



Picture-Naming Performance in Persian-Speaking Patients with Mild Cognitive Impairment and Alzheimer's Disease

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Abstract

Background: Most studies show that picture-naming test is the best task to evaluate the underlined cognitive and language function in the patients with dementia. Naming performance is the most evident linguistic symptom, which starts in the initial phase of the mild cognitive impairment (MCI) and Alzheimer's disease (AD).

Objectives: The current study aimed at determining the picture-naming performance level of Persian-speaking patients with MCI and AD compared with normal peers using naming subtests of Barnes language assessment (BLA).

Methods: In total, 90 subjects were selected through self-report; some relevant tests including mini-mental status examination (MMSE) and functional assessment staging (FAST) scale, as well as experts comments were employed; subjects were divided into three groups of MCI, AD, and normal control (NC) (30 cases per group). Picture-naming performance of patients in the MCI and AD groups was assessed and compared with that of the NC group using the naming subtest of the BLA.

Results: In the picture-naming test of BLA, the AD group performed worse than the NC and MCI groups ($P < 0.001$). Moreover, a significant difference was observed between the NC and MCI groups. While the MCI group performed worse than the NC ($P < 0.001$), it acted better than the AD group ($P < 0.001$).

Conclusions: According to the results of the current study, picture naming test was a useful cognitive-linguistic task, which can accurately differentiate the three study groups, especially MCI from normal subjects, despite its quick and simple application.

Keywords: Mild Cognitive Impairment, MCI, Alzheimer's Disease, AD, Dementia, Picture Naming, Naming Performance

1. Background

Recognized as a transitional phase between natural aging and Alzheimer's disease (AD), mild cognitive impairment (MCI) has symptoms of struggling to continue a conversation and amnesia events. While the mentioned signs might be improved in rare cases, they generally undergo no changes for several years and could be turned into AD (1). Despite a fairly standard general cognitive function and the ability to perform daily activities, the main problems of individuals with MCI are language and memory difficulties. MCI is progressively and broadly evaluated and defined as the predictor and prodromal of dementia. In clinical settings, individuals diagnosed with MCI have a dementia conversion rate of 12% every year (2). However, this process has emotional, financial, and social costs for families,

the society, and most importantly the government. It is significantly crucial to establish methods that are easier, faster, and less invasive to examine, identify, and treat such patients (1). Generally, the language processing is defective at primary phases of MCI and AD. According to the studies, there is a growing language-impairment in patients with AD (1). The main compromised language aspects are being verbally fluent (3, 4), naming of objects (5, 6), discourse processing (7), and semantic comprehension (2, 8). According to previous investigations, most impairments are observed at the semantics level of MCI patients (9).

Starting in the primary stage of MCI, naming function is the most palpable linguistic symptom (3). In regard to the kind of naming mistakes and the process of changes in the impairment over the course of the disease, conflicting results are obtained (10-15). Nevertheless, some studies

found an association between this impairment and deterioration of semantic memory (10). Meanwhile, some other studies found a relationship between this condition and failure of providing the phonological form of a word (11-14). The inability to name items is associated with a faster transition to the disease (16) and higher possibility of atrophy of the whole brain (17). Furthermore, current studies reported that lexical semantic treatment has therapeutic impacts on early AD (18). As a result, it seems necessary to quantitatively and qualitatively describe the naming impairments. The current study aimed at evaluating the performance of patients with MCI and AD in naming processes to detect the type of naming mistakes of such individuals. The main hypothesis of the current study was the differentiation ability of the naming performance between AD, normal control (NC), and MCI.

2. Objectives

The current study aimed at determining the picture-naming ability of Persian-speaking patients with AD and MCI, compared with that of the normal peers. Another goal of the research was determining the type of naming errors using naming subtest of Barnes language assessment (BLA).

3. Methods

3.1. Participants

The current case-control and prospective study had a non-experimental design. In total, 90 subjects were selected and divided into three AD, MCI, and NC groups (30 cases per group).

Inclusion criteria were the diagnosis of MCI or AD in participants referred to a referral center for cognitive disorders and dementia and by a neurologist based on the diagnostic and statistical manual of mental disorders, 4th edition (DSM-IV), NICDS/ADRDA (the national institute of neurological and communicative disorders and stroke/Alzheimer's disease and related disorders association) criteria, and stage of AD scaled in terms of FAST, lack of any other neurological diseases (should be confirmed by a neurologist), age \geq 65 years, no alcohol consumption, no use of psychiatric drugs and anticonvulsants, no (or corrected) hearing or visual problems, and no head trauma. The same inclusion criteria were employed for the NC group in addition to normal cognitive ability.

3.2. Research Execution

All of the participants were selected from Roozbeh hospital and Yaadmaan Medical Center. After the sampling, all

of the participants performed the tests. At first, indirect observations were recorded through an interview with participants and their family members/caregivers in order to obtain demographic characteristics and medical records of the subjects. Then, the patients with MCI and AD or the ones with questionable diagnosis referred to the memory clinic were evaluated using the mini-mental status examination (MMSE) and examination of a neurologist. In the next stage, a picture-naming subtest of BLA was performed on the subjects.

3.3. Materials

Barnes language assessment The components of this one-hour test include word-picture matching, phonological verbal fluency, picture-naming task, written spelling to dictation, word definition, semantic verbal fluency, test for the reception of grammar, digit span, following commands, sentence writing, storytelling, oral reading, and picture description (19).

3.4. Mini Mental State Examination

The MMSE is a frequently used and well-validated standard test used to detect cognitive impairment in adults. In addition, the validity of the Persian version of the test was confirmed (20).

Statistical analysis was conducted using descriptive methods to assess quantitative variables. The Kolmogorov-Smirnov test was applied to confirm the normal distribution of variables in the study. Furthermore, one-way ANOVA or equivalent nonparametric test and the Kruskal-Wallis test were exploited to compare the mean scores of age, level of education, and MMSE among the three groups. On the other hand, Duncan post-hoc test or the Mann-Whitney U test was applied for multiple comparisons. In addition, ordinal logistic regression was used to analyze different naming subtests due to their scoring scales. Data analysis was conducted with SPSS version 21, and P value $<$ 0.05 was considered statistically significant.

4. Results

In the current study, there were 45 males (with the frequency of 50%) and 45 females (with the frequency of 50%) in all three groups (AD, MCI, and NC). According to the results, no difference was observed between the participants of the study groups in terms of visual, paraphasia, and phonological errors (Table 1). In addition, different total naming scores were obtained by the study groups ($P <$ 0.001). In addition, a significant difference was observed between the three groups regarding scores of visual-semantic and semantic errors (Table 1).

Table 1. Results of Ordinal Logistic Regression Models for Total and Subtle Performance Naming Scores

Dependent Variable	Level	β	SE (β)	P Value
Total naming score				
Group	MCI	-2.650	0.714	< 0.001
	AD	-4.697	1.038	< 0.001
	Normal	Reference category		
Age, y		-0.024	0.026	0.351
Education level, y		0.092	0.045	0.040
MMSE score		0.066	0.057	0.245
Semantic visual error				
Group	MCI	3.135	0.804	< 0.001
	AD	4.032	1.109	< 0.001
	Normal	Reference category		
Age, y		-0.046	0.029	0.111
Education level, y		-0.011	0.048	0.815
MMSE score		0.016	0.061	0.797
Visual error				
Group	MCI	0.563	0.729	0.440
	AD	0.362	1.059	0.733
	Normal	Reference category		
Age, y		0.006	0.030	0.832
Education level, y		-0.052	0.053	0.330
MMSE score		0.027	0.065	0.678
Para-aphasia				
Group	MCI	-1.755	1.284	0.172
	AD	1.105	1.228	0.368
	Normal	Reference category		
Age, y		0.001	0.039	0.978
Education level, y		-0.002	0.067	0.974
MMSE score		-0.006	0.074	0.933
Phonological error				
Group	MCI	-0.287	1.013	0.777
	AD	1.635	1.257	0.193
	Normal	Reference category		
Age, y		0.021	0.039	0.591
Education level, y		0.040	0.065	0.536
MMSE score		0.079	0.077	0.306
Semantic error				
Group	MCI	20.796	0.740	< 0.001
	AD	23.651	1.383*	< 0.001
	Normal	Reference category		
Age, y		-0.022	0.029	0.460
Education level, y		-0.036	0.048	0.456
MMSE score		0.045	0.060	0.455

According to the results of the Kolmogorov-Smirnov test, while there was a normal distribution of age in the study groups ($P > 0.05$), no normal distribution was found for the years of education and MMSE ($P < 0.001$). Therefore, one-way ANOVA test was used to compare the mean age of the subjects. Moreover, the Kruskal-Wallis test was used to compare the groups in terms of years of education and MMSE (Table 2). According to the results presented in

Table 2. Descriptive Statistics of Continuous Variables in Different Study Groups^a

Variable	NC	MCI	AD
Age, y	59.57 ± 5.97	71.77 ± 8.91	76.77 ± 7.57
Education level, y	1.23 ± 0.43	14.47 ± 4.77	12.87 ± 4.93
MMSE	29.27 ± 1.41	24.93 ± 3.57	18.57 ± 3.83
Semantic visual errors	0.17 ± 0.38	0.97 ± 0.81	1.27 ± 0.944
Semantic errors	0.00 ± 0.00	1.03 ± 1.03	3.10 ± 1.76
Visual errors	0.37 ± 0.55	0.60 ± 0.855	0.37 ± 0.49
Phonological errors	0.13 ± 0.34	0.13 ± 0.434	0.37 ± 0.615
Para aphasia	0.17 ± 0.38	0.03 ± 0.183	0.53 ± 0.77
Total naming scores	14.03 ± 1.27	10.27 ± 3.129	6.77 ± 2.67

^aValues are expressed as mean ± SD.

Table 2, there was a statistically significant difference between the three groups regarding mean age, years of education, and MMSE score ($P < 0.001$). On the other hand, the Duncan post-hoc test revealed that mean age of the NC group was lower, compared with those of the MCI and AD groups. The Mann-Whitney test with Bonferroni correction demonstrated a decline in the mean years of education in NC, AD, and MCI groups, respectively. Furthermore, the Mann-Whitney test arranged the mean of MMSE scores in AD, MCI, and NC groups in the ascending order. Therefore, to compare the scores of different naming subtests of the groups, ordinal logistic regression was used to adjust the age, educational level, and MMSE scores of subjects. Results of the fitting process are presented in Table 1.

Study groups were homogenous in terms of gender, 15 males and 15 females were selected for each group.

According to Table 1, no difference was observed between the study groups in terms of visual, para-aphasia, and phonological errors after the adjustment based on age, education level, and MMSE score. In addition, a difference was observed between the three groups regarding the total naming score ($P < 0.001$). The estimated parameter of the model for MCI group was -2.650, which indicated the probability of increase in the total naming score in this group, compared with that of NC reported 0.07. Moreover, the estimated parameter of the model for AD group was -4.697, which revealed the probability score (0.009) of increase in the total naming score in this group, compared with that of NC group. In addition, there was a significant difference in the scores of the study groups regarding visual-semantic and semantic errors. Estimated parameter for these naming variables showed that the probability of increasing visual and semantic visual errors were higher in the MCI and AD groups, compared with the normal group.

5. Discussion

The current study aimed at evaluating the naming performance and different naming mistakes made by patients with MCI and AD compared with those of the subjects of the control group, during the process of naming pictures.

According to the obtained results, there was an impairment in the naming performance of patients with AD and MCI. However, no significant difference was observed between patients with NC, MCI, and AD in terms of paraphasia, as well as phonological and visual errors. On the other hand, a significant difference was observed between the study groups regarding semantic and visual-semantic errors (Table 1). In addition, the total naming scores of the study groups were significantly different.

One of the AD symptoms is difficulty in finding words and naming impairments. Therefore, there is a broad application of naming tests in clinical and research settings. It should be noted that the prognostic and diagnostic use of naming performance tests for patients with AD and MCI are assessed in numerous studies. Generally, there was a difference between patients with MCI and subjects of the control group (21), patients with AD and MCI (22), and individuals experiencing AD and non-demented subjects two years before the diagnosis (20). Lower baseline scores and greater deterioration were observed in patients with MCI (23, 24). Sensitivity of face naming and familiarity to impairment of semantic knowledge in patients with MCI and AD, which also anticipates dementia, is demonstrated in several studies (25, 26). Failure in remembering the names of popular people can predict the conversion of individuals to AD not diagnosed yet. On the other hand, it is demonstrated by a few studies that sensitivity to extremely mild AD was higher in the subjects able to properly remember names, compared with other subjects (27).

Results were also indicative of a significant association between naming ability and conversion from MCI to mild AD (28). Literature review revealed that despite the word-finding impairment in the elderly, patients with AD had lower ability to efficiently perform the naming process, compared with healthy individuals (4, 6, 7, 23). Moreover, studies show that lack of proper naming performance could be detected at early stages or unexpectedly during the primary AD stages. Furthermore, progress in the disease course is associated with worsened condition of the deficit in patients (24, 25). In the current study, while there were an elevated number of mistakes, the most significant result was the naming error patterns observed in the patients with AD and MCI. Moreover, despite observing the semantics and visual-semantic errors in all of the subjects, there was an elevation in the level of semantic errors at higher stages of the disease. While naming im-

pairment of patients with AD is demonstrated in numerous studies, there is limited number of studies on the fluctuating nature of naming mistakes during the disease period. There might be a significant relationship between defects in the semantic system and semantics and visual-semantic errors. On the other hand, one of the hypotheses of some studies is less efficient naming performance in patients with AD, compared with that of the normal people, which is due to the semantic failure created by deteriorated data storing (7). Neurodegeneration occurs due to defective performance and extends to the association cortices, which supposedly accumulates semantic representations (27). Nevertheless, there is no systematic reflection of just an impairment in the semantic awareness of patients with AD by semantic errors. In contrast, the current study results demonstrated an impairment in remembering phonological forms and in retrieving semantic information in the visual modality (8).

In the current study, progress in the disease course was associated with gradual increase in visual errors, with higher prevalence in patients with AD, compared with other subjects. Due to the use of visual confrontation naming tasks, failure in the system that visually recognizes objects and in availability of the semantic system due to the need for visual processing might be the cause of naming fluctuations. It is noteworthy that decline in meticulous conceptual understanding of an object is mainly responsible for naming difficulties. Therefore, one precise impairment in the semantic processing cannot be the only reason for this type of problems. In visual naming tasks, perceptual defects lead to failure of patients in naming tasks (10, 11), which is mainly due to the fact that visual understanding facilitates recognizing an element by patients. According to the mentioned results, there seems to be a defect in many linguistic subsystems along with various levels of change in linguistic processing. Moreover, there is a general elevation in cognitive changes caused by association of different cerebral regions, resulting in a more serious linguistic-cognitive compromise. In addition, the current study results were indicative of deterioration in naming ability of patients by progress in the course of the disease. It is necessary to recognize different kinds of naming mistakes in patients with AD to properly perform the therapeutic methods for these individuals.

Nevertheless, lack of prediction of incident dementia by naming tests is reported by many studies. This lack of consistency between results might be due to the application of various tests.

According to the results of the current study, naming problems were detected in patients with MCI. In general, naming tests can be applied as an effective recognition device to distinguish individuals with NC, AD, and MCI. In ad-

dition, the current study findings revealed that the three groups under study were accurately separated by the naming test. A more significant result of the current study was distinguishing patients with MCI and normal subjects despite the easy and fast use of the method. Therefore, it is suggested that the technique be used to identify MCI and AD at early stages (29).

Footnote

Conflict of Interest: Authors declared no conflict of interest.

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