

Evaluating the cognitive function of monolingual and bilingual Alzheimer's patients and normal people using the MMSE test

Abstract

The present study evaluates the cognitive function of Alzheimer's patients (monolingual, bilingual) and normal people using the MMSE test. It is applied in terms of purpose, retrospective in terms of time, causal-comparative in terms of data collection method, and its data were collected using a field method. The statistical population of the present study included Alzheimer's patients (monolingual and bilingual) living in nursing homes or centers related to the care of Alzheimer's patients in Fars province (2018). Among them, 90 people, including 60 people with Alzheimer's disease (monolingual and bilingual) and 30 normal people were selected as a sample of the study. The measurement instrument of the study was the Mini-Mental State Examination (MMSE) test, which was distributed among people. To analyze the data in this study, considering the questions and hypotheses, descriptive statistics such as mean, standard deviation, frequency, minimum, and maximum were used. Also, a univariate analysis of variance test was used at the inferential level. The results of the data analysis revealed a significant difference between the compared groups regarding the cognitive function and its components.

Keywords: *Multilingualism, Cognitive function, Alzheimer's disease, Forgetfulness*

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Introduction

There is still no definitive treatment for Alzheimer's disease. The only way to deal with it is prevention and trying to slow down its progress. The results of scientific studies are crucial to help Alzheimer's patients and people normal to prevent its incidence. Disorder in memory and thinking process causes damage to the social and personal functions of the patient and thus may cause depression, anger, and aggression of the patient. This disease gradually ends with the loss of ability to recognize time, depression, loss of speech, isolation, and finally death due to respiratory, cardiac, or nutritional problems. Millions of dollars are spent on the diagnosis and treatment of these patients, including the care and treatment costs of these patients every year in the world. The primary treatments have been biological treatments, drugs, psychosocial interventions, and psychodynamic interventions for families (Davison et al., 2009).

Many studies have indicated that performing mental activities can prevent or slow down the progress of Alzheimer's symptoms. Playing brain games, reading, solving tables, memorizing poems, reading stories, writing, reading newspapers, etc., slow down the progression of Alzheimer's since they involve mental activity (Stern, 1994; Valenzuela & Sachdev, 2006; Bavelier, 2012). The phenomenon of globalization has increased communications between societies and clarified the concepts of bilingualism and multilingualism. Bilingualism is crucial from several points of view. First, some people are bilingual or multilingual in every society.

This part of society has specific characteristics, conditions, and needs, making it necessary to conduct special studies on this group of people to provide suitable conditions for them. For

example, in Iran, students from regions whose mother language is a language other than Persian, such as Lors, Turks, Kurds, or Baluchs are not equal with Persian students in learning the Persian language in school in terms of education, ability, difficulty in learning, etc. Also, students in higher levels such as middle school are required to learn English, which is considered a second language for Persian-speaking students and a third language for bilingual children. This issue is a serious phenomenon, so it is necessary to investigate it comprehensively.

Learning a second language involves a very active mental activity that deals with high brain processes. Accordingly, it is thought that learning a second language or even a third language and more (multilingualism) can play a role in dealing with Alzheimer's disease. In other words, people who are fluent in two languages may be less likely to develop Alzheimer's disease. In the present study, we try to answer the question: Is the cognitive function in monolingual and bilingual Alzheimer's patients the same? What are the cognitive defects of Alzheimer's patients?

Bilingualism and multilingualism

Bilingualism or multilingualism is a term used for speaking in two or more languages. The mother or the first language of the speakers is mostly one of their two languages and it causes them to be called bilingual (Skoten, 2006). In other words, when the speaker has the ability to communicate in more than two languages, this phenomenon is called multilingualism. One of these aspects is the possibility of brain, mental, and cognitive diseases. From the medical science viewpoint, as stated in the previous sections, different types of mental

activities can significantly reduce the possibility of mental diseases, including Alzheimer's.

Several studies have been conducted in this regard to investigate and determine the relationship between bilingualism and the incidence of mental illnesses (these studies have been conducted in various fields of science, including linguistics, medicine, social sciences, and other sciences.), and determine the relationship between the special abilities of bilingual/multilingual people, including the ability to learn better and more accurately. We report some studies conducted regarding the effect of bilingualism on the cognitive function of bilingual people.

Stern (2002) investigated the cognitive needs related to the process of bilingualism and multilingualism leading to mind training. He showed that this process increases cognitive reserve and brain adaptation, and it may delay cognitive reduction related to Alzheimer's disease and other types of dementia. In cognitive sciences and clinical neurosciences, they showed that certain daily activities can protect against attacks on the central nerve. Cognitive function decreases in head injury, stroke, disease, or old age. The logic of this protection against cognitive decline is based on the overlapping concepts of cognitive reserve and brain adaptation. Activities that cause the exercise in a part of the mind increase the adaptability of the brain, and when this part is attacked, the increase in adaptability helps to overcome the injury and compensates for the damage.

Literature review

In his article on word order processing in the brain of bilingual people, Shatreloo (2015) believes that recent studies suggest that age is involved in language learning and especially grammar processing, but word order processing in sentence context has not been specifically tested. In this article, word order processing in the brain of bilingual people is studied and the obtained results are analyzed. Comparing the MRI of bilingual people who started learning a second language after the age of ten with bilingual people who learned both languages before the age of three indicated high levels of activity in the cortex of their brain in the inferior frontal parts of the left. However, in the second group, no activity was observed. Increased activity in the brain can affect the grammatical processing of sentences. Those who have become bilingual in their old age make many mistakes in terms of grammar, the order of the verbs, and the subject of the sentences in the second language. Age of language acquisition (AOA) can affect the grammatical structure of the first language.

In the study of theories and factors affecting bilingualism, Ghavami Lahij (2013) believes that people either acquire both languages simultaneously in childhood or are taught the second language after acquiring the first language. There are different opinions about the phenomenon of bilingualism and linguists have put it in different classifications. This study first gives a brief look at the various theories and definitions presented about bilingualism. Then, based on these theories, it provides answers to the four questions raised. These questions cover the general concepts of bilingualism, namely the brain function of bilinguals and the impact of bilingualism on cognitive aspects. Then, based on these factors, the criteria required for a bilingual teacher are presented.

Sheikh Farshi and Homsian (2012) investigated the practical and applied theories related to bilingual education in Iran and considered bilingualism to be a situation in which a person alternately uses two or more languages, depending on the context, to communicate with others. This phenomenon is common in most countries of the world and it can be better recognized with criteria such as the type of learning (natural and unnatural), the degree of mastery of each language, the social role of language, and types of bilingualism (written and oral). Education systems in different countries have adopted different approaches to this phenomenon. In this article, after the introduction and review of foreign and domestic studies in this field, the authors explained the theoretical and practical solutions of language learning in the bilingual areas of Iran.

In an article entitled "Psychological and Educational Outcomes of Bilingualism on Students", Dana, Fateh, and Poortahmasbi (2008) believe that the content of the course materials is not so simple, systematic, and far from the artificial sequence, highlighting the importance of this issue. In this study, the languages are classified and language teaching methods and bilingualism are discussed. Also, the psychological and educational outcomes of bilingualism are discussed in detail and the problems of bilingual education are raised.

Izadi and Hatamzadeh (2009) compared the performance of bilingual and monolingual students in the second grade of primary school. The mentioned study investigated the effect of education with a bilingual system on the academic progress of students. The statistical population of the study included 78 students who are in the second grade of boy and girl primary schools in the non-profit educational complex of Babolsar with two monolingual and bilingual systems. They were studying in the academic year of 2008 and 2009. The results revealed a significant difference between the GPAs of bilingual and monolingual girl students, but no significant difference was observed in the academic performance of bilingual and monolingual students in science and math courses.

Tanhaye Rashvanloo (2008) investigated the effects of bilingualism on learning, academic progress, cognitive development, and psychological injuries in the studies conducted in this field. Related domestic and foreign studies were retrieved and analyzed. The analyses indicated contradictions in the results of the studies. In most cases, the results indicated the poor performance of bilinguals in learning and academic progress, while some emphasized the positive effects of bilingualism on learning vocabulary of other languages. The positive impacts of bilingualism on the development and improvement of some cognitive abilities such as executive control, verbal, vocabulary acquisition, and speaking development were confirmed in most cases. Also, the results confirmed cognitive and personality differences between bilinguals and the high incidence of some abnormalities such as stuttering, and emphasized the necessity of adopting special diagnostic and treatment methods for bilinguals.

In the field of education, it seems necessary to develop educational programs that pay full attention to the differences between bilinguals and monolinguals and provide the basis for benefiting from the positive characteristics of bilingualism. Klein, Christie & Parkval (2016) sought to find an answer to the question of whether multilingualism affects the incidence of Alzheimer's. The authors stated that the cognitive requirements related to the bilingual or multilingual process involve a kind of mental exercise. This phenomenon along with the repetition and cognitive reaction of the mind and brain preparation causes the delay of Alzheimer's related symptoms. The data were collected from different countries. According to the total information obtained, most evidence emphasizes that multilingualism positively affects the cognitive function of Alzheimer's patients. The present study seeks to answer these questions: Is the cognitive function the same in monolingual and bilingual Alzheimer's patients? What are the cognitive defects of Alzheimer's patients?

Chertkow et al. (2010) studied a sample of 632 patients diagnosed with probable Alzheimer's disease and found a delay of almost 5 years in bilingual patients. Although the result was found only in one immigrant group, a more significant effect was observed in patients who spoke three or more languages. They concluded that bilingualism or multilingualism is associated with a delay of 4 to 5 years in the onset of Alzheimer's disease symptoms. It was found in general samples of more than 1000 patients.

Methods

The present study applied in terms of purpose, retrospective in terms of time, and causal-comparative in terms of data collection method, and its data were collected using a field method. The field section of the study included the collection of medical data from the condition of the studied patients. The

study population in this study included patients with Alzheimer's disease living in nursing homes or centers related to the care of Alzheimer's patients in Shiraz City, and their Alzheimer's disease was confirmed in the second half of 2018. These patients were compared based on the topics of bilingualism.

The statistical sample of the present study included 60 males and females with Alzheimer's disease, monolingual Persian speaking, bilingual, or multilingual, and 30 normal people in Shiraz city. The participants of the study were in the age range of 45 to 75 years. All the participants with Alzheimer's disease were visited by a physician or treatment or care center at least once due to Alzheimer's disease and were recognized by the physician as patients with Alzheimer's disease. A convenience random sampling method was used in 2018.

After identifying the primary patients participating in the test, the same number of normal people was selected as the comparison group (control group). Almost all of them were family members of the patients. The physical and mental health of these people was confirmed by the physicians who participated in this study. The exclusion criteria were the illiterate elderly who had vision, hearing, movement, and any other problems other than Alzheimer's based on the approval of the neurologist and the information in the medical records of the elderly. Among the elderly who were in nursing homes in Shiraz city, their conditions were checked through their medical records. After this initial screening, to obtain permission from the families of the elderly to participate in the test, the necessary explanations were given to them by the research psychologist about the objectives and the process of conducting the study. The implementation of this study did not cause any physical or social harm to the elderly. All subjects were matched in terms of disease severity and MMSE test score. After determining and examining the results of the MMSE test and determining the exact status of the participants of the study, a number of participants withdrew from the research process. The subjects with a score between 10 and 19 were classified as mild Alzheimer's. These people included people with other psychiatric and neurological disorders, alcohol users or other cases, people with brain or skull injuries, people receiving psychological treatments, and people with a history of brain trauma.

Research instrument

Mini-Mental State Examination (MMSE)

This diagnostic test was used since one of the common methods of diagnosing Alzheimer's disease as the preliminary condition of the study is to examine psychological function. This test is one of the most common cognitive disorder screening tools in the world, designed and developed by Folstein et al. (1975). In Iran, Seyedian et al. (2006) standardized this test among the elderly.

The MMSE test includes 5 parts and the total score is 30. A score between 27 and 30 indicates that the person is normal. A score between 10 and 26 indicates that the person has mild to moderate Alzheimer's. A score lower than 10 indicates a severe Alzheimer's disease. These 5 parts include recognition of time and place (10 scores), concentration and repetition (3 scores), accuracy and calculation (5 scores), recall (3 scores), and speech (9 scores). Many studies have tested their validity and reliability. Generally, the Alzheimer's disease was diagnosed by a neurologist. Then, a psychologist determined the severity of Alzheimer's disease with the mentioned test. Scores of 25 and above are classified as normal, scores from 10 to 19 are classified as mild Alzheimer's, and scores below 10 are classified as severe Alzheimer's disease. In this study, people were selected who scored between 10 and 19 and were diagnosed with mild Alzheimer's.

Method of analysis

In this study, based on the questions and hypotheses, descriptive statistics such as mean, minimum, maximum, and standard deviation were used. Also, an analysis of variance test was used at the inferential level.

Results

Descriptive investigation of respondents

Table 1- Frequency and percentage of respondents based on age

Group	Number of children	f	%
normal people	45-55 years	12	40
	56-65 years	12	40
	75-66 years	6	20
	Total	30	100
Bilingual people with Alzheimer's disease	45-55 years	14	46.64
	56-65 years	11	36.66
	75-66 years	5	16.66
	Total	30	100
Monolingual people with Alzheimer's disease	45-55 years	11	36.64
	56-65 years	12	40
	75-66 years	8	26.66
	Total	30	100

Based on Table 1, the highest age percentage is related to the age group of 45 to 55 years old from the group of bilingual Alzheimer's patients, and the lowest age percentage is related to the age group of 66 to 75 years old with 16.66%.

Description of research variables

Table 2- Mean and standard deviation of cognitive function in groups

Variable	Group	Mean	SD
	normal people	1.27	97.1

Cognitive function	Bilingual with Alzheimer's	03.17	02.2
	Monolingual with Alzheimer's	73.11	93.2
time and place	normal people	86.8	07.1
	Bilingual with Alzheimer's	53.4	73.0
	Monolingual with Alzheimer's	1.3	24.1
Focus and repetition	normal people	83.2	37.0
	Bilingual with Alzheimer's	23.2	50.0
	Monolingual with Alzheimer's	43.1	72.0
Accuracy and calculation	normal people	5.4	77.0
	Bilingual with Alzheimer's	56.3	81.0
	Monolingual with Alzheimer's	03.2	80.0
recall	normal people	83.2	37.0
	Bilingual with Alzheimer's	2.2	66.0
	Monolingual with Alzheimer's	93.1	92.0
speech	normal people	06.8	25.1
	Bilingual with Alzheimer's	5.4	07.1
	Monolingual with Alzheimer's	2.3	27.1

Based on Table 2, in the cognitive function test, the best function is related to the normal group (M=27.1), and the worst function is related to the monolingual Alzheimer's group (M=11.73). In the dimension of time and space, the monolingual Alzheimer's group has the worst function (M=3.1), followed by bilingual Alzheimer's (M=4.53), and the best function is related to the normal group (M=8.86). In the concentration and repetition part, the mean for three groups of normal people, bilingual with Alzheimer's, and monolingual with Alzheimer's was 2.83, 2.23, and 1.43 respectively. The highest mean is related to normal people and the lowest mean is related to monolingual Alzheimer's patients. In the accuracy and calculation part, the mean for three groups of normal people, bilingual with Alzheimer's, and monolingual with Alzheimer's was 4.5, 3.56, and 2.03, respectively. In the recall part, the mean for the normal, bilingual with Alzheimer's, and monolingual with Alzheimer's groups was 2.83, 2.2, and 1.93, respectively. In the speech part, the mean for three normal, bilingual with Alzheimer's, and monolingual with Alzheimer's groups was 8.06, 4.5, and 3.2, respectively. Based on these statistics, it can be stated that in all parts, the normal group had the highest score. Also, in all parts, among the two groups with

Alzheimer's, the bilingual group had a higher score than the monolingual group.

Testing the research hypothesis

The cognitive function of Alzheimer's patients (monolingual and bilingual) is different from normal people (MMSE total score).

To test this research hypothesis, univariate analysis of variance test was used. However, before performing the analysis, the assumption of equal variance was investigated using Levene's test. Table 3 presents the results.

Table 3- The results of Levene's test based on the assumption of equal variance of the groups

Variable	F	df1	df2	P
Cognitive function	1.32	2	87	0.17
Recognition of time and place	1.76	2	87	0.09
Concentration and repetition	1.38	2	87	0.15
Accuracy and calculation	0.06	2	87	0.45
Recall	1.45	2	87	0.11
speech	1.12	2	87	0.21

As seen, the results of the Levene's test are not significant. Thus, the assumption of equality is fulfilled and the analysis of variance test can be used.

Table 4 - Results of the analysis of variance test to compare cognitive function of groups

Index		SS	D F	MS	F	P
Cognitive function	Inter - group	62.3655	2	81.1827	23.330	0.001
	Intra - group	53.481	87	53.5		
Recognition of time and place	Inter - group	86.540	2	43.270	27.251	0.001
	Intra - group	63.93	87	07.1		
Concentration and repetition	Inter - group	6.29	2	8.14	86.47	0.001

	Intra - group	9.26	87	309.0		
Accuracy and calculation	Inter - group	06.93	2	53.46	5.72	0.001
	Intra - group	83.55	87	54.0		
Recall	Inter - group	06.12	2	03.6	51.12	0.001
	Intra - group	93.41	87	48.0		
speech	Inter - group	95.380	2	47.190	34.131	0.001
	Intra - group	16.126	87	45.1		

As Table 4 shows, there is a significant difference between the mean scores of cognitive function and its components in the compared groups. The results of the LSD post hoc test show which groups have a significant difference.

Table 5- Results of LSD post hoc test to compare the cognitive function of the groups

Variables	Groups	Difference	Standard deviation error	P
Cognitive function	Normal and bilingual people	06.10	61.0	0.001
	Normal and monolingual people	36.15	61.0	0.001
	Bilingual and monolingual	3.5	61.0	0.001
time and place	Normal and bilingual people	33.4	26.0	0.001
	Normal and monolingual people	76.5	0/26	0.001

	Bilingual and monolingual people	43.1	26.0	0.001
Concentration and repetition	Normal and bilingual people	6.0	14.0	0.001
	Normal and monolingual people	4.1	14.0	0.001
	Bilingual and monolingual people	8.0	14.0	0.001
Accuracy and calculation	Normal and bilingual people	93.0	20.0	0.001
	Normal and monolingual people	46.2	20.0	0.001
	Bilingual and monolingual	53.1	20.0	0.001
Recall	Normal and bilingual people	63.0	17.0	0.001
	Normal and monolingual people	86.0	17.0	0.001
	Bilingual and monolingual people	23.0	17.0	0.19
speech	Normal and bilingual people	56.3	31.0	0.001
	Normal and monolingual people	86.4	31.0	0.001
	Bilingual and monolingual people	3.1	31.0	0.001

The results of Table 5 show that there is a significant difference between cognitive function and its components in all groups (except for the recall component in monolingual and bilingual groups). The mean of normal people is higher than that of bilingual people with Alzheimer's and the mean of the bilingual group is higher than that of the monolingual people.

Conclusion:

Univariate analysis of variance test was used to test the research hypothesis that states the cognitive function of Alzheimer's patients (monolingual and bilingual) is different from that of normal people. The results of Levene's test were

not significant, so analysis of variance was used. The results showed a significant difference between the mean scores of cognitive function and its components in the compared groups. Based on the results, the highest rank in all parts and components belonged to normal people, which was expected. In all components, the mean scores of the bilingual group were higher than those of the monolingual group, and this difference was significant based on calculations.

A significant point that was observed among the research data and was not mentioned in the results of Chapter 4 was that the mean of the bilingual group was close to the normal group in some components. This means that the bilingual group with Alzheimer's had results very close to normal people in some tests and components. However, the monolingual group was very far from these two groups. This means that the bilingual group with Alzheimer's not only had a much better cognitive function compared to the monolingual group but they were even able to perform close and similar to healthy people in some components. This point indicates to what extent bilingualism can play a positive role in the performance of people with Alzheimer's disease. For example, in the concentration and repetition component, the mean score of normal people was 2.83, the mean score of the bilingual group was 2.23, and the mean score of the monolingual group was 1.43. The bilingual group with Alzheimer's showed a very small difference from the normal group. Also, in other components, the distance between the bilingual group and the normal group was very close to the distance between the monolingual group and the normal group. This result is consistent with the results of studies conducted by Bialystok (2007), Hakuta (1986), and Klein and Christie (2016).

Many previous studies have indicated that mental activities positively affect Alzheimer's disease. Some of these activities are mental games, solving tables, solving puzzles, memorizing poetry, chess, and the like. The results of this study are also consistent with the results of previous studies as they have shown that mental activities improve the mental performance of Alzheimer's patients and slow down the progress of the disease. It can be concluded that learning a second language is a very active mental activity for the mind (Stern, 1994; Valenzuela and Sachdev, 2006; Bavelier, 2012). Finally, based on the obtained results, it can be stated that the present study is very useful in the areas of medical and treatment centers for mental diseases and diseases related to dementia in care centers for the elderly.

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