

ARTYKUŁY [Articles]

THE EFFECT OF COGNITIVE TRAINING IN PATIENTS WITH SCHIZOPHRENIA COMPARED TO PATIENTS WITH DEPRESSION

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Summary.

Introduction: Cognitive dysfunctions occur during a depressive episode in about 94% of patients, and in remission in 44%. In some patients, cognitive impairments persist despite the improvement or even disappearance of other symptoms of depression. Cognitive impairments of varying degrees of severity also occur in almost 90% of patients with schizophrenia. Recently, the popularity and possibilities of developing cognitive training, which are used as therapeutic interventions in mental disorders, have been increasing. **Aim:** The aim of the study was to assess the impact of cognitive training using the EXEMEMORY program on cognitive functions in the field of attention, memory, verbal fluency, language and visual-spatial functions in depression and schizophrenia. **Methods:** The study involved 48 residents of a Social Welfare Home and participants of a Community Self-Help Home aged 35 to 65, including 24 people diagnosed with depression (mean age $M = 49.25$) and 24 people diagnosed with schizophrenia (mean age $M = 53.79$). All participants participated in eight sessions of cognitive training during a 4-week cycle. The training cycle was preceded and concluded with an assessment of cognitive functions. In 25 people, cognitive functions were also assessed approximately three months after the end of the training cycle. Cognitive functions were assessed in three measurements using parallel versions: *Addenbrooke's*

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Cognitive Examination-III (ACE-III), Color Traits Test Adult Version (CTT), Rey's Complex Figure Test (TFZ), and Digit Sequence Scale (PC). **Results:** The obtained results indicate an improvement in cognitive functioning in people with schizophrenia in the area of attention, memory, language and visual-spatial functions. In people with depression, an improvement was demonstrated in the area of memory and language functions as well as the general level of cognitive functioning. The thesis about a similar effect of cognitive training on cognitive functions in people with depression and people with schizophrenia in remission was partially confirmed. At the same time, a significant difference was demonstrated in the maintenance of results over time between people with schizophrenia and those with depression, in the area of attention and semantic fluency.

Key words: depression, schizophrenia, cognitive training, cognitive processes

Introduction

Cognitive dysfunctions in schizophrenia, which until recently were considered secondary disorders to the primary psychopathological process, are currently considered a separate aspect of schizophrenia (Jędrzejczyk, 2020). They occur to varying degrees of severity in almost 90% of patients with schizophrenia (Borkowska and Rybakowski, 2005). Cognitive deficits in patients with schizophrenia cause poorer functioning, professional and social problems, as well as lower cooperation in treatment and treatment outcomes (Kopyciński and Czernikiewicz, 2011). They are visible in many areas, such as memory, attention, verbal fluency, learning, reasoning and problem-solving, information processing speed and executive functions (Kopyciński and Czernikiewicz, 2011). The impairment of overall functioning in schizophrenia is more influenced by cognitive dysfunctions and negative symptoms than by productive symptoms (Krzystanek et al., 2013). Cognitive impairments occur at every stage of the disease: prodromal, acute psychotic episode and remission (Wciórka, 2011). In patients with early onset of the disease, there is a relationship with a greater decline in cognitive functions in later years of life, which results in increased adaptation difficulties (Borkowska and Rybakowski, 2005). The prevalence of schizophrenia in the world varies depending on the broad or narrow definition of psychotic disorders. The lifetime prevalence rate ranges from 1.4 to 8.9 per 1,000 inhabitants in different parts of the world (Rymaszewska et al., 2005). Based on the reported number of National Health Fund services, it results that in 2017 there were 182,775 patients among adult patients with schizophrenia. This constitutes .58% of the adult population in Poland (Wróbel and Szulc, 2019).

Depression is a widespread disease and is associated with impaired functioning in the professional, social, and family spheres. It results in a significant reduction in the quality of life in its various aspects. About 6–7% of the general population experiences an episode of major depression within 12 months. The risk of depression during life oscillates between 15–18% (Siwek, 2021). Depression is mainly treated as an affective disorder, but the cognitive dysfunctions present in its course are becoming

increasingly important. Cognitive dysfunctions dominate during an episode of depression, along with a lack of energy and sleep disorders. They occur during a depressive episode and remission (Czerwińska and Pawłowski, 2020). Studies indicate that in the acute phase of the disease, cognitive disorders occur in 94% of patients, and in the remission phase in 44%. Cognitive deficits increase with subsequent episodes (Biernacka, 2015). In some patients, cognitive dysfunctions persist despite improvement or even disappearance of other symptoms of depression, and persistent dysfunctions may increase the risk of recurrence of depression (Biernacka, 2015; Murawiec et al., 2015). This applies most to the areas of attention, verbal memory, learning and executive functions (Murawiec et al., 2015).

Recently, the popularity and possibilities of developing cognitive trainings, which are used as therapeutic interventions in mental disorders, have been increasing. Regular training stimulates the natural process of brain plasticity, thus contributing to the improvement of its functioning (Mosiółek, 2015). Studies from the last few decades demonstrate that cognitive training in people with schizophrenia has an impact on adaptive changes and improvement of cognitive functioning (Krzystanek et al., 2013). However, there is also a large number of studies that indicate that cognitive deficits are a very stable symptom in schizophrenia, and are also independent of the duration and course of the disease. Therefore, the impact of cognitive training may have a limited effect on cognitive neuroplasticity (Krzystanek et al., 2013). Analyzing the available studies conducted since 2008 on people with schizophrenia using cognitive training shows that they achieved a better level of cognitive functioning, improved attention and working memory, prospective memory, executive functions, psychomotor skills and visual-spatial functions (Chen et al., 2021; Krzystanek et al., 2013; Mak et al., 2019; Szöke et al. 2008).

A meta-analysis to determine the effectiveness of computer-based cognitive training in depressive disorders was conducted by Motter et al (2016). The analysis included nine randomized controlled trials of adults with depression. The results of this meta-analysis revealed a small but statistically significant effect of computer-based cognitive training on mood in depression, daily functioning, and a positive effect on three of the five cognitive domains studied: attention, working memory, and global functioning. The most recent meta-analysis of 24 studies of people with a diagnosis of depression indicates that computer-based cognitive training is an effective intervention for improving general cognitive functions and mood in people with depression. Benefits were also found in psychosocial functioning and specific cognitive functions in the areas of abstract reasoning, learning efficiency, working memory, inhibition, and processing speed (Lauder et al., 2021). The results of the analysis reveal a significant effect of cognitive training dose on general cognitive functions, indicating that the more frequent the training, the greater the improvement in cognitive functions. The analysis of studies also showed that due to the focus on short-term cognitive and functional outcomes, the durability of the observed benefits in terms of general and cognitive functioning in people with depression is unknown. The authors of the

analysis suggest that in the future, the durability of the effects of cognitive training should also be studied both in symptomatic states of depression and during remission (Lauder et al., 2021).

Aim

The aim of the study was to assess the impact of cognitive training using the EXEMEMORY program on cognitive functions in the field of attention, memory, verbal fluency (semantic and phonemic), linguistic and visual-spatial functions, and the general level of cognitive function in schizophrenia and depression.

Methods

Research tools

To assess cognitive functions in three measurements (pretest, posttest-1 and posttest-2) the following were used: *Addenbrooke's Cognitive Examination-III* (ACE-III), *Color Traits Test for Adults* (CTT), *Rey's Complex Figure Test* (TFZ), *Digit Sequence Scale* (PC).

Addenbrooke's Cognitive Examination-III (ACE-III) Polish version developed by Senderecka et al. (2014). ACE-III is a short test assessing five areas of cognitive functioning: attention, memory, verbal fluency, language functions and visual-spatial functions. The overall test result ranges from 0 to 100 points, in which higher scores indicate better cognitive functioning.

Colour Traits Test Adult Version (CTT) (adapted and standardized by: Łojek, Stańczak, 2012). The test examines various processes in the field of executive functions, including the ability to deliberately search for material, maintain and shift attention, sequentially process information, and monitor one's behavior. The test consists of two parts (CTT1 and CTT2) and requires knowledge of numbers from 1 to 25 and graphomotor skills. In CTT1, the task consists of connecting numbers in ascending order as quickly as possible. In CTT2, the subject connects a sequence of numbers while taking into account the alternation of yellow and pink colors. Versions A, B, and C of the test were used in the study. The following indicators were taken into account in the analysis of the results: – CTT1 execution time, – CTT2 execution time, – interference index (the difference in the execution times of CTT2 and CTT1 divided by the execution time of CTT1): informs about the extension of the time needed to complete a task with a higher degree of cognitive complexity.

Rey Complex Figure Test (TFZ) examines visual perception and visual-motor coordination. The authors of the test state that it can be used to examine: the level of perceptual structuring, attention and visual-motor control, memory capacity, i.e. direct visual memory (Strupczewska, 1990). The test consists of a figure with a complex structure, constructed from 18 elements, which does not resemble any real object. Each element has its own value in perceiving and mapping the figure, each can be

mapped in an isolated way, but arranging them into a whole requires complex perceptual organization and planning skills.

The test consists of two phases: first, one has to copy a figure from a pattern (copy) without time limits, and then, after 3 minutes from the end of copying, one has to draw it from memory (reproduction). In both phases, the time of execution is measured (Strupczewska, 1990).

The Digit Sequence Scale directly examines verbal-auditory short-term memory, while the *Digit Sequence Scale* backwards examines verbal-auditory working memory, as well as the ability to concentrate, pay attention, learn, use patterns and change them.

The Beck Depression Inventory-II (BDI-II) was used to measure the severity of depressive symptoms. It is a self-report instrument consisting of 21 items. It is used to obtain an index of the presence and severity of depressive symptoms consistent with DSM-IV.

The Simplified Negative and Positive Symptoms Interview (SNAPSI) was used to assess the severity of schizophrenia symptoms. It includes selected items from several commonly used psychiatric assessment scales, such as items from *The Brief Psychiatric Rating Scale (BPRS)* (Overall and Gorham, 1962), *The Positive and Negative Syndrome Scale (PANSS-6)* (Østergaard et al. 2016, 2017), *The Positive and Negative Syndrome Scale (PANSS)* (Kay et al., 1987), and *The Brief Negative Syndrome Scale (BNSS)* (Kirkpatrick et al., 2011). The SNAPSI consists of two sets of questions, the first intended for the patient and the second intended for healthcare staff, family members or friends. It is a semi-structured interview, therefore the questions contained in it are intended to serve as a guide and additional questions can be asked if they help determine the score for a given factor. The study used a patient section to obtain information on the occurrence of hallucinations, delusions, flattened affect, passive social withdrawal, and conceptual disorientation. A time frame of two weeks was used.

During the research experiment, the EXEMEMORY cognitive function rehabilitation program was used. It is a computer version of exercises for neuropsychological rehabilitation developed substantively by Monika Wiłkość-Dębczyńska, and programmatically by Memandis Sp. z o.o. It is intended for people with cognitive function disorders, and consists of five training areas: memory, classification, orientation, arithmetic, and attention, and each of them has ten levels of difficulty.

Characteristics of the study participants

The experiment involved 74 people. Of the people indicated by the facility staff or volunteers, 26 people did not qualify for the experiment or withdrew from the study for various reasons. Finally, 48 residents of the Social Welfare Home and participants of the Community Self-Help Home aged between 35 and 65 were subjected to pretest and posttest-1 tests (Table 1). They were assigned to equal groups according to the

inclusion criteria, which for group D included a diagnosis of recurrent depressive disorders in the interview and a BDI-II score indicating the occurrence of depression in the pretest (min. 14 points). For group S, they included a diagnosis of schizophrenia in the interview, in remission at the time of the study, and a BDI-II score below 13 points. For both groups, the exclusion criteria were: visual, hearing and/or motor dysfunction preventing the performance of tests and/or use of training, other coexisting mental disorders, neurological diseases, and previous craniocerebral injuries. The cognitive processes posttest-2 test was performed on 24 people in each group. The study received a positive opinion from the Committee for Ethics of Scientific Research at the Faculty of Psychology of the Kazimierz Wielki University in Bydgoszcz. All the people studied signed an informed consent to participate in the research. The study participants were informed about the anonymous nature of the study, assumptions, objectives, course and duration of the study and the way it was conducted. They also received information about the possibility of withdrawing from the study at any stage of its duration without giving a reason.

Table 1. Characteristics of the study participants

	Group D		Group S	
	women	men	women	men
Gender	$n = 13$ (54.17%)	$n = 11$ (45.83%)	$n = 14$ (58.33%)	$n = 10$ (41.67%)
Age	$M = 49.25$ ($SD = 11.80$)		$M = 53.79$ ($SD = 9.71$)	
Years of Education	$M = 11.88$ ($SD = 2.36$)		$M = 11.46$ ($SD = 1.64$)	
BDI-II	$M = 27.54$ ($SD = 9.56$)		$M = 6.42$ ($SD = 4.11$)	

Annotation: BDI-II - Beck Depression Inventory-II.

Statistical analysis

The analysis of the research results presented in the article covered several aspects:

- a. assessment of the impact of cognitive training on indicators of cognitive processes in people with schizophrenia;
- b. assessment of the impact of cognitive training on indicators of cognitive processes in people with depression;
- c. comparison of the impact of cognitive training in both study groups;
- d. comparison of the maintenance of the training effects obtained in both study groups over time.

To compare the results obtained by the subjects in pretest and posttest-1, the Student's t-test for dependent data was used, and additionally – due to the lack of normality of the distribution of the variable parts – the nonparametric Wilcoxon signed-rank test. The analysis of the effect size for people with depression compared to people with schizophrenia in remission and the maintenance of training effects over time was performed using the ANOVA test with repeated measures. Statistical calculations were performed using the Statistica 13.3 package.

Results

a. The influence of cognitive training on indicators of cognitive processes in people with schizophrenia

The results showed that in the area of attention, one of the indicators (the subscale score in the ACE-III) significantly improved with a very strong effect size. All tasks included in this subscale require selectiveness and concentration of attention on auditory-verbal material. In the area of memory, all four indicators examining short-term, working and long-term memory significantly improved with a strong, very strong and huge effect size. In the area of verbal fluency: phonemic verbal fluency significantly improved with a huge effect size, while semantic verbal fluency did not improve. In language functions, the results significantly improved with a very strong effect size. In the area of visual-spatial functions, the results also significantly improved with a very strong effect size and in the overall level of cognitive functioning there was a significant improvement reaching a huge effect size.

Table 2. Results of Student's T-tests for cognitive process indicators for the group of people with schizophrenia

Cognitive functions (indicator)	Pretest	Posttest-1	Student's t-test			
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>N</i>	t-test	<i>p</i> [*] level	Cohen's <i>d</i>
Memory (ACE-III)	17.54 (6.16)	19.08 (5.51)	24	-2.41	.024	-2.12
Phonemic Verbal luency ACE-III	8.79 (4.39)	10.29 (3.78)	24	-2.90	.008	-2.43
Semantic Verbal luency ACE-III	11.00 (5.22)	12.54 (4.25)	24	-1.70	.103	
Overall level of cognitive functioning (ACE-III total)	74.13 (13.54)	81.79 (10.75)	24	-6.46	<.001	-3.82

Annotation: ACE-III – Addenbrooke's Cognitive Examination-III.

* significance level for $p < .05$.

Table 3. The effect of training on indicators of cognitive processes in people with schizophrenia

Cognitive functions	Pretest	Posttest-1	Wilcoxon Test			
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>N</i>	<i>Z</i> Test	<i>p</i> level	<i>r_c</i>
Attention ACE-III – subscale score	14.75 (2.03)	16.50 (1.62)	21	3.74	<.001	0.82
Attention CTT-1 execution time	101.58 (49.68)	98.83 (56.04)	24	.84	.399	
Attention CTT-2 execution time	182.25 (61.45)	173.33 (56.79)	22	1.14	.256	
Attention TFZ copy points	24.48 (8.73)	27.38 (8.52)	18	1.52	.127	
Memory PC directly – points	6.13 (1.39)	7 (1.93)	18	2.35	.019	.55
Memory PC backwards – points	3.63 (1.28)	5 (1.22)	22	3.91	<.001	.83
Memory TFZ reproduction points	5.85 (3.82)	8.60 (5.55)	19	2.88	.004	.66
Language functions ACE-III – subscale score	22.29 (3.24)	24.33 (2.16)	19	3.70	<.001	.85
Visual-spatial functions ACE-III – subscale score	12.25 (2.52)	13.58 (1.91)	17	3.15	.002	.76

Annotation: ACE-III – Addenbrooke’s Cognitive Examination-III, CTT-1, CTT-2 – Colour Traits Test Adult version, TFZ – Rey Complex Figure Test, PC – Digit Repetition scale, * significance level for $p < .05$.

b. The influence of cognitive training on indicators of cognitive processes in people with depression

The results showed that in the area of attention, similarly to the group of people with schizophrenia, one of the indicators significantly improved with a strong effect size. In the area of memory, all four indicators significantly improved with a moderate and strong effect size. In the area of verbal fluency: phonemic verbal fluency significantly improved, while semantic verbal fluency did not improve. In the area of language functions, the results significantly improved with a strong effect size. Visual-spatial functions did not improve after training. However, the overall level of cognitive functioning showed a significant improvement with a strong effect size after cognitive training. The obtained results are inconsistent, especially

in the area of attention. While general attention improved, visual attention, visual field searching, psychomotor speed or attention shifting did not show significant improvement.

Table 4. Results of Student's t-tests for cognitive process indicators for the group of people with depression

Cognitive functions (indicator)	Pretest	Posttest-1	Student's t-test			
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>N</i>	<i>t</i> Test	<i>p</i> level	Cohen's <i>d</i>
Attention TFZ copy points	20.64 (9.11)	20.48 (9.74)	21	.13	.902	
Attention CTT-2 execution time	184.63 (80.54)	175.46 (78.75)	24	1.11	.279	
Operational Memory PC backwards – points	3.14 (1.64)	4.09 (1.80)	22	-4.48	<.001	-3.17
Memory ACE-III – subscale score	16.09 (6.12)	17.55 (5.40)	22	-2.11	.047	-.59
Semantic Verbal Fluency ACE-III	14.05 (6.20)	14.68 (5.79)	22	-.81	.425	
Visual-spatial functions ACE-III – subscale score	12.45 (2.20)	12.73 (2.51)	22	-1.19	.248	
Overall level of cognitive functioning (ACE-III total)	70.27 (15.79)	75.64 (13.73)	22	-4.79	<.001	-3.28

Annotation: ACE-III – Addenbrooke's Cognitive Examination-III, CTT-2 – Colour Traits Test Adult version, TFZ – Rey Complex Figure Test, PC – Digit Repetition scale,
* significance level for $p < .05$.

Table 5. The effect of training on indicators of cognitive processes in people with depression

Cognitive functions	Pretest	Posttest-1	Wilcoxon Test			
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>N</i>	<i>Z</i> Test	<i>p</i> level	<i>r_c</i>
Attention ACE-III – subscale score	14.55 (2.74)	15.27 (2.23)	16	2.28	.023	0.57
Attention CTT-1 execution time	108.75 (53.77)	98.25 (59.21)	24	1.54	.123	
Memory PC directly – points	5.36 (1.71)	6.23 (1.54)	18	2.59	.010	0.61

Cognitive functions	Pretest	Posttest-1	Wilcoxon Test			
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>N</i>	<i>Z</i> Test	<i>p</i> level	<i>r_c</i>
Memory TFZ reproduction points	7.38 (5.57)	9.96 (7.68)	19	2.25	.024	.52
Phonemic Verbal Fluency ACE-III	8.77 (5.06)	10.82 (5.11)	18	2.66	.008	.63
Language functions ACE-III – subscale score	19.36 (5.21)	21.23 (4.67)	19	2.88	.004	.66

Annotation: ACE-III – Addenbrooke’s Cognitive Examination-III, CTT-1, – Colour Traits Test Adult version, TFZ – Rey Complex Figure Test, PC – Digit Repetition scale,
* significance level for $p < .05$.

c. The effect of cognitive training in people with schizophrenia compared to people with depression

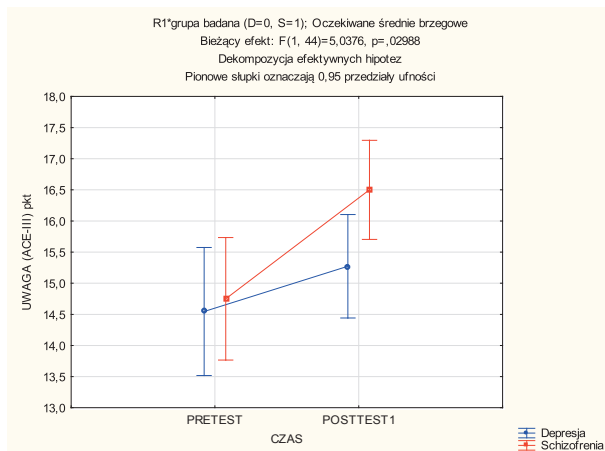
Table 6. Results of ANOVA for repeated measures of cognitive process indices for the group of people with depression and the group of people with schizophrenia

Cognitive functions (indicator)	Group Depression		Group Schizophrenia		ANOVA	
	Pretest	Posttest-1	Pretest	Posttest-1	F	<i>p</i> level
	<i>M</i>	<i>M</i>	<i>M</i>	<i>M</i>		
Attention (ACE-III – subscale score)	14.55	15.27	14.75	16.50	5.04	.030
Attention (TFZ copy points)	20.64	20.48	24.47	26.90	1.42	.240
Attention (CTT-1 execution time)	108.75	98.25	101.58	98.83	.97	.331
Attention (CTT-2 execution time)	184.62	175.46	182.25	173.33	.000	.983
Short term Memory (PC directly – points)	5.36	6.23	6.13	7.00	.00	.978
Operational Memory (PC backwards – points)	3.14	4.09	3.62	5.00	2.20	0.145
Memory (ACE-III – subscale score)	16.09	17.55	17.54	19.08	.01	.927

cont. tab. 6

Cognitive functions (indicator)	Group Depression		Group Schizophrenia		ANOVA	
	Pretest M	Posttest-1 M	Pretest M	Posttest-1 M	F	p level
Memory(TFZ reproduction points)	7.38	9.96	5.85	8.60	.20	.658
Phonemic Verbal Fluency (ACE-III)	8.77	10.82	8.79	10.29	.44	.509
Semantic Verbal Fluency (ACE-III)	14.05	14.68	11.00	12.54	.56	.458
Language functions (ACE-III – subscale score)	19.36	21.23	22.29	24.33	.08	.778
Visual-spatial functions (ACE-III – subscale score)	12.45	12.73	12.25	13.58	5.94	.019
Overall level of cognitive functioning (ACE-III total)	70.27	75.64	74.13	81.79	1.97	.167

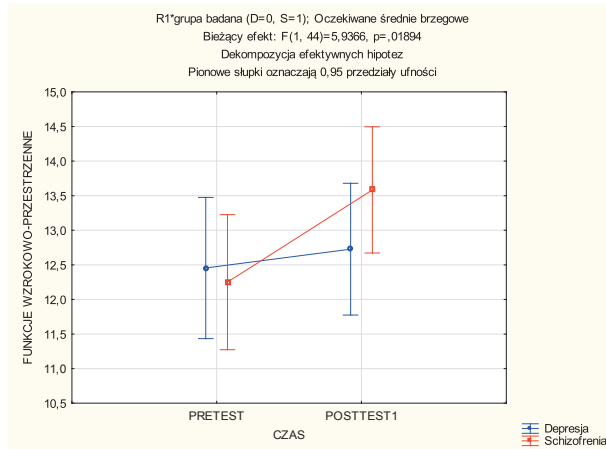
Annotation: ACE-III – Addenbrooke’s Cognitive Examination-III, CTT-1, CTT-2 – Colour Traits Test Adult version, TFZ – Rey Complex Figure Test, PC – Digit Repetition scale,
* significance level for $p < .05$.



Graph 1. Repeated Measures ANOVA Plot of Attention (ACE-III) variable for the group of people with depression and the group of people with schizophrenia

Annotation: ACE-III – Addenbrooke’s Cognitive Examination-III.

The obtained results showed no significant difference in the way cognitive training affected the efficiency of cognitive functions in people with depression and people with schizophrenia in terms of memory, verbal fluency, language functions and the general level of cognitive functioning. However, significant differences were observed in the scope of visual-spatial functions and in one of the indicators of attention functions, which was described earlier. In this area, improvement was noted in both groups, but the effect was stronger in people with schizophrenia. The indicator of visual-spatial functions improved only in people with schizophrenia, while in people with depression, no significant improvement was achieved.



Graph 2. ANOVA plot for repeated measures variables Visual-spatial functions (ACE-III) for the group of people with depression and the group of people with schizophrenia

Annotation: ACE-III – Addenbrooke’s Cognitive Examination-III.

d. Comparison of the maintenance of the obtained cognitive function results in both study groups over time

Table 7. Comparison of the persistence of cognitive process indicators over time for the group of people with depression and the group of people with schizophrenia

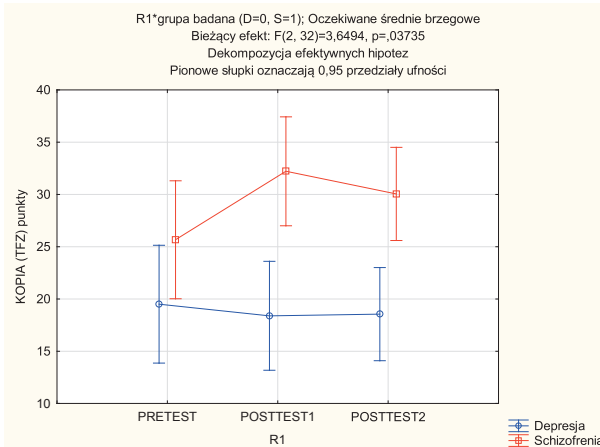
Cognitive functions (indicators)	Group D		Group S		ANOVA	
	Nr	M	Nr	M	F	p* level
Attention (ACE-III)	1	13.91	1	15.77	1.90	.162
	2	15.36	2	17.38		
	3	15.27	3	16.23		

cont. tab. 7

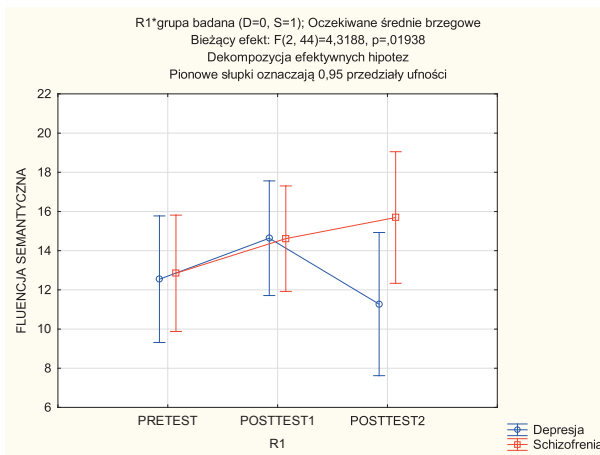
Cognitive functions (indicators)	Group D		Group S		ANOVA	
	Nr	M	Nr	M	F	<i>p</i> * level
Attention/visual-spatial functions (TFZ copy points)	1	19.50	1	25.67	3.65	.037
	2	18.39	2	32.22		
	3	18.56	3	30.06		
Attention (CTT-1 execution time)	1	121.25	1	79.23	2.15	.128
	2	104.17	2	83.31		
	3	98.25	3	68.85		
Attention (CTT-2 execution time)	1	188.17	1	156.54	.13	.878
	2	185.75	2	154.62		
	3	171.25	3	146.38		
Short term Memory (PC directly – points)	1	5.27	1	6.61	1.81	.176
	2	5.73	2	7.38		
	3	5.36	3	7.61		
Operational Memory (PC backwards – points)	1	2.82	1	4.23	.93	.403
	2	3.82	2	5.46		
	3	3.45	3	4.54		
Memory (ACE-III - subscale score)	1	15.73	1	20.69	.28	.758
	2	18.18	2	22.08		
	3	18.09	3	22.69		
Memory (TFZ reproduction points)	1	8.39	1	7.06	2.40	.107
	2	7.33	2	11.33		
	3	10.06	3	10.11		
Phonemic verbal fluency (ACE-III)	1	9.27	1	10.38	.08	.924
	2	10.91	2	11.54		
	3	11.00	3	11.92		
Semantic verbal fluency (ACE-III)	1	12.54	1	12.85	4.32	.019
	2	14.64	2	14.61		
	3	11.27	3	15.69		
Language functions (ACE-III – subscale score)	1	19.82	1	23.27	1.55	.224
	2	22.09	2	25.23		
	3	22.27	3	24.85		
Visual-spatial functions (ACE-III – subscale score)	1	12.73	1	13.15	1.11	.340
	2	13.09	2	14.38		
	3	13.45	3	14.69		
Overall level of cognitive functioning (ACE-III total)	1	69.73	1	81.85	.30	.740
	2	77.64	2	88.31		
	3	77.54	3	88.08		

Annotation: ACE-III – Addenbrooke's Cognitive Examination-III, CTT-1, CTT-2 –Colour Traits Test Adult version, TFZ – Rey Complex Figure Test, PC – Digit Sequence scale,

* significance level for $p < .05$.



Graph 3. Repeated measures ANOVA plot of Attention/visual-spatial function (TFZ copy number of points) comparing the results over time for the group of people with depression and the group of people with schizophrenia
Annotation: TFZ – Rey Complex Figure Test.



Graph 4. Repeated Measures ANOVA Plot of Semantic Verbal Fluency (ACE-III) Comparing Scores Over Time for the group of people with depression and the group of people with schizophrenia
Annotation: ACE-III – Addenbrooke’s Cognitive Examination-III.

Analyzing the results of studies using repeated measures designs, it can be concluded that in most indicators, the obtained results of cognitive training remain similar over time in people with depression and people with schizophrenia during remission. However, differences were noted in the scope of the two indicators. In

the group of people with schizophrenia, the results in the TFZ Copy (points) indicator, which examines visual-spatial and attentional functions, significantly increased and were maintained over time, while in the group of people with depression, the results did not change. On the other hand, in the semantic verbal fluency indicator, the average results in the pretest and after cognitive training, posttest-1, remained at a similar level, while after three months in the group of people with depression, the result decreased significantly, reaching an average result below the pretest average. This was probably related to the intensification of depression and the resulting decrease in the efficiency of verbal and executive functions in the scope of the strategy of searching long-term memory according to the semantic criterion.

Discussion

The study assessed the effect of cognitive training on indicators of cognitive processes in people with schizophrenia and people with depression. The obtained results indicate an improvement in the scope of attention, memory, phonemic verbal fluency, language functions, visual-spatial functions and the general level of cognitive functioning in people with schizophrenia. This result is consistent with the results of previous studies (Krzystanek et al., 2013; Szöke et al., 2008), in which cognitive training was associated with the improvement of attention, memory and visual-spatial functions.

In the group of people with depression, improvements were achieved in attention, memory, phonemic verbal fluency, language functions and the overall level of cognitive functioning. The obtained result is consistent with the results of the meta-analysis by Launder et al. (2021) indicating that in people with depression, computer-based cognitive training is an effective therapeutic intervention that improves general cognitive functions, as well as efficiency in specific cognitive areas, including working memory or learning. They also confirm the conclusions from the meta-analysis by Motter et al. (2016), which showed a positive effect of cognitive training on the efficiency of attention, working memory and the level of general cognitive functioning. At the same time, it is worth noting that in our study, the improvement in attention in both groups concerned concentration during the performance of the auditory-verbal task. However, no changes were observed in the indicators measuring field search or shifting of attention on the visual-spatial material,

Analyzing the effect of cognitive training in people with schizophrenia compared to people with depression, it was found that cognitive training had a similar effect on the efficiency of cognitive functions in both groups in terms of memory, verbal fluency, language functions and the general level of cognitive functioning. However, in terms of attention and visual-spatial functions, the effect of cognitive training was greater in people with schizophrenia. Similarly, comparing the maintenance of the obtained effects of training in people with depression and people with schizophrenia over time, a significant difference was shown in terms of visual-spatial and attention

functions and semantic verbal fluency. These results may be related to the specificity of the studied groups. The subjects with schizophrenia were in remission, while all people with depression were found to have persistent depressive symptoms, which may limit the positive effect of cognitive training.

Limitations of own research

The limitation of the conducted study was the specificity of the study groups. While the study participants with schizophrenia were in remission, the patients with depression, despite treatment, still showed symptoms of depression of varying intensity. Moreover, the group of study participants was small, 24 people in the group of people with schizophrenia and 24 people in the group of people with depression. The third measurement, posttest-2, was performed on 13 people in the group of people with schizophrenia and 12 people in the group of people with depression. It is also worth emphasizing that the group of study participants was mostly not involved at all or was only slightly involved in social life, and none of the study participants was professionally active, which increases the specificity of the study sample and limits the possibility of generalizing the results to a wider population.

Conclusion

The results of the conducted studies lead to the conclusion that it is possible to achieve an improvement in cognitive functioning in patients with schizophrenia and patients with depression as a result of using cognitive function training. The effect of cognitive training on cognitive functions in people with schizophrenia in remission and people with depression is similar, although inconsistent. The cognitive functioning of patients with schizophrenia and patients with depression after cognitive training is maintained over time in most of the functions studied.

Translated by Katarzyna Jenek

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WPLYW TRENINGU KOGNITYWNEGO U PACJENTÓW ZE SCHIZOFRENIĄ W PORÓWNANIU DO CHORYCH Z DEPRESJĄ

Streszczenie.

Wprowadzenie: Dysfunkcje kognitywne występują w czasie trwania epizodu depresyjnego u około 94% pacjentów, a w czasie remisji u 44%. U części pacjentów zaburzenia poznawcze utrzymują się pomimo poprawy lub nawet ustąpienia innych objawów depresji. Zaburzenia poznawcze o różnym stopniu nasilenia występują także u prawie 90% chorych na schizofrenię. W ostatnim czasie wzrasta popularność oraz możliwości opracowywania treningów poznawczych, które stosowane są jako interwencje terapeutyczne w zaburzeniach psychicznych

Cel: Celem badania była ocena wpływu treningu kognitywnego z zastosowaniem programu EXEMEMORY na funkcje poznawcze w zakresie uwagi, pamięci, fluencji słownej, funkcji językowych oraz wzrokowo przestrzennych w depresji i w schizofrenii. **Metody:** W badaniu wzięło udział 48 mieszkańców Domu Po-

mocy Społecznej i uczestników Środowiskowego Domu Samopomocy w wieku od 35 do 65 lat, w tym 24 osoby z rozpoznaną depresją (średnia wieku $M = 49.25$) oraz 24 osoby z diagnozą schizofrenii (średnia wieku $M = 53.79$) Wszyscy badani uczestniczyli w ośmiu sesjach treningu kognitywnego w trakcie 4-tygodniowego cyklu. Cykl treningowy był poprzedzony i zakończony oceną funkcji poznawczych. U 25 osób dokonano oceny funkcji poznawczych również po ok. 3 miesiącach od zakończenia cyklu treningowego. **Wyniki:** Uzyskane wyniki wskazują na poprawę funkcjonowania poznawczego u osób ze schizofrenią w zakresie uwagi, pamięci i funkcji językowych oraz wzrokowo-przestrzennych. U osób z depresją wykazano poprawę w zakresie pamięci i funkcji językowych oraz ogólnego poziomu funkcjonowania poznawczego. Częściowo potwierdzono tezę o podobnym wpływie treningu poznawczego na funkcje poznawcze u osób z depresją i osób ze schizofrenią w okresie remisji. Wykazano istotną różnicę w utrzymywaniu się wyników w czasie pomiędzy osobami ze schizofrenią i z depresją, w zakresie uwagi i fluencji semantycznej.

Słowa kluczowe: depresja, schizofrenia, trening kognitywny, procesy poznawcze

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