

## The Effects of COVID-19 lockdown in Speech Progress of Patients with Mild Cognitive Impairment and Dementia

Alopoudi Aristi<sup>1</sup>, Ocalidou A<sup>3</sup>., Tsolaki Magda<sup>1,2</sup>

<sup>1</sup>Greek Alzheimer's Disease and Related Disorders Association, Thessaloniki,, Makedonia, Greece

<sup>2</sup>1<sup>st</sup> Dept of Neurology, School of Medicine, Aristotle University of Thessaloniki, Makedonia, Greece

<sup>3</sup>Dept of Edu & Social Policy, Uni of Macedonia, Thessaloniki, Greece

### Abstract

*Patients with Mild Cognitive Impairment (MCI) face difficulties in many cognitive function such as speech production, memory, thinking and judgment. These deficits are greater than normal age-related changes. Patients with dementia suffer from a variety of symptoms which vary depending on the form of dementia, but the main problems of this disease are memory loss and difficulties with communication or finding words, visual or spatial abilities, handling complex tasks, organizing, planning and coordination etc. The aim of this study was to examine the effects of COVID-19 lockdown in patients with MCI and Dementia after a four-month period of abstention from speech language therapy sessions. Both types of patients were assessed with Boston Naming Test and informal tasks which evaluated production of spontaneous speech, semantics, categorization, memory, sequence and description. The assessment showed that patients with MCI had difficulties with naming and fluency in spontaneous speech but their performance was significantly better in semantics ( $p=0.003$ ), sequencing cards ( $p=0.037$ ), memory ( $p=0.182$ ) and description ( $p=0.182$ ) than the performance of patients with Dementia whose performance was lower in semantics ( $p=0.007$ ), in sequencing cards ( $p=0.037$ ), in memory ( $p=0.016$ ), in description ( $p=0.120$ ) and in categorization.. Additionally, patients with MCI named correctly the cards after the semantic or phonemic aid. Patients with Dementia were not able to name the cards correctly, regardless of the aid. There were scheduled individualized sessions based on the patients' needs according to the first assessment of each patient. In every session the therapist took down notes about the progress of the participants, while the main goal for all of them was the enhancement of naming and speech production. MCI patients were on a higher level than Dementia patients. It was noticeable that Dementia patients tend to produce longer sentences and they tried to communicate and discuss with the therapist. After five sessions of speech language interventions (five weeks) due to Greece's lockdown it was necessary the sessions to be stopped. Thus, patients did not take part in any session of speech language therapy for four months. The assessment after the lockdown highlighted that the verbal skills of patients have declined and the results were similar to the first assessment. Not only patients realized their difficulties and claimed about the problems of word finding, but also the results of the assessment underline that speech production and memory skills remain in the same level as they have never received any speech-language session. According to the results, the significant difference between the performance of MCI and Dementia patients as groups was in naming ( $p= <0.001$ ), sequencing cards ( $p=0.037$ ) and memory ( $p=0.004$ ). In description there was no significant difference as well as, in description. Thus, COVID-19 lockdown had a negative impact on the progress of verbal and cognitive skills of patients with MCI and Dementia.*

**Keywords:** Mild Cognitive Impairment, Dementia, Speech production, Memory, Semantics, Non-pharmacological interventions

JEL Classifications: I12, I18, I31

## **Introduction**

Mild Cognitive Impairment (MCI) is a syndrome featured by cognitive decline which is not related with individual's age or educational level. There is no influence in daily activities of patients with MCI. When it comes to cognitive decline is conditioned as a memory deficit, impaired language, speech, orientation, decision making, planning and interpreting instructions (Gauthier et al. 2006, Themistocleous et al. 2020) According to Bidelman et al. (2017) MCI is associated with lower encoding and transfer speech signals between the functional levels of process in auditory system underline the comprehension of cognitive aging and it is manifested subcortical deficits in auditory sensory after sound onset and before emergence of perceptual speech deficits.

Dementia is the decline of cognition which affects the daily functioning of the patients and it is significant enough, because patients become dependent (Gale et al. 2018). Dementia, also, describes a group of symptoms which vary depending on the kind of dementia, but the main symptoms of this disease are memory loss and difficulties with communication or finding words, visual or spatial abilities, handling complex tasks, organizing, planning and coordination etc. The number of people living with dementia is rising and it estimated that in 2050 we will count about 152 million patients (Patterson, 2018). Prevention, intervention and care (Livingston et al. 2020, Chan et al., 2019) are the main suggested factors to remain cognitively and physically active the patients with dementia (Chapman et al., 1995).

The aim of this study was to identify whether the measures about COVID-19 pandemic lockdown have influenced the speech production skills of patients with MCI and dementia. Covid-19 was first noticed in Wuhan as a serious illness which causes pneumonia and death (Ahn et al 2020). The first report of Covid-19 was in December 2019 from the World Health Organization China Country Office and the number of cases reported has been growing since then (WHO, 2020). The majority of people who have been reported as cases in other countries were travelers who have visited China during this period of spread and they have been infected under unknown conditions (WHO, 2019). In March 2020 the Greek government announced the decision of lockdown in order to prevent people from the pandemic. As a result, the patients stopped to take part in group activities and speech language therapy sessions. Due to their high risk in Covid-19 spread, patients isolated themselves for a four-month period. The impact of this social isolation was investigated to highlight the importance of speech therapy in patients with MCI and dementia.

## **Materials and Methods**

### **Participants**

The participants in this study were 9 patients (five women and four men). Four of them have diagnosed with MCI, and the other five participants have diagnosed with Dementia. The age range varies from 54 to 85 years old with mean age 72.4. All individuals recruited from the Greek Association of Alzheimer Disease in Thessaloniki.

Obviously, all of them are members of Greek Association of Alzheimer Disease and they participated in group therapy activities specific days per week. Additionally, they have received five speech therapy sessions (one per week) before the lockdown in March 2020. All of them live in the same city, in Thessaloniki and they took part in the same group activities of the Greek Association of Alzheimer Disease.

## **Method**

We assessed the speech (both verbal and cognitive skills) of each patient, individually, in order to organize and plan the speech therapy sessions according to the patients' needs. For the speech assessment were used:

### **Neuropsychological test**

#### 1. Boston Naming Test (Naming Task)

During the stabilized task Boston Naming Task, patients had to name sixty objects. The researcher gave them one card with one object each time and asked them to name it. For each item the patients saw and they were not able to name, the researcher gave them phonological aid. This task assessed the vocabulary and semantics of patients.

### **Informal Tasks**

#### 2. Memory Cards

Memory cards was a game with 4 couples of cards. For each card there was one same card. Patients had to name each card and then they received the couple of each card. The researcher hid the front side of each card and then patients were asked to find and name correctly each card. They had to remember which item/animal was in each card and match them correctly, named them see the items based on their memory. In this task we could assess the short-term memory, vocabulary, perception and attention of patients. But we used this tool to evaluate the ability of the short-term memory.

#### 3. Picture Description

The picture description task included one colorful picture, which patients had to notice carefully and then describe what they have seen. This task assessed spontaneous speech and, at the same time, the ability to produce the suitable words in order to describe the picture they saw. The more sentences produced the more score achieved. Thus, spontaneous speech (speech production), vocabulary, perception, semantics and narrative ability were assessed. In this task must be referred ten objects/subjects in the form of sentences, as the main information of the picture.

#### 4. Sequencing Cards

The researcher gave cards to the patients with a no normal sequence. They were asked to put the cards in the correct sequence creating a story and then to narrate it. This exercise evaluated critical thinking, perception and narrative skills.

#### 5. Vocabulary Cards

The last task was categorization of cards. The patients received ten cards. Then they had to categorize all the cards according to their group (animals or fruits). In this task we assessed the skill of categorization in order to evaluate the vocabulary, semantics and critical thinking of patients.

Both in the first assessment and in the second one, were used exactly the same tools and that is why the aim of this method was to evaluate the same individuals in the same tasks to find out whether the absence of social interaction and participation in interventions and activities have affected the specific skills which were tested.

**Results**

The results of this study provide us the suitable information about the speech production and verbal skills of patients with MCI and Dementia. According to the statistical analysis and the graphs, we can understand the impact of four-month period of lockdown in their speech performance.

Statistical analysis has been done by SPSS program (IBM, 2016 version 24.0) for the validity of the results. Even the sample was not a great number, the researcher preferred to analyze data in the more scientific way. For the raw scores we used Excel in order to organize our data and have a first option of the results.

In table 1, we have named patients as a sample, according to their disease. In the first list of Boston Naming Task we can see the results of the first assessment, while in the second one we can see the decline of the naming skills which was presented during the second assessment after lockdown.

(Table 1)

Patients	Boston Naming Task 1	Boston Naming Task 2
MCI 1	49/60	44/60
MCI 2	57/60	54/60
MCI 3	52/60	47/60
MCI 4	52/60	47/60
D1	35/60	30/60
D2	52/60	49/60
D3	10/60	8/60
D4	15/60	8/60
D5	10/60	5/60

What we can conclude according to the raw scores, is that the score of all patients have been declined. Obviously, MCI patients were scored at higher level than dementia patients. Moreover, MCI patients scored lower in the second assessment, but the score difference was not so big than the difference in scores of dementia patients.

		Paired Differences				t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper			
Pair 1	Boston Naming 1 - Boston Naming 2	7,50000%	1,66667%	0,83333%	4,84796% 10,15204%	9,000	3	,003

(Fig.1)

The p- value is less than 0.05 so we can conclude that there is a statistically significant difference between the scores in Boston Naming Test 1 and Boston Naming Test 2 among MCI patients.

**Paired Samples Test**

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Boston Naming 1 - Boston Naming 2	7,33333%	3,24893%	1,45297%	3,29925%	11,36741%	5,047	4	,007

(Fig. 2)

The p- value is less than 0.05 so we can conclude that there is a statistically significant difference between the scores in Boston Naming Test 1 and Boston Naming Test 2 among Dementia patients. In Figure 3 there is the paired samples tests about the results of the task of Boston Naming Test in the first assessment and the results of the task of Boston Naming Test in the second assessment of all patients. Thus, patients have declined in the task of naming. Even though, MCI patients performed better than Dementia patients, there is a difference in their performance, too.

**Paired Samples Test**

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Boston Naming Test 1 - Boston Naming Test 2	.0703703704	.0200308404	.0066769468	.0549733034	.0857674373	10,539	8	<.001

(Fig. 3)

The p- value is less than 0.05 so we can conclude that there is a statistically significant difference between the scores in Boston Naming Test 1 and Boston Naming Test 2. Thus, the naming task (vocabulary, semantics) has been affected during the lockdown.

In table 2 we can see the raw scores of sequencing cards of all patients during the first and the second assessment.

Patients	Sequencing 1	Sequencing 2
MCI 1	3/4	2/4
MCI 2	2/4	2/4
MCI 3	2/4	2/4
MCI 4	3/4	3/4
D1	2/3	1/3
D2	2/3	1/3
D3	2/3	1/3
D4	1/3	1/3
D5	1/3	1/3

(Table 2)

**Paired Samples Test**

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Sequence 1 - Sequence 2	6,25000%	12,50000%	6,25000%	-13,64029%	26,14029%	1,000	3	,391

(Fig. 4)

The p- value is greater than 0.05 so we can conclude that there is no statistically significant difference between the scores in Sequence 1 and Sequence 2 among MCI patients.

**Paired Samples Test**

		Paired Differences				t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper			
Pair 1	Sequence 1 - Sequence 2	20,000000%	18,25742%	8,16497%	-2,66958% 42,66958%	2,449	4	,070

(Fig.5)

The p- value is greater than 0.05 so we can conclude that there is no statistically significant difference between the scores in Sequence 1 and Sequence 2 among Dementia patients.

Since MCI patients were in a higher level than dementia patients, they received four cards of sequencing instead of three cards which were received from dementia patients. The majority of patients with Dementia performed lower than in the first assessment. Noticeably, the performance of dementia patients has declined. Three of five dementia patients have lost their narrative ability and as a result, all dementia patients performed at the same level during the last assessment. All of them had name some objects of the cards during the first assessment but their score has been decreased significantly during the second assessment after the lockdown. Half of MCI patients remained at the same level, while other two patients have declined ¼ of their ability to put in sequence the cards and then to narrate the story.

In Figure 6 we can see the comparison between the score of sequencing cards in the first assessment and the score of the same task in the second assessment of all patients.

**Paired Samples Test**

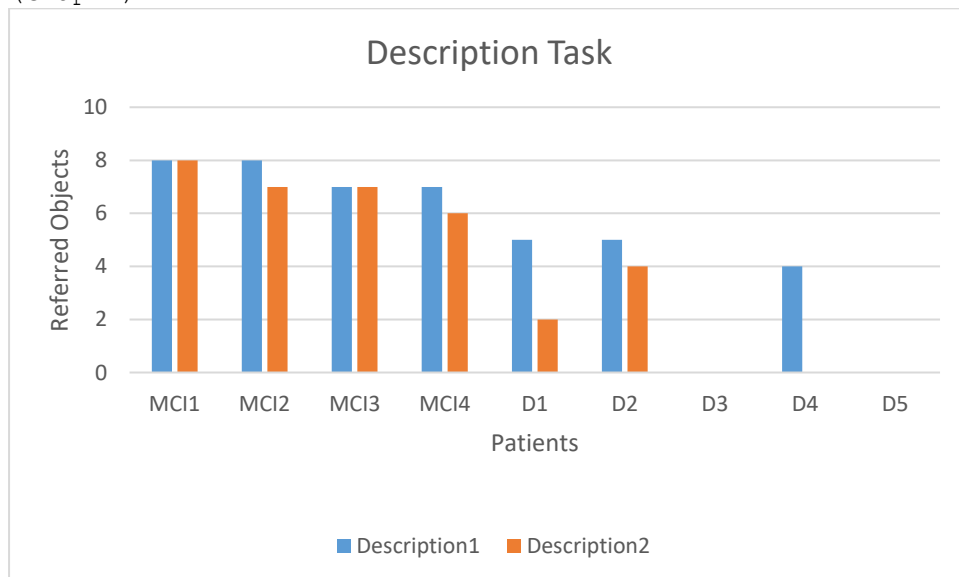
		Paired Differences				t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower Upper			
Pair 1	Sequence 1 - Sequence 2	.1388888889	.1666666667	.0555555556	.0107775480 .2670002297	2,500	8	,037

(Fig.6)

The p- value is less than 0.05 so we can conclude that there is a statistically significant difference between the scores in Sequence 1 and Sequence 2.

In the Graph 1 we can see the raw scores of the assessments. Patients were asked to describe a picture and they had to refer some objects in their sentences in order to describe the picture.

(Graph1)



In the picture description task there was no significant difference between the first and the second assessment. Moreover, the whole performance of the patients seems to be at the same level, except from three dementia patients who performed in a lower level during the second assessment. As a result, they have lost the skill of description and they did not describe any item of the picture at all. In Graph 1 we can see the performance of patients in both assessments. All patients have described more or less, but there were patients who were not able to describe nothing. That is why, there is absent the bar chart of some dementia patients. The sample of speech of MCI patients was in a greater vocabulary level as it is obvious from the graph. For example, one patient produces these sentences at the beginning of her description: "There are **children** in the **park**. Children **are playing** and some **people walk**." These sentences include four of ten objects which must be referred. In contrast, dementia patients who produced a few sentences referred only four to five objects in this task of the first assessment and two to four objects in the second one. For example one dementia patient said: "There are **children**... Are they children? What are they doing? **Balloons**..." This speech sample claims insecurity of speech production and word usage. It is clear that this task was not completed by all patients, while three of them were not able to produce speech in the form of a sentence. The description of MCI patients was declined in a small score in comparison with their first score, or remained at the same level. Paired sample tests of MCI and Dementia patients proved the results above.

**Paired Samples Test**

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Description 1 - Description 2	5,00000%	5,77350%	2,88675%	-4,18693%	14,18693%	1,732	3	,182

(Fig. 7)

The p- value is greater than 0.05 so we can conclude that there is no statistically significant difference between the scores in Description 1 and Description 2 among MCI patients.

**Paired Samples Test**

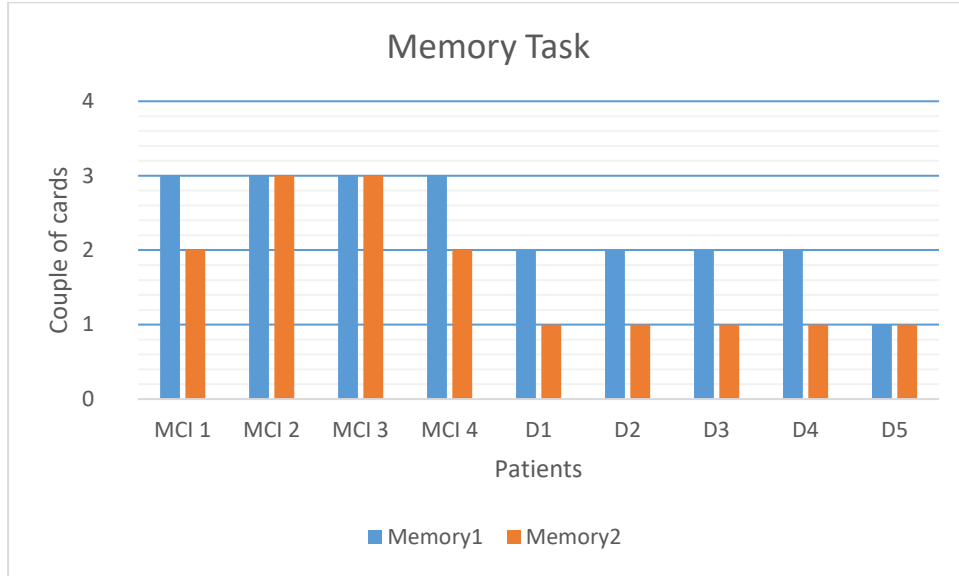
		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Description 1 - Description 2	16,00000%	18,16590%	8,12404%	-6,55595%	38,55595%	1,969	4	,120

(Fig. 8)

The p- value is greater than 0.05 so we can conclude that there is no statistically significant difference between the scores in Description 1 and Description 2 among Dementia patients.

Almost all patients had a lower score in memory skills. Furthermore, in Graph 2 we can see detailed information about the tasks of Memory and to get a clear picture of the results and the difference between the scores. Graph 2 is based on the raw scores, while it is presented how many cards patients achieved to remember. They had maximum four couples of cards. MCI patients almost remained stable at their memory skills, instead of two patients who dropped slightly. Dementia patients had a great difference between their first scores and their last ones.

(Graph 2)



The p- value is less than 0.05 so we can conclude that there is a statistically significant difference between the scores in Memory 1 and Memory 2 of all patients. The results of the comparison between Memory 1 and Memory 2 assessment are shown in figure 9.

Pair 1	Memory 1 - Memory 2	Paired Differences			95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
		,16667	,12500	,04167	,07058	,26275	4,000	8	,004

(Fig.9)

MCI patients have no significant difference between their first and second assessment and it is shown in figure10.

Pair 1	Memory Task 1 - Memory Task 2	Paired Differences			95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
		12,50000%	14,43376%	7,21688%	-10,46733%	35,46733%	1,732	3	,182

(Fig.10)

The p- value is greater than 0.05 so we can conclude that there is no statistically significant difference between the scores in Memory Task 1 and Memory Task 2 among MCI patients.

Pair 1	Memory Task 1 - Memory Task 2	Paired Differences			95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
		20,00000%	11,18034%	5,00000%	6,11777%	33,88223%	4,000	4	,016

(Fig. 11)

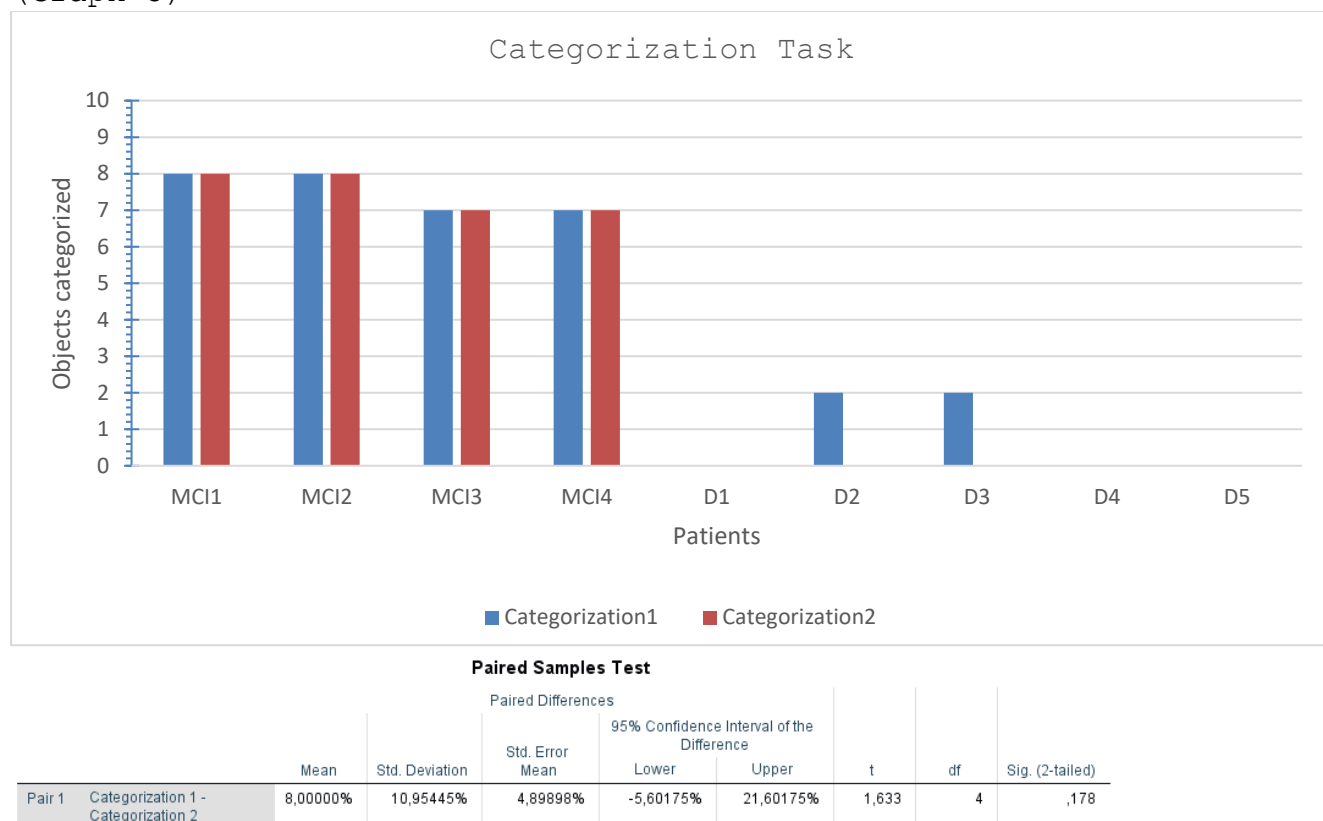
The p- value is less than 0.05 so we can conclude that there is a statistically significant difference between the scores in Memory Task 1 and Memory Task 2 among Dementia patients.

Categorization was the last task. During the first assessment four dementia patients were not able to categorize correctly. Now it is obvious that the number of patients who have not



succeeded in this task were five patients. All of them are patients with dementia. As a result; it is shown that Dementia is the group of patients with the lower performance and they have lost their ability to categorize objects according to their group. That is why, bar charts are absent while they did not categorize any card. It is shown, that all MCI patients completed the task with a higher score than dementia patients. Additionally, we assessed if both groups of patients were able to categorize the vocabulary cards and then to investigate the difference in their scores. In Graph 3 there are information about the scores in the first and the second assessment.

(Graph 3)



(Fig.12)

In figure 12 we can see that there is no significant difference among Dementia patients in the scores of the first and second assessment, while the p-value is greater than 0.05. The scores of MCI patients remained the same, so it was not necessary to be analyzed.

What we can conclude through the results, is that the MCI patients have maintained their skills in a great level but they have been affected in naming task (vocabulary, semantics) and slightly (with no significant difference) in sequencing cards (narrative ability- spontaneous speech). On the other hand, patients with Dementia have been declined in all their skills; based on the tasks of memory, naming, categorization, description and sequencing cards.

## Discussion

In this study we aimed to investigate the effects of Covid-19 lockdown in speech skills of patients with MCI and Dementia. However, there are many recent studies about the impact of pandemic in neurological disorders and older people (Simonetti et al., 2020) there is a gap in research about how these patients have declined in speech skills due to the lockdown. It is known that patients with MCI and dementia have to face their difficulties not only in cognitive functions, but also in their communication. The goal of dementia care is the wellbeing and this includes individualized interventions (Livingston et al., 2020).

This is the first study to report information on speech of patients with Dementia and MCI under Covid-19 lockdown. Some limitations should be considered. Moreover, the number of participants in this study are limited due to the fear of the patient to visit the Alzheimer Disease Associations day centers, because of the measures which were taken for the restriction of coronavirus spread. The tasks which have been used are in their majority are part of a speech therapy assessment. In further investigation we could analyze the length and frequency of speech production and the time which is given to respond. Speech production is a complex task with many factors that could be analyzed and give us information about the communicational skills of the patients. This study is the first step of the investigation of speech production in patients with memory problems during Covid-19 lockdown. The aim was to make clear and well-known the importance of speech production and interventions in patients with this kind of problems, if we are willing to maintain their quality of life. There is no life quality without communication and self-expression.

During this pandemic, the most disadvantaged are older people (Simonetti et al., 2020, Alzheimer Europe, 2020). Worsening agitation, apathy and aberrant motor activity in patients with AD and MCI have been referred (Lara et al., 2020, Simonetti et al., 2020). Dementia is known to be a risk factor for mortality among older people, but there are no studies confirming dementia as a risk factor for mortality in infected patients by Covid-19 (Di Gennaro et al., 2020, Enfermedad por Nuevo coronavirus, COVID-19, 2020) Some patients need to be treated at home with caregivers isolated, because of the lockdown measures and by limitation of home services (D' Adamo et al., 2019, Morandi et al., 2019, Bianchetti et al. 2020), but no significant changes in life quality have been reported (Goodman-Casanova, 2020, Brown et al., 2020). There are no previous studies about patients with memory problems and their speech production before and after the pandemic and that makes clear the importance of further investigation (Ho et al., 2020, Wang et al., 2020, Alzheimer's Disease International, 2020, Enfermedad por Nuevo coronavirus, 2020). Speech therapy is not the vital care that patients with neurological problems and memory deficits receive in order to survive, but the importance of speech therapy may influence the psychological impact of these patients. All the services should be changed or synchronized to the needs that Covid-19 generates (Legido-Quigley et al., 2020). Since the profound effect on people with cognitive problems, their treatment must be the utmost priority (Matias-Guiu et al., 2020, Kuo et al., 2020).

Self-isolation may contribute to generate feelings like loneliness and disruptions (Armitage and Nellums, 2020, Wang et al., 2020). Patients with cognitive disturbances are in urgent need of special support during such critical events (Lucero et al., 2019). During this pandemic it was noticed worsening of cognitive symptoms and functional decline, while at the same time caregivers claimed higher

levels of stress and exhaustion (De Leo and Trabucchi, 2020, Canavelli et al., 2020). As it is shown from our results, self-isolation had a negative effect in the skills of speech of patients with cognitive deficits. It is clear that not only all health professionals noticed the changes of their patients in many factors, but also caregivers did. According to the claims of our patients, they have isolated themselves to be protected from infection of Covid-19. Simultaneously, they did not have any social contact and they have noticed that their speech production has been reduced. They claimed that they tried to find the correct word to produce a sentence, but they faced difficulties that they have not before the lockdown. Caregivers said that patients seem to be insecure, or closed to themselves without willing to communicate. Thus, since they have stopped speech therapy and isolated themselves they declined in speech skills.

It is declared that people with MCI and mild dementia will face the greatest challenges during this breakout, while more than half of infected patients were over sixty years old (WHO, 2020) (Fundacio Pasqual Maragall, 2020), with negative consequences such as social isolation and restriction of movement of daily life activities (Brooks et al., 2020, Di Gennaro et al., 2020). Speech therapy is a therapy that must be received without breaks, even if it is possible via virtual connection. This study could motivate health professionals worldwide to continue their work by distance and safety.

As it is known, currently there is no cure for Dementia, AD or MCI. Identifying the symptoms of MCI and applying suitable supporting therapy in a systematic way can postpone the progress of MCI to AD. This underlines the significance of intervention since the progression of MCI could be delayed and the cognitive skills to be maintained (Zucchella et al., 2018). It is of utmost importance to develop reliable diagnostic measurements and provide further individualized therapies. We can identify objective measures for diagnose of MCI through speech (Themistocleous et al., 2018, Themistocleous et al., 2020). Language impairment is a common symptom in Dementia and MCI, with effects in various language domains and functions such as phonology (Sajjadi et al., 2012), phonetics (Lundholm et al., 2018 and Themistocleous et al., 2018), morphosyntactic structure (syntax, length of utterances, proportions), semantics (Braaten et al., 2006, Kemper et al., 1993), discourse and conversation (Sajjadi et al., 2012, Lira et al., 2014, Chapman et al., 1995). Moreover, slow recall of words has a negative effect in speech fluency and it is a common symptom both in MCI and Dementia. These domains and functions are the main goals of speech therapy to be remained stable or to be enhanced.

MCI and Dementia patients must be further investigated since the way of their non-pharmacological management tent to be altered due to COVID-19 and its lockdown. We need to examine a greater sample and more domains - in order to conclude how speech production of patients with MCI and Dementia is influenced during the pandemic. Recent studies have referred important functions of human-being influenced by Covid-19 infection (Suzuki et al., 2020), but there is a great need to be analyzed the factor of speech and take into consideration all the above in order to prevent patients of negative effects in speech production and other cognitive skills. In this study, we conclude that the effects of lockdown were mainly in speech production and vocabulary in MCI patients and all assessed skills of dementia patients were declined because of the absence of speech therapy as intervention. This have been referred, also, from the patients and their environment who has noticed the difference in their communication and expression of verbal skills.

## Acknowledgements

We thank all participants for their effort and willing to participate in the speech therapy interventions and this study. We also thank the Greek Association of Alzheimer Disease for the permission to carry out our study in the place of this association in Thessaloniki.

## References

- Ahn, D.G., Shin H.J, Kim, M.H., Lee, S., Kim, H.S., Myoung, J., Kim, B.T., Kim, S.J. (2020). Current Status of Epidemiology, Diagnosis, Therapeutics, and Vaccines for Novel Coronavirus Disease 2019 (COVID-19). *J. Microbiol. Biotechnol.*30:3, 313-324. <https://doi.org/10.4014/jmb.2003.03011>
- Alzheimer Europe. Living with dementia: COVID-19 URL: <https://www.alzheimer-europe.org/Living-with-dementia/COVID-19> [Accessed May 14, 2020].
- Armitage, R. and Nellums, L.B. (2020). COVID-19 and the consequences of isolating the elderly. *The Lancet. Public Health.* 5:5, 256. DOI: 10.1016/s2468-2667(20)30061-x.
- Bianchetti, A., Rozzini, R., Guerini, F., Boffelli, S. (2020). Clinical Presentation of COVID19 in Dementia Patients. *J Nutr. Health Aging* 24, 560-562. <https://doi.org/10.1007/s12603-020-1389-1>
- Bianchetti, A., Bellelli, G., Guerini, F., Marengoni, A., Padovani, A., Rozzini, R. and Trabucchi M. (2020). Improving the care of older patients during the COVID-19 pandemic. *Aging Clin. Exp. Res.* 32, 1883-1888. <https://doi.org/10.1007/s40520-020-01641-w>
- Braaten, A.J, Parsons, T.D., McCue, R., Sellers, A., Burns, W.J. (2006). Neurocognitive Differential Diagnosis Of Dementing Diseases: Alzheimer's Dementia, Vascular Dementia, Frontotemporal Dementia, And Major Depressive Disorder. *International Journal of Neuroscience.* 116:11, 1271-93. <https://doi.org/10.1080/00207450600920928> PMID: 17000529
- Bidelman, G.M., Lowther, J.E., Tak, S.H., Alain, C. (2017). Mild Cognitive Impairment Is Characterized by Deficient Brainstem and Cortical Representations of Speech. *The Journal Of Neuroscience: The Official Journal Of The Society For Neuroscience.* 37:13, 3610-20. <https://doi.org/10.1523/JNEUROSCI.3700-16.2017> PMID: 28270574.
- Brooks, S.K., Webster, R.K., Smith, L.E., Woodland, L., Wessely, S., Greenberg, N., Rubin, J. (2020). The psychological impact of quarantine and how to reduce it: rapid review of the evidence. *Lancet.* 395:10227, 912-920. doi: 10.1016/s0140-6736(20)30460-8
- Brown, E.E., Kumar, S., Rajji, T.K., Pollock, B.G., Mulsant, B.H. (2020). Anticipating and mitigating the impact of the 279 COVID-19 pandemic on Alzheimer's disease and related 280 dementias. *Am J Geriatr Psychiatry* 28, 712-721. <https://doi.org/10.1016/j.jagp.2020.04.010>
- Canevelli, M., Valletta, M., Toccaceli Blasi, M., Remoli, G., Sarti, G., Nuti, F., Sciancalepore, F., Ruberti, E., Cesari,

- M. and Bruno, G. (2020). Facing Dementia During the COVID-19 Outbreak. *J. Am. Geriatr. Soc.* 68, 1673-1676. <https://doi.org/10.1111/jgs.16644>
- Chan, K.Y., Adeloje, D., Asante, K.P., Calia, C., Campbell, H., Danso, S.O., Juvekar, S., Luz, S., Mohan, D., Muniz-Terrera, G., Nitrini, R., Noroozian, M., Nulkar, A., Nyame, S., Paralikar, V., Parra Rodriguez, M.A., Poon, A.N., Reidpath, D.D., Rudan, I., Stephan, B.C., Su, T., Wang, H., Watermeyer, T., Wilkinson, H., Yassuda, M.S., Yu, X., Ritchie, C. (2019). Global Dementia Prevention Program (GloDePP). Tackling dementia globally: the Global Dementia Prevention Program (GloDePP) collaboration. *J. Glob. Health.* 9:2, e020103. doi:10.7189/jogh.09.020103. PMID: 31893025; PMCID: PMC6925964.
- Chapman SB, Ulatowska HK, King K, Johnson JK, McIntire DD. Discourse in early Alzheimer's disease versus normal advanced aging. *American Journal of Speech-Language Pathology.* 1995; 4:4, 124-129.
- Goodman-Casanova JM, Dura-Perez E, Guzman-Parra J, Cuesta-Vargas A, Mayoral-Cleries F. Telehealth Home Support During COVID-19 Confinement for Community-Dwelling Older Adults With Mild Cognitive Impairment or Mild Dementia: Survey Study *J Med Internet Res* 2020;22:5, e19434 <https://www.jmir.org/2020/5/e19434> DOI: 10.2196/19434
- D'Adamo, H., Yoshikawa, T. (2020). Ouslander JG. Coronavirus Disease 2019 in Geriatrics and Long-term Care: The ABCDs of COVID-19. *JAGS* 68:5, 912-917. doi: 10.1111/jgs.16445
- De Leo, D., and Trabucchi, M. (2020). The fight against COVID-19: A report from the Italian trenches. *International Psychogeriatrics*, 32:10, 1161-1164. doi:10.1017/S1041610220000630
- Di Gennaro, F., Pizzol, D., Marotta, C., Antunes, M., Racalbutto, V., Veronese, N., Smith, L. (2020). Coronavirus Diseases (COVID-19) Current Status and Future Perspectives: A Narrative Review. *Int. J. Environ. Res. Public Health.* 17:8, 2690.
- Ho, C.S., Chee, C.Y., Ho, R.C. (2020). Mental health strategies to combat the psychological impact of COVID-19 beyond paranoia and panic. *Ann. Acad. Med. Singapore.* 49, 155-160.
- Gale, S.A., Acar, D., Daffner, K.R. (2018) Dementia. *Am. J. Med.* 131:10, 1161-1169. doi: 10.1016/j.amjmed.2018.01.022
- Kemper, S., LaBarge, E., Ferraro, F.R., Cheung, H., Cheung, H., Storandt, M. (1993). On the Preservation of Syntax in Alzheimer's Disease: Evidence From Written Sentences. *Archives of Neurology.* 50:1, 81-6. <https://doi.org/10.1001/archneur.1993.00540010075021> PMID: 8418805
- Kuo, C.L., Pilling, L.C., Atkins, J.L., Masoli, J.A.H., Delgado, J., Kuchel, G.A., Melzer, D. (2020). ApoE e4e4 Genotype and 289 Mortality With COVID-19 in UK Biobank. *J. Gerontol. A* 290 *Biol. Sci. Med. Sci.* 75, 1801-1803.
- Matias-Guiu, J., Porta-Etessam, J., Lopez-Valdes, E., Garcia-Morales, I., Guerrero-Sola, A., Matias-Guiu, J.A. (2020). Management of neurological care during the COVID-19

- pandemic. *Neurologia*. 35:4, 233-237. doi: 10.1016/j.nrl.2020.04.001
- IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. Armonk, NY: IBM Corp. <https://www-01.ibm.com/support/docview.wss?uid=swg21476197>
- Lara, B., Carnes, A., Dakterzada, F., Benitez, I. and Piñol-Ripoll, G. (2020). Neuropsychiatric symptoms and quality of life in Spanish patients with Alzheimer's disease during the COVID-19 lockdown. *Eur. J. Neurol.*, 27: 1744-1747. doi:10.1111/ene.14339
- Legido-Quigley, H., Mateos-García, J.T., Campos, V.R., Gea-Sánchez, M., Muntaner, C., McKee, M. (2020). The resilience of the Spanish health system against the COVID-19 pandemic. *Lancet Public Health*. 5:5, 251-252. doi: 10.1016/s2468-2667(20)30060-8
- Lira J Od Minett T.S.C., Bertolucci, P.H.F., Ortiz, K.Z. (2014). Analysis of word number and content in discourse of patients with mild to moderate Alzheimer's disease. *Dementia & neuropsychologia*. 8:3, 260-5.
- Livingston, G., Huntley, J., Sommerlad, A., Ames, D., Ballard, C., Banerjee, S., Brayne, C., Burns, A., Cohen-Mansfield, J., Cooper, C., Costafreda, S. G., Dias, A., Fox, N., Gitlin, L. N., Howard, R., Kales, H. C., Kivimäki, M., Larson, E. B., Ogunniyi, A., Orgeta, V., Mukadam, N. (2020). Dementia prevention, intervention, and care: 2020 report of the Lancet Commission. *Lancet*. 396:10248, 413-446. [https://doi.org/10.1016/S0140-6736\(20\)30367-6](https://doi.org/10.1016/S0140-6736(20)30367-6)
- Lucero, R.J., Fehlberg, E.A., Patel, A.G.M., Ragnhildur P.I., Bjarnardottira, R.W., KarisLeod M.A., BakkenfJose, A.S, Mittelmanh, L.M. (2020). The effects of information and communication technologies on informal caregivers of persons living with dementia: A systematic review. *Alzheimer's & Dementia: Translational Research & Clinical Interventions*. 5, 1-12. Doi: 10.1016/j.trci.2018.11.003
- Lundholm F.K., Fraser, K.C., Themistocleous, C., Kokkinakis, D. (2018) Prosodic features as potential markers of linguistic and cognitive deterioration in Mild Cognitive Impairment. *Alzheimer's & Dementia*. 14: 7, 1195-1196. <https://doi.org/10.1016/j.jalz.2018.06.1658>.
- Morandi, A., Di Santo, S.G., Zambon, A., Mazzone, A., Cherubini, A., Mossello, E., Bo, M., Marengoni, A., Bianchetti, A., Cappa, S., Fimognari, F., Incalzi, R.A., Gareri, P., Perticone, F., Campanini, M. Penco, I., Montorsi, M., Di Bari, M., Trabucchi, M., Bellelli, G. (2019). Italian Study Group on Delirium (ISGoD), Delirium, Dementia, and In-Hospital Mortality: The Results From the Italian Delirium Day 2016, A National Multicenter Study, *The Journals of Gerontology: Series A*. 74:6, 910-916. <https://doi.org/10.1093/gerona/gly154>
- Patterson, C. (2018). *World Alzheimer Report 2018: The State of the Art of Dementia Research: New Frontiers*. London, UK: Alzheimer's Disease International (ADI).
- Sajjadi, S.A., Patterson, K., Tomek, M., Nestor, P.J. (2012). Abnormalities of connected speech in semantic dementia vs Alzheimer's disease. *Aphasiology*. 26:6, 847-66.

- <https://doi.org/10.1080/02687038.2012.654933>  
WOS:000304530100006.
- Suzuki, M., Hotta, M., Nagase, N., Yamamoto, Y., Hirakawa, N., Satake, Y., Nagata, Y., Suehiro, T., Kanemoto, H., Yoshiyama, K., Mori, E., Hashimoto, M., Ikeda, M. (2020). The behavioral pattern of patients with frontotemporal dementia during the COVID-19 pandemic. *Int. Psychogeriatr.* 32:10, 1231-1234. doi:10.1017/286.S104161022000109X.287
- Themistocleous, C., Kokkinakis, D., Marie, E., Kathleen, F., Lundholm, K. F. (2018). Effects of Cognitive Impairment on vowel duration. *Proceedings of the 9th Tutorial & Research Workshop on Experimental Linguistics*. Paris, France. 113-6.
- Themistocleous, C., Eckerström, M., Kokkinakis, D. (2020). Voice quality and speech fluency distinguish individuals with Mild Cognitive Impairment from Healthy Controls. *PLoS ONE* 15:7. <https://doi.org/10.1371/journal.pone.0236009>
- World Health Organization. (2020). Director-General's Opening Remarks at the Media Briefing on COVID-19 <https://www.who.int/dg/speeches/detail/who-director-general-s-openingremarks-at-the-media-briefing-on-covid-19--11-march-2020> [Accessed March 11, 2020].
- World Health Organization. (2020). Mental health and psychosocial considerations during the COVID-19 outbreak URL:<https://www.who.int/publications-detail/WHO-2019-nCoV-MentalHealth-2020.1> [Accessed May 14, 2020].
- WHO Novel Coronavirus (2019-nCoV) SITUATION REPORT. (2020). [https://www.who.int/docs/default-source/coronaviruse/situationreports/20200121-sitrep-1-2019-ncov.pdf?sfvrsn=20a99c10\\_4](https://www.who.int/docs/default-source/coronaviruse/situationreports/20200121-sitrep-1-2019-ncov.pdf?sfvrsn=20a99c10_4). [Accessed February 28, 2020].
- WHO Coronavirus disease 2019 (COVID-19) Situation Report (2020). [https://www.who.int/docs/default-source/coronaviruse/situationreports/20200215-sitrep-26-covid-19.pdf?sfvrsn=a4cc6787\\_2](https://www.who.int/docs/default-source/coronaviruse/situationreports/20200215-sitrep-26-covid-19.pdf?sfvrsn=a4cc6787_2). [Accessed March 2, 2020].
- World Health Organization. (2020). Mental health and psychosocial considerations during the COVID-19 outbreak. <https://www.who.int/publications-detail/WHO-2019-nCoV-MentalHealth-2020.1> [Accessed May 14, 2020].
- Wang, H., Li, T., Barbarino, P., et al. Dementia care during COVID-19. *Lancet* 2020; 395: 1190-1191. [https://blog.fpmaragall.org/ca?\\_ga=2.87820506](https://blog.fpmaragall.org/ca?_ga=2.87820506).
- Informe sobre la situación de COVID-19 en personal sanitario en España. (2020). Government of Spain <https://www.lamoncloa.gob.es/serviciosdeprensa/notasprensa/sanidad14/Documents/2020/060520-Informe%20sobre%20la%20situaci%C3%B3n%20de%20COVID-19%20en%20personal%20sanitario.pdf> [Accessed May 14, 2020].
- Zucchella C, Sinforiani E, Tamburin S, Federico A, Mantovani E, Bernini S, et al. The Multidisciplinary Approach to Alzheimer's Disease and Dementia. A Narrative Review of Non-Pharmacological Treatment. *Frontiers in Neurology*. 2018; 9:1058. <https://doi.org/10.3389/fneur.2018.01058>
- Alzheimer Disease International. (2020). <https://www.alz.co.uk/news/adi-offers-advice-and-support-during-covid-19> [Accessed May 8, 2020].

Fundacio Pasqual maragall. (2020).

<https://blog.fpmaragall.org/ca? ga=2.87820506.394158172.1588929167-492552293.1588929167> [Accessed May 8, 2020].

Alzheimer's Disease International. (2020).

<https://www.alz.co.uk/news/adi-offers-advice-and-support-during-covid-19> [Accessed May 8, 2020].

Enfermedad por nuevo coronavirus, COVID-19

<https://www.mscbs.gob.es/profesionales/saludPublica/ccayes/alertasActual/nCov-China/home.htm> (accessed 25/ 04/2020)