Neurology Asia 2017; 22(2) : 143 – 148

Word finding difficulties in multiple sclerosis

[1]Mona Ebrahimipour, [2]Farzad Weisi, [3]Mohammad Rezaei, [4]Mohammad Reza Motamed, [5]Hassan Ashayeri, [6]Yahya Modarresi, [7]Mohammad Kamali

[1]Department of Speech Therapy, University of Social Welfare & Rehabilitation Science, Tehran; [2]Department of Speech Therapy, School of Rehabilitation, Iran University of Medical Sciences, Tehran; [3]Department of Speech Therapy, School of Rehabilitation, Hamadan University of Medical Sciences, Hamadan; [4]Department of Neurology, Faculty of Medicine, Iran University of Medical Sciences, Tehran; [5]Department of Basic Sciences in Rehabilitation, School of Rehabilitation, Rehabilitation Research Center, Iran University of Medical Sciences, Tehran; [6]Department of Linguistics, Human Sciences and Cultural Education Institute, Tehran; [7]Department of Rehabilitation Management, School of Rehabilitation, Iran University of Medical Sciences, Tehran, Iran.

Abstract

Word finding difficulty is a known impairments in multiple sclerosis (MS). The purpose of this study is to adapt homophone meaning generation test to Persian language, and then examine word storage and access in multiple sclerosis patients through these three word-finding tests. This study examined the word retrieval in 90 Persian speaking patients with multiple sclerosis and 90 matched healthy controls through three tasks: semantic fluency, phonemic fluency, and homophonic meaning generation. The Persian homophone meaning generation test had a strong convergent validity with semantic and phonemic switching and an adequate divergent validity with semantic and phonemic clustering. There was a significant difference between two groups in all three tests ($p<0.001$) except semantic and phonetic clustering ($p\geq 0.05$). Multiple sclerosis is a disease affecting word access, but not the word storage, and Persian homophone meaning generation test is an appropriate, valid, and reliable test to evaluate word-finding difficulties in this population.

Keywords: Language, Naming, verbal fluency, HMGT.

INTRODUCTION

Multiple sclerosis (MS) is a chronic autoimmune neurological condition with a prevalence of 28 per 1000 persons in Iran[1,2] with up to 70% of patients showing cognitive dysfunction.[3,4] Cognitive status predicts the patient's quality of life at all stages of the disease.[5,6] However, not all neuropsychological tests are suitable in the detection of cognitive impairments in MS.[7] Thus, a comprehensive battery for cognitive evaluation was suggested by an expert panel in 2000.[8] Based on this battery, which covers processing speed, working memory, learning and memory, executive function, visuospatial processing, and word-finding, only 23.4% of MS patients are cognitively normal.[9,10]

Word finding difficulty is one of the cognitive impairments in people with MS. Word retrieval composes of two components: lexical knowledge, and search process within existing lexical knowledge.[11] Word finding is usually evaluated by confrontation naming tasks such as Boston Naming Test[12], which only addresses word knowledge, and does not detect lexical access.[11]

Verbal fluency is another test which is used frequently.[13] It has two subtests, namely, semantic fluency and phonemic fluency. The participant is asked to generate as many words as possible in 60 seconds. The words are within a semantic category in semantic fluency tasks, or start with a specific letter in the phonemic fluency tasks.[14] Unlike picture naming, verbal fluency covers both lexical storage and efficient access to word storage by its two components which are known as clustering and switching.[11,13] Clustering represents the production of words within the semantic or phonemic subcategories which evaluates the lexical storage, and switching reflects the ability to shift between clusters which evaluates the lexical access.[11]

Homophone meaning generation test (HMGT) is a test that assess retrieval flexibility. In this

Address c*orrespondebce to:* [3]Department of Speech Therapy, University of Social Welfare & Rehabilitation Science, Tehran, Iran. Tel: +98 22180043, Email: mo.ebrahimipour@uswr.ac.ir

test, participants are required to generate multiple meanings for each homophone. HMGT requires more searching strategies than the previous two tests, since after the first retrieval attempt, examinee needs to continue searching by more complicated techniques.[11,15,16] Warrington suggested that this test measures the ability to switch between alternative verbal concepts, and patients with anterior brain lesions were found to be more impaired on the HMGT than those with posterior lesions.[15] Kavé adapted this test to Hebrew language and study the correlation between HMGT and verbal fluency.[17] She maintained that HMGT is highly correlated with total score, switching, and clustering in semantic and phonemic fluency tasks but not with phonemic cluster size. Furthermore, Castner proposed that patients with Parkinson's disease had lower scores on HMGT than healthy controls.[18] Moreover, Kavé *et al*. evaluated word finding abilities in 207 normally developing Hebrew-speaking children aged 8-17 using picture naming, phonemic and semantic fluency, and HMGT. She found no sex effect, but a positive correlation between age and test scores.[11] This correlation was weakest for the naming test and strongest for the HMGT. Therefore, the more executive demands required by a test the steeper the slope of performance increase on this test.

The main purpose of this study is to examine word-finding performance in MS patients through these three word-finding tests.

METHODS

Participants

A convenience sample of 90 Persian-speaking patients with relapsing-remitting MS with EDSS≤6 and 90 healthy controls were recruited non-randomly. By carefully considering all exclusion and inclusion criteria, and having a large group with the least standard error, we tried to minimize the selection bias. All subjects were literate, 20-50 years old, right-handed, and acquire Persian as their maternal tongue (Table 1). MS patients were the subjects registered in Iranian Multiple Sclerosis Society. Exclusion criteria include: History of head trauma in the last 10 years, stroke, and epilepsy, history of other neurologic or psychiatric diseases, alcohol abuse, severe depression, and history of speech, language, or learning problems.

Procedure

HMGT was adapted to Persian by extracting all Persian homophones with at least 3 possible meanings from the Persian dictionary.[19] Sixteen homophones were selected based on their frequency and their content validity was evaluated by eight professional experts. The list of items is presented in Table 2. The selected homophones were randomly mixed in one list, and the same list was administrated to all participants without time constraint and with all responses recorded verbatim. Each distinct meaning was scored one point, and the sum of distinct meanings generated for 16 homophones were considered the total test score.

In addition to HMGT, two other tests - semantic and phonetic fluency- were administrated to both groups. Subjects were instructed to generate as many words as possible within 60 s on each of two semantic categories (animals and fruits) and three letters (ف /f/, آ /A/, and س/s/). The following scores were obtained in the phonemic and semantic fluency tests: (1) number of word produced, excluding errors and repetitions, (2) mean cluster size, and (3) number of switches. Detailed rules for scoring cluster size and switches for both fluency tasks have been provided by Troyer *et al*.[13] The internal consistency of scores on the HMGT was examined using Cronbach's coefficient (α).

These surveys were conducted according to the ethical rules of the National Public Health Institute, and the investigations were performed in accordance with the Declaration of Helsinki. Ethics committee of Iran University of Medical Sciences approved the study.

Table 1: Demographic information of the MS patients and controls

	Gender	Education ≤12 yrs			Education >12 yrs			Total
		20-30 yrs	31-40 yrs	41-50 yrs	20-30 yrs	31-40 yrs	41-50 yrs	
Patients	56 (62.22%)	15 (17%)	16 (18%)	17 (19%)	16 (18%)	13 (14%)	13 (14%)	90
Controls	45 (50.0%)	11 (12%)	14 (16%)	12 (13%)	20 (22%)	17 (19%)	16 (18%)	90

Table 2: Number of possible meaning per target on the Persian homophone meaning generation test and the mean number of distinct meaning generated per target across healthy controls

	Target	Possible meanings	Mean no. of distinct meanings generated
1	گاز /gaz/	4	2.55
2	دوش /duŝ/	4	2.73
3	سیر /sir/	4	2.34
4	تن /ton/	3	2.48
5	پارتی /parti/	3	1.95
6	پاس /pas/	8	2.81
7	شور /ŝur/	7	2.34
8	ترک /tærk/	3	1.61
9	وجه /væǰh/	6	1.67
10	مینا /mina/	4	2.38
11	بار /bar/	8	2.27
12	باز /baz/	6	2.83
13	تیر /tir/	7	2.75
14	بوم /bum/	5	2.65
15	هوا /hæva/	7	1.97
16	قرار /qærar/	6	2.31

RESULTS

Validity and reliability

Demographic information of two groups is presented in Table 1. The tests were administered to 90 patients and 90 healthy controls; 56 (62%) and 45 (50%) female in patient and control groups respectively. A Kolmogorov- Smirnov test applied to the distribution of HMGT scores in the healthy sample showed that HMGT scores are normally distributed; z=0.80, p=0.52. The internal consistency of scores on the HMGT was examined using Cronbach's coefficient; which showed that alpha value of 0.80. Inter-item correlation indicated a positive relationship between items and also between the items and the total score ($p<0.05$) (Table 3). Sex had no significant effect on HMGT scores (p=0.59). There was also no significant correlation between age and performance on the word generation test (r=0.00, p=0.99). However the correlation between HMGT score and the level of education was highly significant (r=0.28, p=0.006). Test-retest analysis indicated high reliability (α=0.98, r=0.97). Furthermore, there was substantial agreement between the two scorers on the HMGT total score (intra-class correlation coefficient=0.99, and standard error of measurement=1.71). Reliability was further demonstrated through a Guttman split-half reliability coefficient of 0.75. The items in form A were /gaz/, /duŝ/, /sir/, /ton/, /parti/, /pas/, /ŝur/, and /tærk/, and form B composed of /væǰh/, /mina/, /bar/, /baz/, /tir/, /bum/, /hæva/, and /qærar/.

In addition to reliability, validity of HMGT was examined. Content validity ratio (CVR) of the items were all above the cut-off value presented in Lawsche Table (0.75) and therefore all items were retained for the next stage. Also based on the results of content validity index (CVI) calculation, all the items were accepted. Since their CVI values were greater than 0.79 (Table 4).

In order to examine the construct validity, convergent and divergent validity were analyzed by correlations with HMGT and semantic and phonemic total score, clustering and switching. This correlation was significant for total score and switches in both semantic and phonemic fluency tests but not for semantic or phonemic clustering at the 0.01 level as presented in the Table 5.

Table 3: Item-total correlation coefficients, and Cronbach's alpha when each item excluded

Items	Item-total correlation	Cronbach's alpha if item excluded
گاز /gaz/	0.33	0.80
دوش /duŝ/	0.36	0.80
سیر /sir/	0.22	0.80
تن /ton/	0.36	0.80
پارتی /parti/	0.43	0.79
پاس /pas/	0.53	0.78
شور /šur/	0.45	0.79
ترک /tærk/	0.43	0.79
وجه /væǰh/	0.36	0.80
مینا /mina/	0.35	0.80
بار /bar/	0.55	0.78
باز /baz/	0.46	0.79
تیر /tir/	0.32	0.80
بوم /bum/	0.57	0.78
هوا /hæva/	0.42	0.79
قرار /qærar/	0.32	0.80

Table 4: Content validity ration (CVR) and content validity index (CVI) of items of homophone meaning generation test

Items	CVR	CVI		
		S-CVI	C-CVI	R-CVI
گاز /gaz/	1	1	1	1
دوش /duŝ/	1	0.88	1	1
سیر /sir/	1	1	1	1
تن /ton/	1	0.88	0.77	0.88
پارتی /parti/	0.77	0.88	0.88	0.88
پاس /pas/	1	0.77	0.88	0.88
شور /šur/	1	1	1	1
ترک /tærk/	1	0.88	0.88	0.77
وجه /væǰh/	1	0.77	0.88	0.77
مینا /mina/	1	0.88	0.77	0.88
بار /bar/	1	1	1	1
باز /baz/	1	1	1	1
تیر /tir/	1	0.77	1	1
بوم /bum/	0.77	0.88	0.88	1
هوا /hæva/	1	1	0.88	0.88
قرار /qærar/	1	1	0.88	1

S-CVI, Simplicity-CVI; C-CVI, Clarity-CVI; R-CVI, Relevancy-CVI

Table 5: Correlation of HMGT with the scores in phonemic and semantic fluency test.

	Fluency		*Switching*		*Clustering*	
	Phonemic	Semantic	Phonemic	Semantic	Phonemic	Semantic
HMGT	r= 0.65	r= 0.54	r= 0.58	r= 0.36	r= 0.05	r= 0.22
	P< 0.01	P< 0.01	P< 0.01	P< 0.01	p=0.44	p=0.03

After studying psychometric properties, i.e. validity and reliability of the HMGT, we compared word-finding performance in MS group and healthy group using independent t-test. As presented in Table 6, normal subjects had significantly higher scores on all tests and scores ($p<0.01$) except semantic and phonemic clustering ($p\geqslant0.05$).

DISCUSSION

Measurement characteristics of Persian HMGT

The Kolmogorov-Smirnov test showed that Persian HMGT row scores did not depart significantly from a normal distribution, similar to the English and Hebrew language versions.[15-17] The Persian HMGT was also found to have an acceptable level of reliability with high inter-rater and intra-rater reliability.

Word-finding difficulties in multiple sclerosis

This investigation addressed the question of whether HMGT reflects word-finding problems in MS population. As hypothesized, patients tended to have lower scores in word generation test, total scores and switches in verbal fluency, but equal scores in semantic and phonemic clustering.

The findings are important in the evaluation and treatment of anomia in a variety of medical conditions since understanding the underlying processes in word-finding performance could lead to the precise diagnosis and appropriate treatment. Word generation on fluency tests depends on both normal executive search strategies and lexical knowledge which are reflected mostly by the number of switches and cluster size respectively.[11,13] However Homophone Meaning Generation Test basically represents retrieval flexibility.[15] Previous studies indicated that patients with MS produced fewer words and switching responses, but had normal size clusters.[20,21] We hypothesized that word finding difficulty in these patients was due to impaired strategic search. Therefore, HMGT, which is a test of word access, is thought better suited for screening and evaluating anomia in MS subjects. Our results suggest that MS patients are impaired on both semantic and fluency tasks, and as predicted, this deficit is mainly due to their weakness in switching strategies which reflect strategic search, response initiation, monitoring, shifting, and flexibility.[13,22,23] On the other hand, these patients produced fewer distinct meanings for selected homophones.

To summarize, MS individuals are more impaired on the verbal switching tasks than lexical repertoire. We showed that Persian HMGT is more suitable in assessing MS patients than verbal fluency test in assessing anomia in MS population.

ACKNOWLEDGEMENTS

This study was supported by Iran University of

Table 6: Scores of three tests in MS patients and healthy controls

	MS Patients	Healthy Controls	P-value
HMGT	28.61 (7.84)	37.72 (5.90)	<0.01
Semantic fluency	33.22 (8.30)	42.43 (7.25)	<0.01
Phonemic fluency	21.48 (9.52)	33.91 (7.33)	<0.01
Semantic switches	15.84 (4.19)	19.82 (3.95)	<0.01
Phonemic switches	14.84 (7.56)	24.01 (5.35)	<0.01
Semantic clustering	1.01 (0.37)	1.09 (0.41)	0.18
Phonemic clustering	0.39 (0.31)	0.34 (0.22)	0.28

Medical Sciences. We would like to acknowledge Payam Mihanparast for their help with data collection and compilation. We would also like to thank the patients, Iranian Multiple Sclerosis Society staff, and volunteers for their involvement in this study.

DISCLOSURE

Conflict of interest: None

REFERENCES

1. Cohen JA, Rae-Grant A. Handbook of multiple sclerosis. Springer, 2010.
2. Sahraian MA, Khorramnia S, Ebrahim MM, Moinfar Z, Lotfi J, Pakdaman H. Multiple sclerosis in Iran: a demographic study of 8,000 patients and changes over time. *Eur Neurol* 2010; 64(6):331-6.
3. Langdon DW. Cognition in multiple sclerosis. *Curr Opin Neurol* 2011; 24(3):244-9.
4. Chiaravalloti ND, DeLuca J. Cognitive impairment in multiple sclerosis. *Lancet Neurol* 2008; 7(12):1139-51.
5. Potagas C, Giogkaraki E, Koutsis G, *et al*. Cognitive impairment in different MS subtypes and clinically isolated syndromes. *J Neurol Sci* 2008; 267(1):100-6.
6. Portaccio E, Goretti B, Zipoli V, Siracusa G, Sorbi S, Amato M. A short version of Rao's Brief Repeatable Battery as a screening tool for cognitive impairment in multiple sclerosis. *Clin Neuropsychol* 2009; 23(2):268-75..
7. Messinis L, Kosmidis MH, Lyros E, Papathanasopoulos P. Assessment and rehabilitation of cognitive impairment in multiple sclerosis. *Int Rev Psychiatry* 2010; 22(1):22-34.
8. Benedict RH, Shapiro A, Priore R, Miller C, Munschauer F, Jacobs L. Neuropsychological counseling improves social behavior in cognitively-impaired multiple sclerosis patients. *Mult Scler* 2000; 6(6):391-6.
9. Benedict RH, Fischer JS, Archibald CJ, *et al*. Minimal neuropsychological assessment of MS patients: a consensus approach. *Clin Neuropsychol* 2002; 16(3):381-97.
10. Benedict RH, Cookfair D, Gavett R, *et al*. Validity of the minimal assessment of cognitive function in multiple sclerosis (MACFIMS). *J Int Neuropsychol Soc* 2006; 12(04):549-58.
11. Kavé G, Kukulansky-Segal D, Avraham A, Herzberg O, Landa J. Searching for the right word: Performance on four word-retrieval tasks across childhood. *Child Neuropsychol* 2010; 16(6):549-63.
12. Goodglass H, Kaplan E, Weintraub S, Segal O. Boston naming test. Lippincott Williams & Wilkins, 2001.
13. Troyer AK, Moscovitch M, Winocur G. Clustering and switching as two components of verbal fluency: evidence from younger and older healthy adults. *Neuropsychology* 1997; 11(1):138.
14. Chapey R. Language intervention strategies in aphasia and related neurogenic communication disorders. Lippincott Williams & Wilkins, 2001.
15. Warrington EK. Homophone meaning generation: A new test of verbal switching for the detection of frontal lobe dysfunction. *J Int Neuropsychol Soc* 2000; 6(06):643-8.
16. Crawford J, Warrington EK. The Homophone Meaning Generation Test: Psychometric properties and a method for estimating premorbid performance. *J Int Neuropsychol Soc* 2002; 8(04):547-54.
17. Kavé G, Avraham A, Kukulansky-Segal D, Herzberg O. How does the homophone meaning generation test associate with the phonemic and semantic fluency tests? A quantitative and qualitative analysis. *J Int Neuropsychol Soc* 2007; 13(03):424-32.
18. Castner JE, Copland DA, Silburn PA, Coyne TJ, Sinclair F, Chenery HJ. Subthalamic stimulation affects homophone meaning generation in Parkinson's disease. *J Int Neuropsychol Soc* 2008; 14(05):890-4.
19. Moein M. Moein Persian dictionary. Amir Kabir Publication, 1999.
20. Tröster AI, Fields JA, Testa JA, *et al*. Cortical and subcortical influences on clustering and switching in the performance of verbal fluency tasks. *Neuropsychologia* 1998; 36(4):295-304.
21. Ebrahimipour M, Shahbeigi S, Jenabi MS, Amiri Y, & Kamali M. Verbal Fluency Performance in Patients with Multiple Sclerosis. *Iranian J Neurol* 2008; 21(7):138-42.
22. Troyer AK. Normative data for clustering and switching on verbal fluency tasks. *J Clin Exp Neuropsychol* 2000; 22(3):370-8.
23. Troyer AK, Moscovitch M, Winocur G, Alexander MP, Stuss D. Clustering and switching on verbal fluency: The effects of focal frontal-and temporal-lobe lesions. *Neuropsychologia* 1998; 36(6):499-504.