "f", "a", and "s" and semantic fluency in the "animal" and "fruit" categories on three types of MS.

2. Objectives

The ultimate goal was to determine whether there was a difference between the phonological and semantic fluency of participants in the MS groups.

3. Methods

The present research was a cross-sectional study. The samples were collected using the convenience sampling technique from patients with MS visiting Rofeideh Rehabilitation Hospital in 2018 according to the inclusion criteria. The inclusion criteria were as follows: diagnosis of MS type by a neurologist; adequate hearing ability; lack of other psychiatric disorders; willingness to participate in the research; scores higher than 18 on the mini-mental state examination (MMSE) test. The sample size was calculated by considering the SD of phonological fluency = 12, the least mean difference between groups $d = 10$, confidence interval 95%, and power 80%. The sample size was 23 in each group. We allocated 24 cases to each group. Groups were RR, PP, and SP MS types.

For gathering data, two questionnaires were used. The mini-mental state examination (MMSE) to assess the cognitive condition of the patients. The reliability of MMSE was assessed by Cronbach alpha = 0.78, and sensitivity and specificity were 90% and 84%, respectively, for the cutting point 21 (17). This test consists of 3 items of 5 scores, each item is 5 questions of 1 score, 3 items of 3 scores, 1 item of 2 scores, and 4 items of 1 point and a total of 30 scores. In this study, a score of less than 18 was excluded from the research process. The verbal fluency test was conducted on the semantic and phonological fluency levels with reliability (Cronbach alpha = 0.98) to assess the verbal fluency of the participants (18,19). In the subtests, the patients were asked to name items of a semantic or phonological category within 60 seconds. In the semantic fluency subtest, the animal and fruit categories were used. The patients were asked to name as many items as possible in a semantic category. The “f”, “a”, and “s” categories were analyzed in the phonological subtest, and the patients had to list words starting with the mentioned phonemes within 60 seconds. Time was controlled manually using a Q&Q HS43 chronometer, and the respondents’ answers were recorded using a Leono voice recorder. Then words named by subject for each subtest, were counted. Scoring was calculated according to the instructions of the verbal fluency test (obtaining 6 scores at the end of the test).

For describing the demographic variables, count (percent) and mean (SD) were calculated. The Shapiro-Wilk test was conducted to examine the normal distribution of the data. Mean of the main variables was compared by the two independent groups *t*-test, one-way ANOVA. The Bonferroni tests were carried out for pair-wise comparison of the means of the main variables. Data were analyzed in SPSS 19 at a 5% significance level.

4. Results

In this study, 72 subjects as 24 persons at each of MS types participated. Thirty-five subjects were males, 17 (23.6%) subjects were illiterate, and guidance school, 33 (23.6%) were diploma, and 22 (30.6%) higher than diploma. The number of women was higher on RR (40.5%). The number of men was higher on the SP (40%). The distribution of gender, age, and MMSE was homogenous at each of the MS types (Table 1). The main variables were phonological switching, semantic switching, speech switching (Total), phonological fluency, semantic fluency, and verbal fluency (Total). The normality of these variables was checked by the Shapiro-Wilk test, and the results showed that they follow normal distribution (P value > 0.05).

Means of main variables are shown in Table 2. Means of the main variables at gender and education levels were

compared by *t*-test and ANOVA. The results showed that the mean of all variables did not differ between gender groups (P value > 0.05). All of the main variables were significantly different between education levels (P value < 0.05) except semantic fluency and semantic switching (Table 2).

The relationship between age, MMSE, and the main variables was assessed by Pearson correlation coefficients. There was not a significant relationship between age and the main variables (P value > 0.05), but the relationship between MMSE and the main variables was significant (P value < 0.05) (Table 3).

Comparison of the mean of the main variables in the MS types was conducted by ANOVA. Means of all of them were significantly different (P value < 0.05). The mean of all variables in the RR MS type was more than other types. The result of the Bonferroni test for pair-wise comparison of MS types indicated all of the variables’ means were significant between RR and PP MS types and between RR and SP except in the semantic switching variable. But means of all main variables were not different between PP and SP MS types (Table 4).

5. Discussion

In the advanced phases of MS, communication and neurological problems are exacerbated. Consequently, the subsequent decrease in social participation due to communication problems jeopardizes the mental and emotional health of patients with MS. In fact, The clinical symptom of patients with MS causes numerous problems such as problems with naming and discussing, lack of verbal fluency, repetition of sentences, problems with word finding and retrieving, problems with verbal explanations and definition of words, narrative discourse disability, difficulties in starting conversations and comprehending words and metaphors, problems with memory working, and attention deficit, which usually affect the speed and efficiency of verbal fluency (4-6). In some studies, the communication problems of patients with MS were attributed to speech motor disorders, which cause demyelination (20). Troyer described verbal fluency as a multifactor process involving multiple cognitive processes are related to the organization, storage, and retrieval of words (12). In his view, verbal fluency must be analyzed as a concept beyond the total scores calculated traditionally. In fact, the high level of language activities of patients with MS has attracted the attention of many researchers in the past decade. Therefore, the present research analyzed the verbal fluency of patients suffering from three types of MS. It was found out that gender does not influence the verbal fluency of patients with MS. This finding is in line with the study by Brickman et al. (21). The present research also showed that

Table 1. Comparison of Distributions of Gender, Age, and MMSE in the MS Types

Variables	RR	PP	SP	P Value
Gender, No. (%)				0.348
Male	9 (25.7)	12 (34.3)	14 (40.0)	
Female	15 (40.5)	12 (32.4)	10 (27.0)	
Age, mean \pm SD	43.3 \pm 7.1	41.6 \pm 8.5	41.1 \pm 8.9	0.329
MMSE, mean \pm SD	25.6 \pm 2.5	22.4 \pm 4.3	28.4 \pm 2.2	< 0.001

Table 2. The Mean \pm SD of Different Types of Switching and Fluency in Gender and Education

Variables	Total	Gender		P Value	Education			P Value
		Male	Female		Illiterate and Guidance	Diploma	Higher	
Phonological switching	14.9 \pm 8.9	15.7 \pm 8.7	14.0 \pm 9.3	0.872	9.6 \pm 6.6	18.0 \pm 10.0	14.2 \pm 6.7	0.005
Semantic switching	9.2 \pm 4.3	9 \pm 4.1	8.5 \pm 4.4	0.188	7.1 \pm 2.2	9.7 \pm 3.9	10.0 \pm 5.1	0.061
Speech switching (total)	12 \pm 5.8	12.6 \pm 5.7	11.4 \pm 6.0	0.574	8.3 \pm 3.7	13.9 \pm 6.3	12.0 \pm 5.1	0.005
Phonological fluency	27.9 \pm 10.7	27.5 \pm 11.1	28.4 \pm 10.4	0.717	22.2 \pm 8.2	30.3 \pm 10.4	28.7 \pm 11.6	0.034
Semantic fluency	28.4 \pm 9.3	28.9 \pm 8.9	27.8 \pm 8.9	0.686	24.2 \pm 8.9	28.7 \pm 8.1	31.2 \pm 10.5	0.065
Verbal fluency (total)	28.2 \pm 9.0	28.7 \pm 9.6	27.8 \pm 8.5	0.672	23.2 \pm 7.1	29.5 \pm 8.4	30.0 \pm 10.2	0.033

Table 3. The Pearson Correlation Coefficients (P Value) for Age and MMSE with Different Types of Switching and Fluency

Variables	Age	MMSE
Phonological switching	-0.118 (0.323)	0.410 (< 0.001)
Semantic switching	-0.121 (0.312)	0.343 (0.003)
Speech switching (total)	-0.135 (0.260)	0.439 (< 0.001)
Phonological fluency	-0.127 (0.288)	0.533 (< 0.001)
Semantic fluency	0.013 (0.913)	0.685 (< 0.001)
Verbal fluency (total)	-0.068 (0.569)	0.680 (< 0.001)

education influences verbal, phonological, and semantic fluency. Also, patients with higher levels of education performed better in the verbal fluency tasks, which was also in line with the research by Brickman et al. (21). Verbal fluency in the study groups indicated that all three types of MS differed significantly in at least one type of verbal, phonological, or semantic fluency. Besides, semantic and phonological fluency in the three types of MS is more or less different. This finding complies with the results reported by Ebrahimipour et al. (14), who stated that semantic, and phonological fluency is damaged in patients with MS, and the damage is manifested as a decrease in the number of correctly articulated words and a decrease in phonological and semantic switching. Hence, the findings from the present study not only comply with the aforementioned studies but also stress the problems with starting conversations, naming, language processing, recalling

words, working memory, and sustained attention depending on the types of MS. All of these problems are language factors, affecting the speed of naming and recalling and efficiency of verbal fluency. However, it could be stated that the performance of patients MS in the verbal fluency test is contingent on an adequate word the ability to retrieve information from the semantic memory. In addition, problems with word finding, classifying, naming, selecting, or replacing words are the other signs of difficulties in language content production. Finally, from the clinical point of view, timely speech therapy exercises for reinforcing respiratory support, understanding the coordination between respiration and phonation, reinforcing the facial and oral muscles, increasing the clarity of speech, and reinforcing memory working may improve the verbal fluency of patients with MS.

5.1. Conclusions

Based on the findings from the present research, there was no significant difference among the PP, SP, and RR forms of MS in terms of word switching. In addition, there were significant differences among the three types of MS, at least in verbal, phonological, or semantic fluency. Our findings also showed that the mean phonological, semantic, and the results of verbal switching in RR and PR type were highest and lowest, respectively. The mean phonological, semantic, and verbal fluency in the RR were also highest were also highest. The mean difference between the types of switching and fluency in gender and educational level has also been reported. The mean of none of

Table 4. The Mean \pm SD of Different Types of Switching and Fluency in MS Types and the P Value of the Bonferroni Test for Pair-Wise Comparison of the Mean

Variables	MS Types			P Values of Pair-Wise Comparison of the Means			
	RR	PP	SP	P-Value (ANOVA)	RR-PP	RR-SP	PP-SP
Phonological switching	19.2 \pm 8.4	11.8 \pm 10.2	13.6 \pm 6.3	0.009	0.010	0.012	1.000
Semantic switching	11.3 \pm 3.6	7.0 \pm 4.7	9.2 \pm 3.2	0.001	< 0.001	0.138	0.108
Speech switching (total)	15.3 \pm 5.1	9.4 \pm 6.7	11.4 \pm 3.9	0.001	< 0.001	0.002	0.613
Phonological fluency	36.9 \pm 8.3	23.1 \pm 10.9	23.8 \pm 6.2	< 0.001	< 0.001	< 0.001	1.000
Semantic fluency	34.9 \pm 8.3	22.8 \pm 9.6	27.6 \pm 5.3	< 0.001	< 0.001	< 0.001	0.116
Verbal fluency (total)	35.9 \pm 7.0	22.9 \pm 9.0	25.7 \pm 5.0	< 0.001	< 0.001	< 0.001	0.545

the studied variables in women and men with MS was not significantly different. Also, according to a one-way analysis of variance, the mean phonological and speech (total) switching in patients with different educational levels was significantly different. These cases are more common in people with higher diplomas than less than diplomas.

Footnotes

Authors' Contribution: Study concept and design: M. F. and M. A.; acquisition of data: M. A. and S. F.; Analysis and interpretation of data: S. H. and M. F.; drafting the manuscript: M. F. and M. F.; Critical revision of the manuscript for important intellectual content: M. F., A. F., and M. F.; statistical analysis: S. H.; Administrative, technical, and material support: M. F. and M. A.; study supervision: M. F. and M. A.

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