ISSN: 3066-716X
Research Article
Journal of Clinical and Biomedical Advances

Internet-based Program "Symparastasi": Psychoeducational and Multi-component Education for the Caregivers of Patients with Mild Dementia: A Pilot Study

Tatiana-Danai Dimitriou*, and Evangelia Zacharia

International Hellenic University

***Corresponding author:** Tatiana-Danai Dimitriou, International Hellenic University.

Submitted: 01 July 2024 **Accepted:** 09 July 2024 **Published:** 15 July 2024

https://doi.org/10.63620/MKJCBA.2024.1030

Citation: *Tatiana-Danai, D., & Zacharia, E. (2024). Internet- Based Program "Symparastasi": Psychoeducational and Multicomponent Education for The Caregivers of Patients with Mild Dementia: A Pilot Study. J of Clin Bio Med Adv, 3(4), 01-20.*

Abstract

Dementia is characterized by a decline in cognitive functions and includes diseases such as Alzheimer's disease (AD), cardiovascular dementia (CvD), Lewy body Dementia (DLB), Parkinson's dementia (PDD), and Frontotemporal Dementia (FTD). The study focused on an Internet-based program called "Symparastasi," which provided psychoeducational and multicomponent education for caregivers of patients with mild dementia. The study aimed to decrease Behavioral and Psychological Symptoms in Dementia (BPSD) and improve the quality of life for both patients and their caregivers. The program included 24 weeks of online sessions with specialists and collaboration with a fitness specialist. The results indicated that the combination of psychoeducation and multicomponent exercise effectively decreased BPSD and improved the quality of life. However, the study had a small sample size and further research with larger samples is needed.

Keywords: Dementia, Alzheimer's Disease, Psychoeducation, Multicomponent Exercise, Caregivers, Behavioral and Psychological Symptoms in Dementia (BPSD), Internet-based Program, Quality of Life.

Abbreviations

- **ACE-R:** Addenbrooke's Cognitive Examination (Revised)
- **AD:** Alzheimer's Disease
- **BDI:** Beck Depression Inventory
- **BPSD:** Behavioural and Psychological Symptoms in Dementia
- **CDR_SB:** Clinical Dementia Rating Scale
- **CVD:** Cardiovascular Dementia
- **DLB:** Lewy Body Dementia
- **FTD:** Frontotemporal Dementia
- **MCI:** Mild Cognitive Impairment
- **MMSE:** Mini Mental State Examination
- **NPI:** Neuropsychiatric Inventory
- **PDD:** Parkinson's Dementia
- **PwD:** Patients with Dementia
- **RCT:** Randomized Controlled Trial
- **STAI-S:** State Trait Anxiety Inventory
- **ZBI:** Zarit Burden Interview

Introduction

Dementia is an umbrella term which includes many reversible and non-reversible diseases and is characterized by decline in all cognitive functions [1]. There is clinical variability in etiology, patterns, progression and prognosis [2]. The most common disease that causes non-reversible dementia is Alzheimer's disease (AD) accounting for about 60-70% of all dementia cases, followed by cardiovascular dementia (CvD) with a prevalence of 20%, Lewy body Dementia (DLB), Parkinson's dementia (PDD) and Frontotemporal Dementia (FTD) [3]. Nowadays, there are 50 million cases around the world and this number is estimated to increase to 152 million patients by 2050 in low and middle-income countries (Alzheimer's Association, 2021). Dementia affects patients, their caregivers and the economy, as it costs about 1 trillion US dollars annually [4]. Therefore, it is a major health problem which affects families and societies and presents extensive challenges to healthcare systems [4].

As there is no cure for dementia nowadays, the interest is detected in early stages of dementia, or even in mild cognitive impairment (MCI). Petersen et al [5]. defined MCI as a clinical and neuropsychological syndrome, which is characterized by cognitive decline and it is an intermediate state between normally ageing and dementia. MCI patients have declines in their cognitive abilities but these declines are not severe enough and therefore the patients can normally function in their daily lives [6]. On the other hand, the stage of mild dementia is characterized by cognitive declines and impairments in daily functions, though the patient has still some good skills and cognitive abilities in order to perform quiet well in his/ her daily life.

Along with cognitive and functional decline, almost the 90% of the Patients with Dementia (PwD) also experience behavioural and psychological symptoms of dementia (BPSD) [7]. These symptoms have been categorized in 12 BPSD, by Cummings (1994) and are the following: delusions, hallucinations, agitation, depression, anxiety, euphoria, apathy, disinhibition, irritability, wandering, sleeping disorders and eating problems. BPSD have a profound effect on PwD and their caregivers, as well. BPSD affect cognitive decline, lead to disease progression, reduce independence and inability to function normally in daily life [8]. Several times are the reason of early hospitalization and they increase caregivers' burden [9]. BPSD are among the earliest signs of neurodegenerative diseases, they affect most of the PwD and their severity increases over the course of the disease [10].

Currently the use of pharmacological treatments for the BPSD and cognitive decline has shown severe side effects such as muscle pain, sleep problems, diarrhoea, vomiting, fatigue, headaches, loss of appetite, itching, falls etc [11]. Therefore, current evidence has demonstrated the effectiveness of non-pharmacological interventions, which show no side-effects and have positive results [12]. Global action plan on the public health highlights the potential benefit from non- pharmacological interventions, which are cost-effective, sustainable, and pleasurable, for both PwD and their caregivers [3]. A wide-range of technology-based non- pharmacological interventions has been introduced, lately [7]. At the same time, traditional interventions have also a huge impact on the management of cognitive decline and BPSD. Non-pharmacological interventions can be categorized into cognitive interventions (such as reminiscence therapy, validity therapy, orientation etc.), sensory interventions (aromatherapy, massage, music therapy, art therapy, snoezelen environment etc.), behavioural interventions (communication, daily living, social interaction, nutrition etc.), educational interventions (psychopeducational classes for the caregivers) and other interventions (physical exercise) [7].

During the covid-19 pandemic PwD have experienced a greater burden than the healthy population. The pandemic exacerbated patients' vulnerability and the lockdowns have made the social support and medical systems difficult to access [13]. Therefore, dementia caregivers during the pandemic had to manage their patients all by themselves. This had a tremendous impact on their psychology because they were fully responsible for their patients. It seemed that there was a need for online professional support [14].

Therefore, the aim of the current pilot study is to evaluate two non-pharmacological interventions and its combination (psychoeducation and multicomponent exercise) in terms of: a) which intervention can effectively increase cognitive abilities in patients with MCI and mild dementia, b) which intervention can effectively reduce BPSD in those patients, and c) which intervention can effectively enhance quality of life in PwD and their caregivers.

Methods

Subjects

The study included patients with Alzheimer's disease and other related dementias, who are on MCI stage or have Mild Dementia. Their caregivers were also included. The study included 90 participants and their caregivers from all over Greece. Patients and caregivers have given written consent and the study kept full anonymity of their personal data.

Interventions

The programme "Symparastasi" was created in order to give the opportunity to the PwD and their caregivers to have access to professional care, despite the lockdown. Later, as the lockdowns were not the case anymore, "Symparastasi" programme aimed to help PwD and their caregivers who lived in cities with no access to medical systems or they could not afford a third age center to receive professional support. "Symparastasi" is an online programme which addresses to patients with mild dementia and their caregivers. The programme offers two non-pharmacological interventions: a) psychoeducation to the caregivers and methods and techniques in order to apply several non-pharmacological interventions to their patients (such as music therapy, aromatherapy and massage, art therapy, orientation therapy, validation therapy etc.) and b) physical exercise programme, which consists of multicomponent exercise (strength, balance, endurance and flexibility). The programme is only available online and it is completely free. It consists of 11 online courses on psychoeducation and 11 online courses on multicomponent exercise. In those sessions the neuroscientist educates the caregivers on dementia and gives instructions on how to perform the non-pharmacological interventions. On the other hand, the fitness specialist performs the exercises and explains the right techniques in order to perform them safely. The duration of each video estimates in about 10-15 minutes. Each psychoeducation video has two parts: one part consists of the theoretical background that the caregivers need to know (such as which are the BPSD) and the other part is practical (such as how to perform the music therapy: exactly what kind of music, how much time, how many times in a week etc.). Each fitness video consists of three parts: warm-up, the main exercises and cool down. The caregivers had the opportunity at any time of the programme to contact with the specialists via telephone, email or video call. The 12th session was a personal session of the caregiver with the neuroscientist or/ and the fitness specialist in order to have the opportunity to ask questions and be supported individually. The participants were randomly assigned into 3 groups. Group A received only multicomponent exercise, group B received only psychoeducation and group C received both.

The aim of the psychoeducational programme is to educate the caregivers in several aspects of dementia, such as; a) what is dementia, b) its' prognosis, c) daily activities, d) other non-phar-

macological interventions and their implementation, e) psychological support of the caregivers and f) effective non-pharmacological ways in order to communicate with the patient. On the other hand, the aim of the multicomponent exercise programme is to educate the caregivers on the multicomponent physical exercise in order for them to be able to perform those exercises to their patients safely and effectively. Therefore, programme "Symparastasi" aims to educate the caregivers in non-pharmacological techniques in order for the caregivers to be able to perform them in their patients safely. It is critical to mention that programme "Symparastasi" did not aim to replace the professional specialists, but aims to help the informal caregivers in order to perform non-pharmacological interventions to their patients safely and effectively.

Inclusion Criteria

The inclusion criteria were: subjects who have received a diagnosis of MCI or mild dementia (Mini Mental State Examination MMSE cut off point 23/30) who do not receive any other non-pharmacological intervention from anyone else. Moreover, it was necessary for the caregivers to have access to the internet. The patients should not have mobility problems in order to be able to perform the physical exercises, unless some of them who suffered from a few injuries and so they automatically assigned into group B (only received psychoeduction).

Measures

The measurements used were the following: a) for the cognitive abilities: Mini Mental State Examination (MMSE), and Addenbrooke's Revised Cognitive Examination (ACE-R), b) for activities of the daily living: Clinical Dementia Rating–Sum of Boxes (CDR_SB), and c) for the BPSD: Neuropsychiatric Inventory (NPI). For the caregivers: a) anxiety level: State Trait Anxiety Inventory (STAI-S), b) depression level: Beck Depression Inventory (BDI), c) caregivers' burden: NPI and Zarit Burden Interview (ZBI). At the same time, before the beginning of the research the fitness specialist used the following measurements for the strength, balance, and functional evaluation: Senior Fitness Test (chair stand test), Berg Balance test and Timed up and Go Test, which seems to be suitable in assisting the diagnosis and identification of dementia stages. ACE-R is a questionnaire which examines all cognitive functions and includes MMSE. NPI is a questionnaire to the caregiver which assess the severity and frequency of an unwanted behaviour and the impact on the caregiver, as well. CDR_SB is a scale that measures the severity of dementia. STAI-S, BDI, and ZBI are all questionnaires that evaluate the anxiety and depression levels.

Results

Our sample was consisted of 90 PwD with their caregivers (N=90). 51 participants were females (56,67%). The mean age was 71.2 years old (SD 5.71) and the years of education was 9.41 (SD 4.36). The mean score of MMSE and ACE-R tests were 26.1 (SD 1.60) and 91.2 (SD 2.84) accordingly. Demographics and clinical characteristics of the sample are presented in Table 1. The study groups were similar in terms of age, education and sex. According to the results the mean score in MMSE in group A before exercise treatment was 25.9 (SD 1.62) and after 6 months of exercise was 26.4 (SD 1.40) and after 3 months by the end of the treatment was 26.7 (SD 1.40). Moreover, for group B the mean score of MMSE test before psychoeducation treatment was 26.3 (SD 1.54), after 6 months of psychoeducation was 26.8 (SD 1.30) and after 3 months was 26.8 (SD 1.32). For group C before the combination of exercise and psychoeducation was 26 (SD 1.67), after the treatment was 26.5 (SD 1.43) and after 3 months was 26.4 (SD 1.59). Analytical statistics of the comparisons are shown in table 2. MMSE had a statistically significant difference in T1 test of group A with T3 test of the same group ($p=0.024$) and in group C from T1 test to T2 test ($p=0.043$).

Group A which received only the multicomponent exercise programme after 6 months of the intervention did not report any statistically significant changes in ACE-R ($p=0.330$), which means that the cognitive abilities after 6 month of physical training they did not improve. Group B which received only the psychoeducation after 6 months of the intervention did not report any statistically significant changes in ACE-R, as well ($p=0.681$). No statistical significance was shown in group C as well. STAIS scale showed a statistically significant difference in all groups but the most statistically significant difference was mentioned in group C ($p<0.001$). CDR_SB scale showed improvements only in group C. BDI scale was also improved in all groups. MMSE showed statistically significant difference only between T1 test and T2 test in group A. ZBI scale showed improvements in all groups between T1 test and T2 test, but the most statistically significant changes were reported in group C. However, none of the groups maintained the good results in the follow up test. Lastly, NPI questionnaire showed improvements in all groups, but in group C there was the most statistically significant difference. NPI questionnaire for the caregivers showed improvements in all groups, but the only group C maintained the good results in the follow up test. Table 2 shows all the statistics results.

Descriptives of the sample

Descriptives	Group	Gender	Age	Years of education
N	90	90	90	90
Mean		1.57	71.2	9.41
Standard deviation		0.498	5.72	4.37

Descriptives MMSE

Descriptives	Group	MMSE	MMSE T2	MMSE T3
N	a	30	30	30
	b	30	30	30

[1]The jamovi project (2022) jamovi (Version 2.3) https://www.jamovi.org.

[2]Core Team R (2021) R: A Language and environment for statistical computing. (Version 4.1/) https://cran.r-project.org.

	c	30	30	30
Mean	a	25.9	26.4	26.7
	b	26.3	26.8	26.8
	c	26.0	26.5	26.4
Standard deviation	a	1.62	1.40	1.40
	b	1.54	1.30	1.32
	c	1.67	1.43	1.59

Repeated Measures ANOVA

Within Subjects Effects	SphericityCorrection	Sum of Squares	df	Mean Square	F	p	η^2G
Time period	None	15.20	2	7.600	15.266	<.001	0.026
	Huynh-Feldt	15.20	1.77	8.565	15.266	<.001	0.026
Time period * Group	None	1.51	4	0.378	0.759	0.553	0.003
	Huynh-Feldt	1.51	3.55	0.426	0.759	0.539	0.003
Residual	None	86.62	174	0.498			
	Huynh-Feldt	86.62	154.39	0.561			

Note. Type 3 Sums of Squares

Between Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η^2G
Group	6.02	2	3.01	0.540	0.585	0.010
Residual	484.94	87	5.57			

Note. Type 3 Sums of Squares

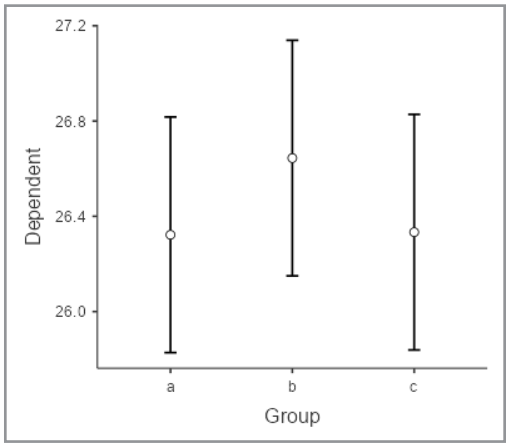
Post Hoc Tests

Post Hoc Comparisons - time period * Group

time period	Group		time period	Group	Mean Difference	SE	df	t	ptukey
T2	a	-	T3	c	-0.4000	0.213	87.0	-1.8770	0.631
		-	T2	b	-0.4333	0.356	87.0	-1.2178	0.950
		-	T2	c	-0.1667	0.356	87.0	-0.4684	1.000
		-	T3	a	-0.3000	0.174	87.0	-1.7244	0.730
		-	T3	b	-0.4333	0.364	87.0	-1.1900	0.957
	b	-	T3	c	-0.0667	0.364	87.0	-0.1831	1.000
		-	T2	c	0.2667	0.356	87.0	0.7494	0.998
		-	T3	a	0.1333	0.364	87.0	0.3662	1.000
		-	T3	b	-9.66e−15	0.174	87.0	-5.55e−14	1.000
	c	-	T3	c	0.3667	0.364	87.0	1.0070	0.984
		-	T3	a	-0.1333	0.364	87.0	-0.3662	1.000
		-	T3	b	-0.2667	0.364	87.0	-0.7323	0.998
T3		-	T3	c	0.1000	0.174	87.0	0.5748	1.000
	a	-	T3	b	-0.1333	0.372	87.0	-0.3582	1.000
		-	T3	c	0.2333	0.372	87.0	0.6268	0.999
	b	-	T3	c	0.3667	0.372	87.0	0.9850	0.986

[3]Singmann H (2018) afex: Analysis of Factorial Experiments. https://cran.r-project.org/package=afex.
[4]Lenth R (2020) emmeans: Estimated Marginal Means, aka Least-Squares Means. https://cran.r-project.org/package=emmeans.

Estimated Marginal Means
Group



Estimated Marginal Means - Group

		95% Confidence Interval		
Group	**Mean**	**SE**	**Lower**	**Upper**
a	26.3	0.249	25.8	26.8
b	26.6	0.249	26.1	27.1
c	26.3	0.249	25.8	26.8

Descriptives ACE
Descriptives

	Group	**ACE-R**	**ACE-R T2**	**ACE-R T3**
N	a	30	30	30
	b	30	30	30
	c	30	30	30
Mean	a	91.3	91.5	91.2
	b	91.7	92.1	92.1
	c	90.8	91.3	90.9
Standard deviation	a	3.29	3.44	3.79
	b	2.02	1.95	2.08
	c	3.07	2.73	2.76

Repeated Measures ANOVA
Within Subjects Effects

	Sphericity Correction	**Sum of Squares**	**df**	**Mean Square**	**F**	**p**	**η^2G**
Time period	None	5.07	2	2.533	3.928	0.021	0.002
	Huynh-Feldt	5.07	1.60	3.163	3.928	0.030	0.002
	None	2.04	4	0.511	0.792	0.532	0.001
time period *Group	Huynh-Feldt	2.04	3.20	0.638	0.792	0.507	0.001
Residual	None	112.22	174	0.645			
	Huynh-Feldt	112.22	139.36	0.805			

Note. Type 3 Sums of Squares

Between Subjects Effects

	Sum of Squares	**df**	**Mean Square**	**F**	**p**	**η^2G**
Group	44.1	2	22.0	0.946	0.392	0.020
Residual	2026.4	87	23.3			

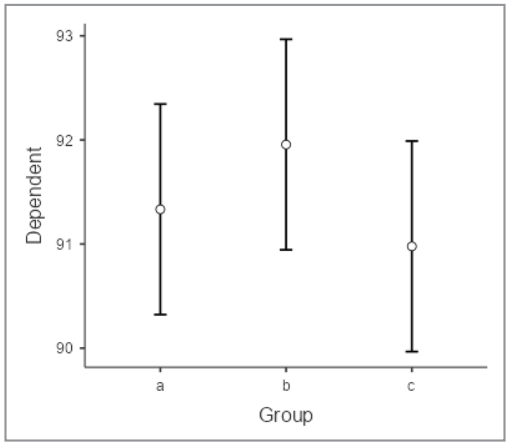
Note. Type 3 Sums of Squares

Post Hoc Tests

Post Hoc Comparisons - time period * Group

	time period	Group	time period	Group	Mean Difference	SE	df	t	ptukey
T1	a	-	T1	b	-0.4333	0.735	87.0	-0.5893	1.000
		-	T1	c	0.5333	0.735	87.0	0.7253	0.998
		-	T2	a	-0.1667	0.184	87.0	-0.9060	0.992
		-	T2	b	-0.7667	0.726	87.0	-1.0564	0.979
		-	T2	c	0.0333	0.726	87.0	0.0459	1.000
		-	T3	a	0.0667	0.255	87.0	0.2612	1.000
		-	T3	b	-0.7667	0.750	87.0	-1.0218	0.983
		-	T3	c	0.4000	0.750	87.0	0.5331	1.000
	b	-	T1	c	0.9667	0.735	87.0	1.3147	0.924
		-	T2	a	0.2667	0.726	87.0	0.3674	1.000
		-	T2	b	-0.3333	0.184	87.0	-1.8119	0.674
		-	T2	c	0.4667	0.726	87.0	0.6430	0.999
		-	T3	a	0.5000	0.750	87.0	0.6664	0.999
		-	T3	b	-0.3333	0.255	87.0	-1.3061	0.927
		-	T3	c	0.8333	0.750	87.0	1.1106	0.971
T2		-	T2	a	-0.7000	0.726	87.0	-0.9645	0.988
		-	T2	b	-1.3000	0.726	87.0	-1.7912	0.688
		-	T2	c	-0.5000	0.184	87.0	-2.7179	0.157
		-	T3	a	-0.4667	0.750	87.0	-0.6219	0.999
		-	T3	b	-1.3000	0.750	87.0	-1.7325	0.725
		-	T3	c	-0.1333	0.255	87.0	-0.5224	1.000
		-	T2	b	-0.6000	0.716	87.0	-0.8379	0.995
	c	-	T2	c	0.2000	0.716	87.0	0.2793	1.000
		-	T3	a	0.2333	0.173	87.0	1.3469	0.914
		-	T3	b	-0.6000	0.741	87.0	-0.8097	0.996
		-	T3	c	0.5667	0.741	87.0	0.7647	0.998
	a	-	T2	c	0.8000	0.716	87.0	1.1172	0.970
		-	T3	a	0.8333	0.741	87.0	1.1246	0.969
		-	T3	b	-1.13e−14	0.173	87.0	-6.50e−14	1.000
		-	T3	c	1.1667	0.741	87.0	1.5744	0.816
		-	T3	a	0.0333	0.741	87.0	0.0450	1.000
	T2	-	T3	b	-0.8000	0.741	87.0	-1.0796	0.976
T3	a	-	T3	c	0.3667	0.173	87.0	2.1165	0.469
		-	T3	b	-0.8333	0.765	87.0	-1.0892	0.974
		-	T3	c	0.3333	0.765	87.0	0.4357	1.000
	b	-	T3	c	1.1667	0.765	87.0	1.5248	0.841

Estimated Marginal Means
Group



Descriptives NPI
Descriptives

	Group	NPItotal	NPI total T2	NPI total T3
N	a	30	30	30
	b	30	30	30
	c	30	30	30
Mean	a	24.5	18.7	23.3
	b	25.4	19.9	24.8
	c	25.6	19.3	24.6
Standard deviation	a	4.36	3.70	3.98
	b	2.90	2.63	3.11
	c	3.16	3.44	2.75

Repeated Measures ANOVA
Within Subjects Effects

Within Subjects Effects	Sphericity Correction	Sum of Squares	df	Mean Square	F	p	η^2G
Time period	None	1798.69	2	899.34	290.602	<.001	0.376
	Huynh-Feldt	1798.69	1.76	1020.98	290.602	<.001	0.376
Time period *group	None	6.82	4	1.71	0.551	0.698	0.002
	Huynh-Feldt	6.82	3.52	1.94	0.551	0.676	0.002
Residual	None	538.49	174	3.09			
	Huynh-Feldt	538.49	153.27	3.51			

Note. Type 3 Sums of Squares

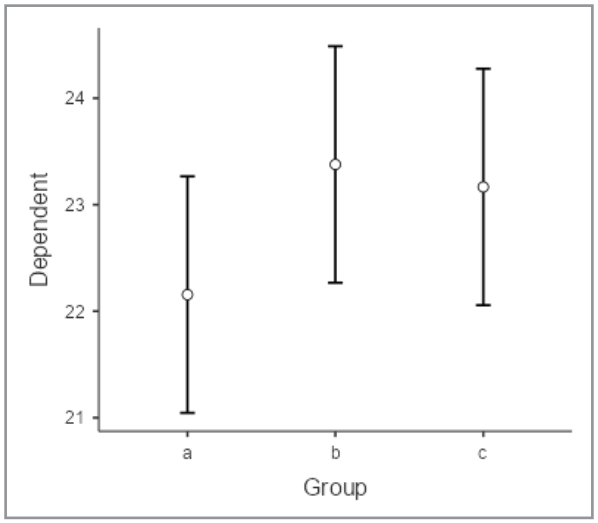
Between Subjects Effects

Within Subjects Effects	Sphericity Correction	Sum of Squares	df	MeanSquare	F	p
Group	76.8	2	38.4	1.37	0.260	0.025
Residual	2443.5	87	28.1			

Time period	Group		Time period	Group	Mean Difference	SE	df	t	ptukey
T1	a	-	T1	b	-0.933	0.911	87.0	-1.024	0.983
		-	T1	c	-1.067	0.911	87.0	-1.170	0.961
		-	T2	a	5.833	0.482	87.0	12.091	<.001
		-	T2	b	4.600	0.881	87.0	5.224	<.001
		-	T2	c	5.200	0.881	87.0	5.905	<.001

		-	T3	a	1.200	0.355	87.0	3.377	0.029
		-	T3	b	-0.300	0.885	87.0	-0.339	1.000
		-	T3	c	-0.133	0.885	87.0	-0.151	1.000
	b	-	T1	c	-0.133	0.911	87.0	-0.146	1.000
		-	T2	a	6.767	0.881	87.0	7.684	<.001
		-	T2	b	5.533	0.482	87.0	11.469	<.001
		-	T2	c	6.133	0.881	87.0	6.965	<.001
		-	T3	a	2.133	0.885	87.0	2.412	0.291
		-	T3	b	0.633	0.355	87.0	1.782	0.694
		-	T3	c	0.800	0.885	87.0	0.904	0.992
	c	-	T2	a	6.900	0.881	87.0	7.836	<.001
		-	T2	b	5.667	0.881	87.0	6.435	<.001
		-	T2	c	6.267	0.482	87.0	12.989	<.001
		-	T3	a	2.267	0.885	87.0	2.562	0.218
		-	T3	b	0.767	0.885	87.0	0.867	0.994
		-	T3	c	0.933	0.355	87.0	2.626	0.191
T2	a	-	T2	b	-1.233	0.849	87.0	-1.453	0.873
		-	T2	c	-0.633	0.849	87.0	-0.746	0.998
		-	T3	a	-4.633	0.510	87.0	-9.089	<.001
		-	T3	b	-6.133	0.853	87.0	-7.193	<.001
		-	T3	c	-5.967	0.853	87.0	-6.997	<.001
	b	-	T2	c	0.600	0.849	87.0	0.707	0.999
		-	T3	a	-3.400	0.853	87.0	-3.987	0.004
		-	T3	b	-4.900	0.510	87.0	-9.612	<.001
		-	T3	c	-4.733	0.853	87.0	-5.551	<.001
	c	-	T3	a	-4.000	0.853	87.0	-4.691	<.001
		-	T3	b	-5.500	0.853	87.0	-6.450	<.001
		-	T3	c	-5.333	0.510	87.0	-10.462	<.001
T3	a	-	T3	b	-1.500	0.857	87.0	-1.751	0.714
		-	T3	c	-1.333	0.857	87.0	-1.556	0.825
	b	-	T3	c	0.167	0.857	87.0	0.195	1.000

Estimated Marginal Means
Group



	Group	STAIS	STAIS T2	STAIS T3
N	a	30	30	30
	b	30	30	30
	c	30	30	30
Mean	a	62.5	53.8	50.7
	b	64.3	56.4	53.5
	c	63.3	54.0	51.3
Standard deviation	a	5.66	6.24	5.54
	b	4.94	5.61	5.59
	c	5.36	4.87	5.23

Repeated Measures ANOVA
Within Subjects Effects

Within Subjects Effects	Sphericity Correction	Sum of Squares	df	Mean Square	F	p	η^2G
Time period	None	6477.1	2	3238.56	368.216	<.001	0.454
	Huynh-Feldt	6477.1	1.64	3953.01	368.216	<.001	0.454
Time period *Group	None	19.2	4	4.79	0.545	0.703	0.002
	Huynh-Feldt	19.2	3.28	5.85	0.545	0.668	0.002
Residual	None	1530.4	174	8.80			
	Huynh-Feldt	1530.4	142.55	10.74			

Note. Type 3 Sums of Squares

Between Subjects Effects

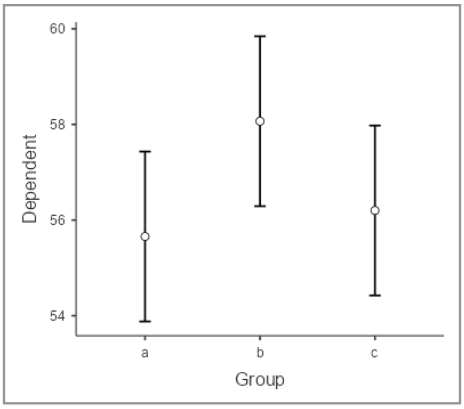
Within Subjects Effects	Sphericity Correction	Sum of Squares	df	Mean Square	F	p	η^2G
Group	288	2	143.9	2.00	0.141	0.036	0.454
Residual	6258	87	71.9				0.454

Post Hoc Tests
Post Hoc Comparisons - Time period * Group

	time period	Group	time period	Group	Mean Difference	SE	df	t	ptukey
0.053	a	-	T1	b	-1.833	1.376	87.0	-1.333	0.919
		-	T1	c	-0.833	1.376	87.0	-0.606	1.000
		-	T2	a	8.633	0.702	87.0	12.305	<.001
		-	T2	b	6.033	1.411	87.0	4.275	0.002
		-	T2	c	8.467	1.411	87.0	5.999	<.001
		-	T3	a	11.800	0.932	87.0	12.661	<.001
		-	T3	b	9.000	1.392	87.0	6.465	<.001
		-	T3	c	11.167	1.392	87.0	8.021	<.001
	b	-	T1	c	1.000	1.376	87.0	0.727	0.998
		-	T2	a	10.467	1.411	87.0	7.416	<.001
		-	T2	b	7.867	0.702	87.0	11.213	<.001
		-	T2	c	10.300	1.411	87.0	7.297	<.001
		-	T3	a	13.633	1.392	87.0	9.793	<.001
		-	T3	b	10.833	0.932	87.0	11.624	<.001
		-	T3	c	13.000	1.392	87.0	9.338	<.001

	c	-	T2	a	9.467	1.411	87.0	6.707	<.001
		-	T2	b	6.867	1.411	87.0	4.865	<.001
		-	T2	c	9.300	0.702	87.0	13.256	<.001
		-	T3	a	12.633	1.392	87.0	9.075	<.001
		-	T3	b	9.833	1.392	87.0	7.063	<.001
		-	T3	c	12.000	0.932	87.0	12.876	<.001
T2	a	-	T2	b	-2.600	1.446	87.0	-1.798	0.683
		-	T2	c	-0.167	1.446	87.0	-0.115	1.000
		-	T3	a	3.167	0.631	87.0	5.018	<.001
		-	T3	b	0.367	1.427	87.0	0.257	1.000
		-	T3	c	2.533	1.427	87.0	1.775	0.698
	b	-	T2	c	2.433	1.446	87.0	1.683	0.755
		-	T3	a	5.767	1.427	87.0	4.040	0.004
		-	T3	b	2.967	0.631	87.0	4.701	<.001
		-	T3	c	5.133	1.427	87.0	3.596	0.015
	c	-	T3	a	3.333	1.427	87.0	2.335	0.333
		-	T3	b	0.533	1.427	87.0	0.374	1.000
		-	T3	c	2.700	0.631	87.0	4.278	0.002
T3	a	-	T3	b	-2.800	1.408	87.0	-1.988	0.556
		-	T3	c	-0.633	1.408	87.0	-0.450	1.000
	b	-	T3	c	2.167	1.408	87.0	1.538	0.834

Estimated Marginal Means
Group



Descriptives BDI
Descriptives

	Group	BDI	BDI T2	BDI T3
N	a	30	30	30
	b	30	30	30
	c	30	30	30
Mean	a	19.6	13.0	11.9
	b	20.8	13.5	13.0
Standard deviation	c	18.3	12.2	11.3
	a	4.33	2.98	3.04
	b	3.73	2.66	2.76
	c	3.78	2.91	2.73

Repeated Measures ANOVA
Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η²G
Time period	3032.2	2	1516.11	318.407	<.001	0.522
Time period * Group	12.6	4	3.15	0.661	0.620	0.005
Residual	828.5	174	4.76			

Note. Type 3 Sums of Squares

Between Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η²G
Group	155	2	77.5	3.46	0.036	0.053
Residual	1946	87	22.4			

Note. Type 3 Sums of Squares

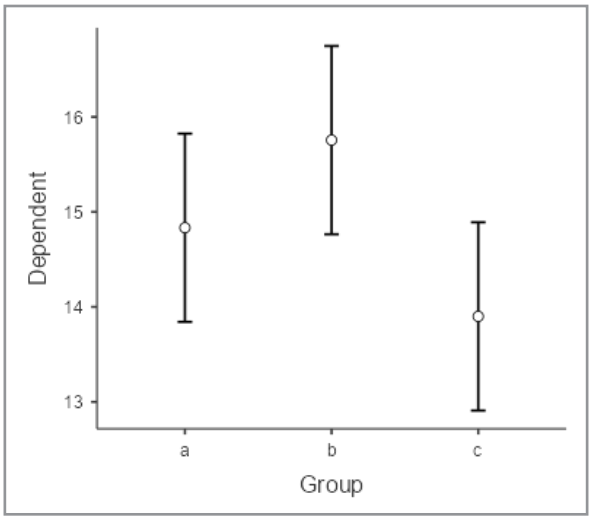
Post Hoc Tests
Post Hoc Comparisons - Time period * Group

< .001	Time period	Group	Time period	Group	Mean Difference	SE	df	t	ptukey
T1	a	-	T1	b	-1.2333	1.021	87.0	-1.2081	0.953
		-	T1	c	1.3000	1.021	87.0	1.2734	0.936
		-	T2	a	6.5667	0.633	87.0	10.3810	<.001
		-	T2	b	6.0667	0.890	87.0	6.8127	<.001
		-	T2	c	7.4000	0.890	87.0	8.3099	<.001
		-	T3	a	7.6333	0.690	87.0	11.0605	<.001
		-	T3	b	6.6000	0.889	87.0	7.4205	<.001
		-	T3	c	8.3000	0.889	87.0	9.3318	<.001
	b	-	T1	c	2.5333	1.021	87.0	2.4815	0.255
		-	T2	a	7.8000	0.890	87.0	8.7591	<.001
		-	T2	b	7.3000	0.633	87.0	11.5403	<.001
		-	T2	c	8.6333	0.890	87.0	9.6949	<.001
		-	T3	a	8.8667	0.889	87.0	9.9689	<.001
		-	T3	b	7.8333	0.690	87.0	11.3503	<.001
		-	T3	c	9.5333	0.889	87.0	10.7185	<.001
	c	-	T2	a	5.2667	0.890	87.0	5.9143	<.001
		-	T2	b	4.7667	0.890	87.0	5.3528	<.001
		-	T2	c	6.1000	0.633	87.0	9.6433	<.001
		-	T3	a	6.3333	0.889	87.0	7.1207	<.001
		-	T3	b	5.3000	0.889	87.0	5.9589	<.001
		-	T3	c	7.0000	0.690	87.0	10.1428	<.001
T2	a	-	T2	b	-0.5000	0.737	87.0	-0.6780	0.999
		-	T2	c	0.8333	0.737	87.0	1.1300	0.968
		-	T3	a	1.0667	0.275	87.0	3.8724	0.006
		-	T3	b	0.0333	0.736	87.0	0.0453	1.000
		-	T3	c	1.7333	0.736	87.0	2.3546	0.322
	b	-	T2	c	1.3333	0.737	87.0	1.8081	0.677
		-	T3	a	1.5667	0.736	87.0	2.1282	0.461
		-	T3	b	0.5333	0.275	87.0	1.9362	0.591
		-	T3	c	2.2333	0.736	87.0	3.0338	0.074

References
1. The jamovi project (2022). jamovi. (Version 2.3) [Computer Software]. Retrieved from https://www.jamovi.org.
2. R Core Team (2021). R: A Language and environment for statistical computing. (Version 4.1) [Computer software]. Retrieved from https://cran.r-project.org. (R packages retrieved from MRAN snapshot 2022-01-01).

	c	-	T3	a	0.2333	0.736	87.0	0.3170	1.000
		-	T3	b	-0.8000	0.736	87.0	-1.0867	0.975
		-	T3	c	0.9000	0.275	87.0	3.2673	0.039
T3	a	-	T3	b	-1.0333	0.735	87.0	-1.4062	0.893
		-	T3	c	0.6667	0.735	87.0	0.9072	0.992
	b	-	T3	c	1.7000	0.735	87.0	2.3134	0.346

Estimated Marginal Means
Group



Repeated Measures ANOVA
Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p
Time period	1925	2	962.48	351.8	< .00 1
Time period * Group	470	4	117.42	42.9	< .00 1
Residual	476	17 4	2.74		

Note. Type 3 Sums of Squares

Between Subjects Effects

	Sum of Squares	df	Mean Square	F	p
Group	246	2	122.8	8.8 7	< .00 1
Residual	1205	8 7	13.8		

Post Hoc Tests
Post Hoc Comparisons - Time period * Group

	Time period	Group	Time period	Group	Mean Difference	SE	df	t	ptukey
T1	a	-	T1	b	-0.8333	0.60 8	87. 0	-1.37 0	0.90 6
		-	T1	c	-0.1333	0.60 8	87. 0	-0.21 9	1.00 0
		-	T2	a	6.3333	0.44 7	87. 0	14.15 4	< .00 1
		-	T2	b	6.1333	0.57 9	87. 0	10.59 7	< .00 1
		-	T2	c	5.9000	0.57 9	87. 0	10.19 4	< .00 1
		-	T3	a	0.5000	0.37 5	87. 0	1.334	0.91 8
		-	T3	b	-0.5333	0.70 3	87. 0	-0.75 9	0.99 8
		-	T3	c	5.8333	0.70 3	87. 0	8.300	< .00 1
	b	-	T1	c	0.7000	0.60 8	87. 0	8.300	0.96 4
		-	T2	a	7.1667	0.57 9	87. 0	12.38 3	< .00 1

		-	T2	b	6.9667	0.44 7	87. 0	15.56 9	< .00 1
		-	T2	c	6.7333	0.57 9	87. 0	11.63 4	< .00 1
		-	T3	a	1.3333	0.70 3	87. 0	1.897	0.61 8
		-	T3	b	0.3000	0.37 5	87. 0	0.800	0.99 7
		-	T3	c	6.6667	0.70 3	87. 0	11.17 3	< .00 1
	c	-	T2	a	6.4667	0.57 9	87. 0	11.17 3	< .00 1
		-	T2	b	6.2667	0.57 9	87. 0	10.82 8	< .00 1
		-	T2	c	6.0333	0.44 7	87. 0	13.48 3	< .00 1
		-	T3	a	0.6333	0.70	87. 0	0.901	0.99
		-	T3	b	-0.4000	0.70 3	87. 0	-0.56 9	1.00 0
		-	T3	c	5.9667	0.37 5	87. 0	15.91 7	< .00 1
T2	a	-	T2	b	-0.2000	0.54 8	87. 0	-0.36 5	1.00 0
		-	T2	c	-0.4333	0.54 8	87. 0	-0.79 1	0.99 7
		-	T3	a	-5.8333	0.45 4	87. 0	-12.8 40	< .00 1
		-	T3	b	-6.8667	0.67 7	87. 0	-10.1 36	< .00 1
		-	T3	c	-0.5000	0.67 7	87. 0	-0.73 8	0.99 8
	b	-	T2	c	-0.2333	0.54 8	87. 0	-0.42 6	1.00 0
		-	T3	a	-5.6333	0.67 7	87. 0	-8.31 5	< .00 1
		-	T3	b	-6.6667	0.45 4	87. 0	-14.6 74	< .00 1
		-	T3	c	-0.3000	0.67 7	87. 0	-0.44 3	1.00 0
	c	-	T3	a	-5.4000	0.67 7	87. 0	-7.97 1	< .00 1
		-	T3	b	-6.4333	0.67 7	87. 0	-9.49 6	< .00 1
		-	T3	c	-0.0667	0.45 4	87. 0	-0.14 7	1.00 0
T3	a	-	T3	b	-1.0333	0.78	87. 0	-1.31 5	0.92 4
		-	T3	c	5.3333	0.78 6	87. 0	6.785	< .001
	b	-	T3	c	6.3667	0.78 6	87. 0	8.099	< .001

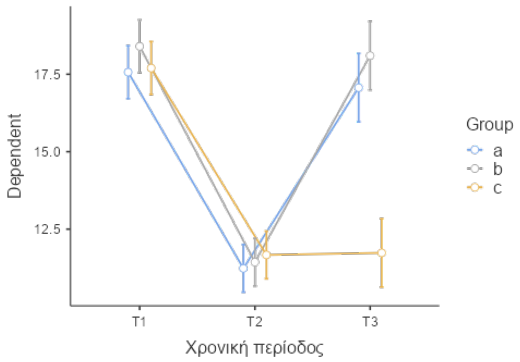
Post Hoc Comparisons - Group
Comparison

	Group	Group	Mean Difference	SE	df	t	ptukey
a	-	b	-0.689	0.55 5	87.0	-1.2 4	0.432
	-	c	1.589	0.555	87.0	2.8 6	0.01 4
b	-	c	2.278	0.555	87.0	4.1 1	< .00 1

Post Hoc Comparisons - Time period
Comparison

	Group	Group	Mean Difference	SE	df	t	ptukey
T1	-	T2	6.44	0.25 8	87. 0	24. 9	< .00 1
	-	T3	2.26	0.21 6	87. 0	10. 4	< .00 1
T2	-	T3	-4.19	0.26 2	87. 0	-16.0	< .00 1

Estimated Marginal Means
Time period * Group



Group Summary

Group	N	Excluded
a	3 0	0
b	3 0	0
c	3 0	0

Results Descriptives ZBI
Descriptives

	Group	ZBI	ZBI T2	ZBI T3
N	a	30	30	30
	b	30	30	30
	c	30	30	30
Mean	a	31.2	26.6	30.9
	b	28.7	23.6	28.2
	c	29.4	20.8	29.4
Standard Deviation	a	6.52	6.07	6.69
	b	6.62	6.38	6.89
	c	7.4 4	5.33	7.26

Repeated Measures ANOVA
Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η²G
Time period	2135	2	1067.27	218.2	< .00 1	0.150
Time period* Group	210	4	52.40	10.7	< .00 1	0.015
Residual	851	174	4.89			

Note. Type 3 Sums of Squares

Between Subjects Effects

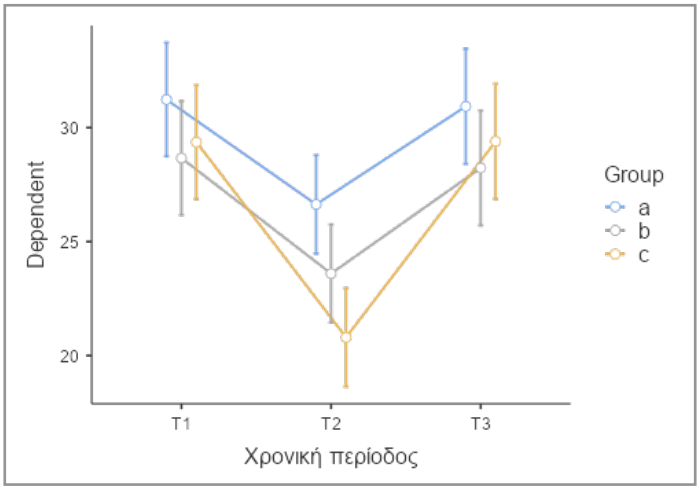
	Sum of Squares	df	Mean Square	F	p	η²G
Group	517	2	258	21.3	0.125	0.036
Residual	10533	87	121			

Post Hoc Tests
Post Hoc Comparisons - Time period * Group

	Time period	Group	Time period	Group	Mean Difference	SE	df	t	ptukey
-	T3	-	T1	b	2.5667	1.774	87. 0	1.446	0.870
		-	T1	c	1.8667	1.774	87. 0	1.052	0.970
		-	T2	a	4.6000	0.656	87. 0	7.008	< .00 1
		-	T2	b	7.6333	1.659	87. 0	4.602	< .00 1
		-	T2	c	10.4333	1.659	87. 0	6.290	< .00 1

		-	T3	a	0.3000	0.273	87. 0	1.099	0.975
		-	T3	b	3.0000	1.785	87. 0	1.681	0.750
		-	T3	c	1.8333	1.785	87. 0	1.027	1.000
		-	T1	c	-0.7000	1.774	87. 0	-0.394	0.949
T2	b	-	T2	a	2.0333	1.659	87. 0	1.226	< .00 1
		-	T2	b	5.0667	0.650	87. 0	7.719	< .00 1
		-	T2	c	7.8667	1.650	87. 0	4.742	< .00 1
		-	T3	a	-2.2667	1.785	87. 0	-1.27 0	0.937
		-	T3	b	0.4333	0.27 3	87. 0	1.587	0.80 9
		-	T3	c	-0.7333	1.78 5	87. 0	-0.41 1	1.000
		-	T3	a	2.7333	1.659	87. 0	1.648	0.77 6
		-	T3	b	5.7667	1.659	87. 0	3.476	0.02 2
		-	T3	c	8.5667	0.65 6	87. 0	13.05 2	< .00 1
		-	T1	a	-1.5667	1.78 5	87. 0	-0.87 8	0.99 4
		-	T2	b	1.1333	1.78 5	87. 0	0.635	0.99 9
		-	T2	c	-0.0333	0.273	87. 0	-0.12 2	1.00 0
	b	-	T2	a	3.0333	1.535	87. 0	1.977	0.56 3
		-	T3	b	5.8333	1.535	87. 0	3.801	0.00 8
		-	T3	c	-4.3000	0.688	87. 0	-6.25 2	< .00 1
		-	T3	c	-1.6000	1.67 0	87. 0	-0.95 8	0.98 9
		-	T3	a	-2.7667	1.67 0	87. 0	-1.65 7	0.77 0
		-	T3	b	2.8000	1.535	87. 0	1.825	0.666
	c	-	T3	c	-10.1333	1.67 0	87. 0	-4.39 2	0.00 1
		-	T1	c	-7.3333	0.688	87. 0	-4.39 2	0.00 1
		-	T2	a	-5.8000	0.68 8	87. 0	-6.73 7	< .00 1
		-	T2	b	-5.8000	1.67 0	87. 0	-3.47 4	0.02 2
		-	T2	c	-5.8000	1.67 0	87. 0	-6.06 9	< .00 1
T3	a	-	T3	a	-8.6000	0.688	87. 0	-4.45 2	< .00 1
		-	T3	b	2.7000	1.79 5	87. 0	-12.5 05	< .00 1
		-	T3	c	1.5333	1.79 5	87. 0	1.505	0.85 0
	b	-	T3	c	-1.1667	1.79 5	87. 0	0.854	0.995

Estimated Marginal Means
Time period * Group



3. Singmann, H. (2018). afex: Analysis of Factorial Experiments. [R package]. Retrieved from https://cran.r-project.org/ package=afex.
4. Lenth, R. (2020). emmeans: Estimated Marginal Means, aka Least-Squares Means. [R package]. Retrieved from https:// cran.r-project.org/package=emmeans.

Descriptives NPI caregivers
Descriptives

	Group	NPI caregiver total	NPIC TOTAL T2	NPIC TOTAL T3
N	a	30	30	30
	b	30	30	30
	c	30	30	30
Mean	a	17.6	11.2	17.1
	b	18.4	11.4	18.1
	c	17.7	11.7	11.7
Standard Deviation	a	2.76	2.03	3.54
	b	2.31	1.14	2.66
	c	1.91	2.84	2.86

Repeated Measures ANOVA
Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p
Time period	1925	2	962.48	351.8	< .001
Time period *Group	470	4	117.42	42.9	< .001
Residual	476	174	117.42		

Note. Type 3 Sums of Squares

Between Subjects Effects

	Sum of Squares	df	Mean Square	F	p
Group	246	2	962.48	8.87	< .001
Residual	1205	87	13.8		

Note. Type 3 Sums of Squares

Post Hoc Tests
Post Hoc Comparisons - Time period * Group

	Time period	Group	Time period	Group	Mean Difference	SE	df	t	ptukey
T1	a	-	T1	b	-0.8333	0.608	87.0	-1.370	0.906
		-	T1	c	-0.1333	0.608	87.0	-0.219	1.000
		-	T2	a	6.3333	0.447	87.0	14.154	< .001
		-	T2	b	6.1333	0.579	87.0	10.597	< .001
		-	T2	c	5.9000	0.579	87.0	10.597	< .001
		-	T3	a	0.5000	0.375	87.0	1.334	0.918
		-	T3	b	-0.5333	0.703	87.0	-0.759	0.998
		-	T3	c	5.8333	0.608	87.0	8.300	< .001
	b	-	T1	c	0.7000	0.579	87.0	1.151	0.964
		-	T2	a	7.1667	0.375	87.0	12.383	< .001
		-	T2	b	6.9667	0.703	87.0	12.383	< .001
		-	T2	c	6.7333	0.703	87.0	1.897	< .001
		-	T3	a	1.3333	0.608	87.0	1.897	0.618
		-	T3	b	0.3000	0.579	87.0	0.800	0.997
		-	T3	c	6.6667	0.447	87.0	9.485	< .001
	c	-	T2	a	6.4667	0.579	87.0	11.173	< .001
		-	T2	b	6.2667	0.703	87.0	10.828	< .001
		-	T2	c	6.0333	0.375	87.0	13.48 3	< .001
		-	T3	a	0.6333	0.703	87.0	0.901	0.992
		-	T3	b	-0.4000	0.579	87.0	-0.569	1.000

		-	T3	c	5.9667	0.579	87.0	15.917	< .001
T2	a	-	T2	b	-0.2000	0.548	87.0	-0.365	1.000
		-	T2	c	-0.4333	0.548	87.0	-0.791	0.997
		-	T3	a	-5.8333	0.45 4	87.0	-12.840	< .001
		-	T3	b	-6.8667	0.677	87.0	-10.136	< .001
		-	T3	c	-0.5000	0.677	87.0	-0.738	0.998
	b	-	T2	c	-0.2333	0.548	87.0	-0.42 6	1.000
		-	T3	a	-5.6333	0.677	87.0	-8.315	< .001
		-	T3	b	-6.6667	0.454	87.0	-14.674	< .001
		-	T3	c	-0.3000	0.454	87.0	-0.443	1.000
	c	-	T3	a	-5.4000	0.677	87.0	-7.971	< .001
		-	T3	b	-6.4333	0.677	87.0	-0.147	< .001
		-	T3	c	-0.0667	0.454	87.0	-0.147	1.000
T3	a	-	T3	b	-1.0333	0.786	87.0	-1.315	0.942
		-	T3	c	5.3333	0.786	87.0	6.785	< .001
	a	-	T3	c	6.3667	0.786	87.0	8.099	< .001

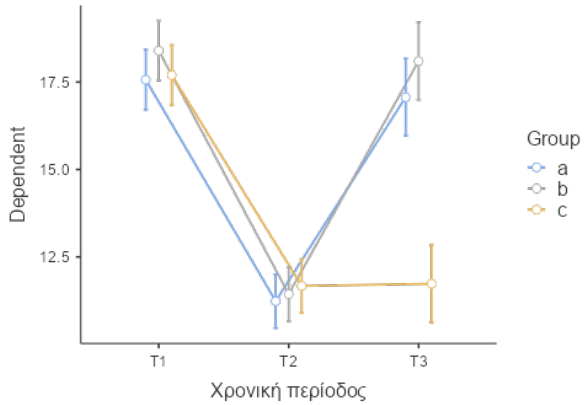
Post Hoc Comparisons - Group

Group	Group	Mean Difference	SE	df	t	ptukey
a	- b	-0.689	0.555	87.0	-1.24	0.43
	- c	1.589	0.555	87.0	2.86	0.014
b	- c	2.278	0.555	87.0	4.11	< .001

Post Hoc Comparisons - Time period

Group	Group	Mean Difference	SE	df	t	ptukey
T1	- T2	6.44	0.258	87.0	24.9	< .001
	- T3	2.26	0.216	87.0	10.4	< .001
T2	- T3	2.26	0.262	87.0	-16.0	< .001

Estimated Marginal Means
Time period * Group



References

1. The jamovi project (2022). jamovi. (Version 2.3) [Computer Software]. Retrieved from https:// www.jamovi.org.
2. R Core Team (2021). R: A Language and environment for statistical computing. (Version 4.1) [Computer software]. Retrieved from https://cran.r-project.org. (R packages retrieved from MRAN snapshot 2022-01-01).
3. Singmann, H. (2018). afex: Analysis of Factorial Experiments. [R package]. Retrieved from https://cran.r-project.org/package=afex.
4. Lenth, R. (2020). emmeans: Estimated Marginal Means, aka Least-Squares Means. [R package]. Retrieved from https://cran.r-project.org/package=emmeans.

Discussion

The study found that the combination of psychoeducation and multicomponent exercise programme has the best results in two domains: a) decrease BPSD, and b) improvements in the quality of life of PwD and their caregivers. No statistically significant differences were found in the cognitive abilities of the PwD. Only in group A (which received only the multicomponent training programme) there was some improvement in MMSE between T1 test and T2 test, but the good results did not seem to maintain over time. Physical exercise has been shown in previous studies as well, that can improve the cognitive abilities of the PwD, however its promising results seem not to be maintained after 3 months of no exercise [15, 16]. Therefore, it is crucial for PwD not to stop exercising as this is a non-pharmacological treatment that can help them decelerate the process of the disease [17].

In terms of BPSD, the combination of psychoeducation and multicomponent exercise has shown beneficial effects in decreasing some BPSD, such as; depression, anxiety, apathy, irritability and sleeping problems. No significant improvements were found in other BPSD. On the other hand, group A, which received only the multicomponent training programme had shown significant improvements in decreasing wandering. The result is in accordance with a previous RCT, which has shown beneficial effects of physical exercise in decreasing wandering in PwD [18]. All groups had shown improvements in NPI inventory, but the most significant changes were mentioned in group C. The combination of multicomponent exercise and psychoeducation had the best impact on reducing the total NPI score, which means that this combination is effective in managing a huge problem in dementia, which is the unwanted psychological behaviours. BPSD cause a tremendous impact on the PwD and their caregivers, as well. BPSD are among the earliest symptoms of neurocognitive disorders and their severity increases over the course of the disease [10]. They are associated with functional problems, faster cognitive decline, reduced independence and several negative outcomes. For the caregivers it is a problem that sometimes it remains unsolved and causes depression and anxiety, because the caregivers do not know how to deal with these behaviours [9]. Therefore, it is very important that there is a combination of non-pharmacological interventions that can effectively manage BPSD. Moreover, the general quality of life of the caregivers was also improved. Statistically significant changes were mentioned in all scales (STAIS, BDI and ZBI) and in all groups. This is interesting because it means that the caregivers can reduce their anxiety and depression by any intervention that seem to work for their PwD. The result is promising and encouraging because it gives hope that every non-pharmacological intervention that has a positive impact on the PwD, it can automatically reduce caregivers' distress.

Lastly, CDR_SB which measures the daily functioning of the PwD also showed improvements in group C. The combination of the multicomponent programme and the psychoeducation was enough in order to improve the daily function ability of the PwD.

Therefore, the results are in accordance with previous studies that have studied the positive impact of some non-pharmacological interventions, such as physical activity, music therapy, aromatherapy, massage therapy, validation therapy, reminiscence therapy etc., in decreasing some BPSD [19-21].

To our knowledge there are three articles that have examined the combination of these two non-pharmacological interventions. The latest one in 2022 by Skov et al., report no significant results. The pilot study examined the effect of psychoeducational programme and multicomponent exercise with 44 participants (N=44). The study lasted for 2,5 months and each intervention lasted 3 hours over the 15-week period (30 sessions in total) and 1 hour of psychoeducation. The study used measurements for both cognitive abilities and physical activity skills, such as; 30s chair stand test, 10-m walk test ingle- task and dual- task, Mini Mental State Examination (MMSE), Quality of Life in Alzheimer's Disease. The study used a mixed-methods design combining observations, tests of both cognitive and physical functioning, interviews and an interviewer-assisted questionnaire, as well. It was a pilot study and reported that the combination of the non-pharmacological interventions was acceptable for people with early stage dementia and their caregivers. However, the study did not show significant changes in physical and cognitive functioning or quality of life of the patients. On the other hand, the qualitative data claimed that participants perceived the intervention as helpful and meaningful and seemed to had a positive influence in their lives.

Another study in 2020 by Brewster et al., lasted for 6 months, but had no follow up. Their sample size was quite large (N=142 patients) and they used Savvy Caregiver programme and aerobic and resistance exercise as their interventions. The measurements used were PROMIS Emotional Distress for Depression and Anxiety, Zarit Burden Interview and Caregiving Competency Scale. According to the results of the study depression and anxiety were decreased, but the study reported no changes in caregivers' burden. In addition, prick et al., (2017) is another study that examined the combination of psychoeducational programme and multicomponent exercise and lasted for 3 months. The sample size was 111 participants and the interventions used were flexibility, strengthening, balance, and endurance for the physical exercise part and psychoeducation, communication skills training, and a pleasant activity training for the psychoeducational programme part. This study emphasized in measurements that examined the cognitive abilities of the patients, such as; 8 Words test, Picture Recognition of the Rivermead Behavioural Memory Test, Digit Span Test Backward, Key Search Test, Category fluency, Digit Span Test Forward. However, it did not include any measurements for the physical activity part. The study did not find positive effects of the combination of the non-pharmacological interventions in terms of memory and executive functions.

It is very crucial that the combination of the interventions has also shown improvements in decreasing some unwanted behaviours, which cause tremendous problems in PwD and their caregivers, as well. The general quality of life of the PwD and their caregivers were also enhanced. The fact that the caregivers found meaningful activities in order to collaborate with their patients gave them joy. They also pointed that during the pro-

gramme they felt less guilty, because now they spent more time with their patients and felt that they are really useful. The comments were made in the last session, that was a private session with the specialists and the instructors recorded these answers as helpful for the study. The results are in accordance with previous studies that have examined the impact of psychoeducation programmes in the general mood and psychology of the dementia caregivers [22]. Moreover, according to the interview in the last session, women patients seemed to be more satisfied with the non-pharmacological interventions that the neuroscientist suggested, such as music therapy, art therapy, aromatherapy and massage and more, and at the same time male patients were more satisfied with physical activity.

Further studies are needed in order to explore if the combination of psychoeducation and multicomponent exercise can effectively enhance cognitive abilities, decrease BPSD and improve the quality of life. Future researches should explore the full potential of the combination and provide solid evidence of the effectiveness of the combination with follow- up studies. It is important to consider how the positive results can be maintained during the disease and prevent risks of relapse into apathy and lack of motivation, which will lead to cognitive decline, enhance of BPSD and social isolation. These all consequences may lead to early institutionalization and increase caregivers' burden.

The study is a pilot study and therefore our results cannot provide solid evidence. The strong method design offered the opportunity to deeply educate the dementia caregivers, by 11 online sessions. The sessions offered knowledge and techniques to the caregivers in order to confront the daily problems of dementia and keep their expectations realistically. Another possible strength is that the study used three different groups and examined three different situations: a) patients who received only psychoeducation, b) patients who received only physical exercises and c) patients who did both. The design gave us the opportunity to compare the three groups and found significant differences in the groups. Furthermore, the measurements used, tried to cover all cognitive domains and physical skills. For example, the study used several measurements in order to score the cognitive abilities of the patients (ACE-R, MMSE) and it also used NPI questionnaire in order to measure BPSD and caregivers' burden. In addition, the study also examined the daily functions of the PwD, by using CDR_SB scale. At the same time, the study also underlined the importance of the caregivers, and that is why it used several questionnaires for measuring their anxiety and depression levels. Moreover, the study also used several tests in order to record the physical abilities of the patients and therefore our results can be accepted safely [23-26]. Additionally, another possible strength of the study was the online session with the specialists, in which the caregivers asked many questions and enhanced their psychology. Another strength of our study is the collaboration with a fitness specialist, who had all the knowledge needed in how to exercise best the PwD, show helpful exercises, and prevent possible injuries. The exercises were simple but effective, and no-one complained that they were too difficult to perform or unsafe. The fitness specialist with a deep knowledge in neuroscience and neurodegenerative diseases in combination with the knowledge of the neuroscientist created a programme that gave the opportunity to the caregivers in 24 weeks to be fully educated in confronting dementia and its symptoms. There were no drop-outs and this is very essential, because both PwD and caregivers seemed to enjoy the intervention [27-30].

However, the study has some limitation, as well. The study is a pilot study and therefore the sample size is quite small. The results of the study should be made with caution.

Conclusions

The combination of psychoeducation and multicomponent exercise programme seems to have effective results in PwD and their caregivers in terms of decreasing BPSD and improving the quality of life of both PwD and their caregivers, as well. The study is a pilot study and thus a larger sample is needed. Future studies should focus on larger samples, strong methodology and follow-up results in order to create safer conclusions.

The authors declare no conflict of interest

References

1. Dementia UK. (2019). What is dementia?
2. Aranda, M. P., Kremer, I. N., Hinton, L., Zissimopoulos, J., Whitmer, R. A., Hummel, C. H., ... & Fabius, C. (2021). Impact of dementia: Health disparities, population trends, care interventions, and economic costs. Journal of the American Geriatrics Society, 69(7), 1774-1783.
3. World Health Organization. (2019, September 19). Dementia. https://www.who.int/news-room/fact-sheets/detail/dementia
4. Alzheimer's Association. (2021). Alzheimer's disease facts and figures: Special report on race, ethnicity and Alzheimer's in America.
5. Panza, G. A., Taylor, B. A., MacDonald, H. V., Johnson, B. T., Zaleski, A. L., Livingston, J., ... & Pescatello, L. S. (2018). Can exercise improve cognitive symptoms of Alzheimer's disease? Journal of the American Geriatrics Society, 66(3), 487-495.
6. Dunne, R. A., Aarsland, D., O'Brien, J. T., Ballard, C., Banerjee, S., Fox, N. C., ... & Burns, A. (2021). Mild cognitive impairment: the Manchester consensus. Age and ageing, 50(1), 72-80.
7. Cho, E., Shin, J., Seok, J. W., Lee, H., Lee, K. H., Jang, J., ... & Kang, B. (2023). The effectiveness of non-pharmacological interventions using information and communication technologies for behavioral and psychological symptoms of dementia: A systematic review and meta-analysis. International Journal of Nursing Studies, 138, 104392.
8. Tampi, R. R., Bhattacharya, G., & Marpuri, P. (2022). Managing behavioral and psychological symptoms of dementia (BPSD) in the era of boxed warnings. Current Psychiatry Reports, 24(7), 431–440.
9. Poon, E. (2022). A systematic review and meta-analysis of dyadic psychological interventions for BPSD, quality of life and/or caregiver burden in dementia or MCI. Clinical Gerontologist, 45(3), 777–797.
10. Calsolaro, V., Femminella, G. D., Rogani, S., Esposito, S., Franchi, R., Okoye, C., ... & Monzani, F. (2021). Behavioral and psychological symptoms in dementia (BPSD) and the use of antipsychotics. Pharmaceuticals, 14(3), 246.
11. Ruangritchankul, S., Chantharit, P., Srisuma, S., & Gray, L. C. (2021). Adverse drug reactions of acetylcholinesterase

inhibitors in older people living with dementia: A comprehensive literature review. Therapeutics and Clinical Risk Management, 17, 927–949.
12. Ghafurian, M., Hoey, J., & Dautenhahn, K. (2021). Social robots for the care of persons with dementia: A systematic review. ACM Transactions on Human-Robot Interaction (THRI), 10(1), 1–31.
13. Liu, N., Sun, J., Wang, X., Zhao, M., Huang, Q., & Li, H. (2020). The impact of dementia on the clinical outcome of COVID-19: a systematic review and meta-analysis. Journal of Alzheimer's Disease, 78(4), 1775-1782.
14. Carbone, E. A., de Filippis, R., Roberti, R., Rania, M., Destefano, L., Russo, E., ... & De Fazio, P. (2021). The mental health of caregivers and their patients with dementia during the COVID-19 pandemic: A systematic review. Frontiers in Psychology, 12, 782833.
15. Panza, G. A., Taylor, B. A., MacDonald, H. V., Johnson, B. T., Zaleski, A. L., Livingston, J., ... & Pescatello, L. S. (2018). Can exercise improve cognitive symptoms of Alzheimer's disease? Journal of the American Geriatrics Society, 66(3), 487-495.
16. Song, D., & Yu, D. S. F. (2019). Effects of a moderate-intensity aerobic exercise programme on the cognitive function and quality of life of community-dwelling elderly people with mild cognitive impairment: A randomised controlled trial. International Journal of Nursing Studies, 93, 97–105.
17. Dimities, M., Xristina, F., Theodora-Elesa, K., & Maria, C. (2021). The impact of exercising in the quality of life of people with dementia–Alzheimer's disease. In GeNeDis 2020: Genetics and Neurodegenerative Diseases (Vol. 1339, pp. 309–315). Springer.
18. Dimitriou, T., Papatriantafyllou, J., Konsta, A., Kazis, D., Athanasiadis, L., Ioannidis, P., ... & Tsolaki, M. (2022). Non-pharmacological interventions for wandering/aberrant motor behaviour in patients with dementia. Brain Sciences, 12(2), 130.
19. Dimitriou, T. D., Verykouki, E., Papatriantafyllou, J., Konsta, A., Kazis, D., & Tsolaki, M. (2020). Non-Pharmacological interventions for the anxiety in patients with dementia. A cross-over randomised controlled trial. Behavioural brain research, 390, 112617.
20. Dimitriou, T. D., Verykouki, E., Papatriantafyllou, J., Konsta, A., & Kazis, D.(2018). Non-pharmacological interventions for sleeping disorders in patients with dementia. Paripex-Indian Journal of Research, 7(10), 89–92.
21. Dimitriou, T., Papatriantafyllou, J., Konsta, A., Kazis, D., Athanasiadis, L., Ioannidis, P., ... & Tsolaki, M. (2022). Assess of combinations of non-pharmacological interventions for the reduction of irritability in patients with dementia and their caregivers: a cross-over RCT. Brain sciences, 12(6), 691.
22. Yu, Y., Xiao, L., Ullah, S., Meyer, C., Wang, J., Pot, A. M., & Shifaza, F. (2023). The experiences of informal caregivers of people with dementia in web-based psychoeducation programs: systematic review and metasynthesis. JMIR aging, 6, e47152.
23. Alves, G. S., Casali, M. E., Veras, A. B., Carrilho, C. G., Bruno Costa, E., Rodrigues, V. M., & Dourado, M. C. N. (2020). A systematic review of home-setting psychoeducation interventions for behavioral changes in dementia: some lessons for the COVID-19 pandemic and post-pandemic assistance. Frontiers in psychiatry, 11, 577871.
24. Borges-Machado, F., Silva, N., Farinatti, P., Poton, R., Ribeiro, Ó., & Carvalho, J. (2021). Effectiveness of multicomponent exercise interventions in older adults with dementia: a meta-analysis. The Gerontologist, 61(8), e449-e462.
25. Cheng, S. T., & Zhang, F. (2020). A comprehensive meta-review of systematic reviews and meta-analyses on nonpharmacological interventions for informal dementia caregivers. BMC Geriatrics, 20, 137.
26. Haeger, A., Costa, A. S., Romanzetti, S., Kilders, A., Trautwein, C., Haberl, L., ... & Reetz, K. (2020). Effect of a multicomponent exercise intervention on brain metabolism: A randomized controlled trial on Alzheimer's pathology (Dementia-MOVE). Alzheimer's & Dementia: Translational Research & Clinical Interventions, 6(1), e12032.
27. Ghosh, M., Dunham, M., & O'Connell, B. (2023). Systematic review of dyadic psychoeducational programs for persons with dementia and their family caregivers. Journal of Clinical Nursing, 32(15–16), 4228–4248.
28. Kasper, S., Bancher, C., Eckert, A., Förstl, H., Frölich, L., Hort, J., ... & Palomo, M. S. M. (2020). Management of mild cognitive impairment (MCI): the need for national and international guidelines. The World Journal of Biological Psychiatry, 21(8), 579-594.
29. Lucero, R. J., Fehlberg, E. A., Patel, A. G., Bjarnardottir, R. I., Williams, R., Lee, K., ... & Mittelman, M. (2019). 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.
30. Yan, J., Li, X., Guo, X., Lin, Y., Wang, S., Cao, Y., ... & Liu, W. (2023). Effect of multicomponent exercise on cognition, physical function and activities of daily life in older adults with dementia or mild cognitive impairment: a systematic review and meta-analysis. Archives of Physical Medicine and Rehabilitation, 104(12), 2092-2108.