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THE AUDIO RECORDED COGNITIVE SCREEN FOR BRIEF SCREENING OF COGNITIVE IMPAIRMENT IN PATIENTS WITH PSYCHOSIS – A PILOT STUDY

KOGNITIVINI SKRINING AUDIO-ZAPISOM KOD OBOLELIH OD PSIHOZE − PILOT STUDIJA

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Summary

Introduction. Disorders of cognitive functioning in patients with psychosis can manifest in different domains. The disorders vary depending on the severity, from mild to severe, and on the severity of symptoms within the underlying disease. The aim of this study was to examine the possibility of using the Audio Recorded Cognitive Screen in patients with schizophrenia. **Material and Methods.** The study included a total of 61 subjects divided into two groups: 31 subjects with schizophrenia and 30 healthy controls. All subjects completed the Audio Recorded Cognitive Screen to assess the cognitive status in five domains of cognitive functioning. **Results.** The Audio Recorded Cognitive Screen showed a good reliability index (α = 0.85). Multivariate analysis of variance confirmed the differences between the two groups in all examined cognitive domains (F (6.53) = 26.719, p < .001). The partial eta squared results were as follows: object naming 0.159; immediate recall 0.531; delayed recall 0.585; visuospatial functions 0.334; attention 0.644; and verbal fluency 0.590. These results indicated significant differences between the two groups. **Conclusion.** The Audio Recorded Cognitive Screen is a feasible tool for the detection of neurocognitive impairment in individuals with schizophrenia. However, it is necessary to conduct further research in larger samples and use additional assessment instruments in this population.

Key words: Cognition Disorders; Cognition; Auditory Perception; Psychotic Disorders; Schizophrenia; Neuropsychological Tests; Psychometrics

Sažetak

Uvod. Poremećaji u oblasti kognitivnog funkcionisanja kod obolelih od psihoze se mogu manifestovati u različitim domenima. Poremećaji mogu varirati u zavisnosti od težine, od blagih do izraženih, i od izraženosti simptoma u sklopu osnovne bolesti. Cilj istraživanja je da ispita mogućnost upotrebe Kognitivnog skrininga audio-zapisom (*Audio Recorded Cognitive Screen*) kod pacijenata sa šizofrenijom. **Materijal i metode.** Istraživanjem je obuhvaćen 61 ispitanik. Podeljeni su u dve grupe: 31 ispitanik sa šizofrenijom i 30 ispitanika zdrave populacije. Za procenu kognitivnog statusa je korišćen Kognitivini skrining audio zapisom koji procenjuje pet domena kognitivnog funkcionisanja. **Rezultati.** Korišćen instrument je pokazao dobru pouzdanost (α = 0,85). Multivarijantan analiza varijanse je potvrdila postajanje razlika između dve grupe u svim ispitivanim domenima (F (6,53) = 26,719, p < ,001). Rezultati parcijalnog eta kvadrata su sledeći: Imenovanje 0,159; Neposredno pamćenje 0,531; Odloženo pamćenje 0,585; Vizuoprostorne funkcije 0,334, Pažnja 0,644 i Verbalna fluentnost 0,590. Navedeno potvrđuje velike razlike između dve ispitivane grupe. **Zaključak.** Kognitvini skrining audio zapisom je primenjiv na popualciju osoba sa šizofrenijom za utvrđivanje kognitivnog statusa. Međutim, neophodno je sprovesti dalju analizu (istraživanje) na većem uzorku i uz korišćenje dodatnih instrumenata procene na ovoj populaciji.

Ključne reči: kognitivni poremećaji; kognicija; auditivna percepcija; psihotički poremećaji; šizofrenija; neuropsihološki testovi; psihometrija

Introduction

Schizophrenia is a complex mental disorder often associated with cognitive deficit that is an integral part of the clinical picture and represents a direct manifestation of schizophrenia neuropathology [1]. Cognitive impairment is a core feature of schizophrenia that usually predates the onset of clinical manifestations [2]. It has been reported that the incidence and intensity of these deficits vary and that about 75% of patients with schizophrenia have deficits in two domains, but about 25% have no neurocognitive deficits [3]. Although it could be expected that the manifestation of neurocognitive deficits correlates with the clinical symptoms of the disease, previous studies have shown that the correlation was low [4, 5] and that the deficits were more related to disorganized and negative symptoms, such as alogia or apathy [6]. Neurocognitive deficits tend to be persistent and are relatively independent during changes in the clinical condition of the patient. Deficits vary moderately with the severity and acuteness of psychotic symptoms, but do not disappear even in a good remission. It is considered that the new-generation antipsychotics, although indirectly beneficial, do not affect cognitive impairment significantly. Cognitive improvement after treatment with antipsychotics, and con-

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Abbreviations

ARCS – Audio Recorded Cognitive Screen
HAT – Hunter attentional task

sequently improved functional outcome, is regarded primarily an effect of withdrawal of psychotic symptoms and consequently more efficient use of cognitive resources [7, 8].

Neurocognitive deficits in schizophrenia may occur even several years before the onset of psychotic symptoms [8]. Social withdrawal and neurocognitive deficits are the earliest signs of schizophrenia, or have the highest correlation with the subsequent development of schizophrenia [9]. The results of neuropsychological studies of schizophrenia show generalized dysfunction. However, certain cognitive domains are more severely impaired, including: memory [10], especially deficits in working memory and verbal memory; attention [11], in particular selective attention; visuospatial ability [10, 12], executive function, manifesting problems characteristic for frontal lobe defects [13]. Verbal abilities are relatively preserved, but also impaired in comparison with healthy population [14]. Since neurocognitive functions include complex behavior, planning and communication, impairment in these areas may affect the quality of life and social functioning of people with schizophrenia [15, 16].

Numerous instruments with different levels of reliability, sensitivity and specificity have been proposed for the purpose of neurocognitive functioning assessment in patients with schizophrenia [17–19].

The aim of this pilot study was to estimate the validity of a brief screening of neurocognitive deficits in patients with schizophrenia using the Audio Recorded Cognitive Screen (ARCS). This was expected to validate the use of this instrument in the clinical practice to better assess neurocognitive deficits in patients with schizophrenia and thereby contribute to the development of effective rehabilitation and create more precise support programs, in order to improve the patients' overall psychosocial functioning.

Material and Methods

We conducted a comparative study between patients with schizophrenia and persons without a mental disorder. The sample included 31 subjects with schizophrenia (study group: 20 men and 11 women) and 30 subjects without a mental disorder (control group: 12 men and 19 women). Patients with schizophrenia fulfilled all the criteria of the International Classification of Diseases (ICD)-10 [20] and the diagnosis was made by a psychiatrist at the clinic/hospital. The average age of study subjects was 41.47 years (SD = 11.38), ranging from 20 to 60 years. Evaluation was conducted at follow-up visits. Selection criteria included a six-month stable treatment. Among controls, the average age was 36.70 years (SD = 13.55), ranging from 18 to 60 years. The controls did not have any psychological or physical diseases, or any previous mental disease. In both groups the subjects met the inclusion criteria of being literate and having normal hearing and sight, while the exclusion criterion was the presence of any head trauma or neurological disease. Using the t-test for independent samples, the age difference between the study and control groups was tested and there was no statistically significant difference ($t = 1.42$, $p = 0.161$).

As regards the level of education, about 20% of the study group completed only eight years of formal education and 16% completed 11 years of formal education. As opposed to controls, who had a college (23.3%) or university (30%) education in over 50%, the percentage of subjects with higher education in the study group was only 15%. Pearson's χ^2 test showed that the groups statistically significantly differed in regard to education; overall, controls had a higher level of education ($\chi^2 = 12.67$, $p < ,05$).

The instrument used in this research was the ARCS [21] for the detection of cognitive impairment or dementia in diseases such as Alzheimer's disease, multiple sclerosis, schizophrenia, or traumatic brain injury. Earlier studies showed the ARCS to be a useful brief assessment tool for examining the cognitive deficits associated with psychosis [22]. The ARCS has eight subtests that measure five cognitive domains: memory (short-term and long-term), verbal fluency, language (object naming), visuospatial functions (clock drawing) and attention - Hunter attentional task (HAT), HAT-A and HAT-B. The ARCS test/instrument is unsupervised, because it employs an audio device (computer, MP3 player, CD player). Before testing, the subjects receive clear instructions on how the testing is performed and what it requires. The key advantage of the ARCS is ease of use. It can be applied by professionals of all profiles. An additional advantage of the ARCS is that it takes about 3 minutes for a clinician to perform scoring and generate a cognitive profile of a respondent. The ARCS has good validity and reliability; in previous studies the reliability ranged from 0.70 HAT-B to 0.88 for total ARCS. It also has excellent sensitivity (92%) and specificity (90%) [22]. In our study, Cronbach's Alpha was 0.85, indicating a good reliability of the instrument that provides further interpretation of the results obtained.

The study was approved by the Ethics Committee of the Clinical Center of Vojvodina and it was conducted in accordance with the Helsinki Declaration.

Results

Descriptive statistics for the ARCS individual subtests and domain scores are presented in **Table 1**. In the study group, the distribution of responses on delayed recognition memory test exceeded the value of 2 (kurtosis 2.45), which deviates from normal distribution according to the criteria proposed by George and Mallery [23]. In the control group, the distribution of scores on the writing speed test (kurtosis = 10.44 and skewness = 2.89) exceeded the borderline values. Having a negative value, the distribution of scores was skewed to the left, which indicated that the test was very easy for the control group

Table 1. ARCS scores
Tabela 1. *Skorovi kognitivnog skrining audio-zapisa*

	Study group/*Eksperimentalna grupa*						Control group/*Kontrolna grupa*					
	Mean *Srednja vrednost*	SD *Standardna devijacija*	Min *Min*	Max *Maks*	Skew *Indikator zakrivljenosti*	Kurt *Indikator zaravnjenosti*	Mean *Srednja vrednost*	SD *Standardna devijacija*	Min *Min*	Max *Maks*	Skew *Indikator zakrivljenosti*	Kurt *Indikator zaravnjenosti*
Immediate recall *Neposredno pamćenje*	15,52	6,2	1	26	-0,47	-0,23	26,6	3,9	18	34	-0,08	-0,30
Visuospatial ability *Vizuoprostorne funkcije*	2,42	2,9	0	10	1,38	1.00	7,03	3,6	0	10	-0,78	-1,23
Writing speed *Brzina pisanja*	10,90	7,6	0	24	-0,25	-1,08	21,2	5,0	0	24	-2,89	10,44
Verbal fluency *Verbalna fluentnost*	18,55	7,5	5	35	0,28	-0,38	37,3	8,0	22	55	0,03	-0,39
Language (object naming) *Jezik (imenovanje predmeta)*	6,97	2,1	2	10	-0,90	0,15	8,43	1.0	7	10	0.30	-0.92
Delayed recall *Odloženo pamćenje*	8.19	3.9	0	12	-.093	-0.13	11.5	0.7	10	12	-1.18	-0.20
Attention/*Pažnja*	12.81	7.2	0	27	-0.39	-0.63	30.0	7.6	11	40	-0.37	-0.32

Legend: Skew - skewness, Kurt - kurtosis, SD – standard deviation
Legenda: Skew – Indikator zakrivljenosti, Kurt – indikator zaravnjenosti, SD – standardna devijacija

and that values (kurtosis) were grouped mainly around the arithmetic mean, which was quite high (M = 21.27). Significant deviation from the normal distribution was recorded also on the test of delayed recognition (false positive). Subjects in this group reported a very small number of false positives and they were grouped around the arithmetic mean, which means that the test was generally easy for them (i.e., they had a small number of false positives).

Multivariate variance analysis (MANOVA) was used to analyze differences between the groups on a series of cognitive functions. Prior to the analysis, separate scores were created for cognitive functions by adding the scores of the ARCS subtests, and then calculating the average value. Six cognitive domains were distinguished: immediate recall, delayed recall, visuospatial ability, language, attention, and verbal fluency. The model was significant ($F(6.53) = 26.719$, $p < .001$), indicating that there were significant differences between the two groups. Further analysis of the results revealed differences between the two groups in all cognitive domains **(Table 2)**.

The arithmetic means presented in **Table 2** show that controls had higher scores in all cognitive functions. In addition, it shows the effect size (partial eta squared) which indicates that in object naming test the effect size was moderate, while in immediate

Table 2. Comparison between the groups regarding the cognitive domains
Tabela 2. *Poređenje između grupa u odnosu na kognitivne domene*

		Mean *Srednja vrednost*	Standard deviation *Standardna devijacija*	F test *F test*	p/*p*	Effect size *Veličina efekta*
Immediate recall *Neposredno pamćenje*	SG	5.17	2.08	65.54	0.00	0.53
	CG	8.86	1.34			
Delayed recall *Odloženo pamćenje*	SG	3.97	3.09	81.73	0.00	0.58
	CG	9.83	1.67			
Visuospatial ability *Vizuoprostorne funkcije*	SG	2.42	2.91	29.08	0.00	0.33
	CG	7.03	3.69			
Language *Jezik*	SG	6.97	2.19	10.93	0.00	0.15
	CG	8.45	1.02			
Attention *Pažnja*	SG	9.96	5.81	104.73	0.00	0.64
	CG	26.87	6.96			
Verbal fluency *Verbalna fluentnost*	SG	6.18	2.52	83.63	0.00	0.59
	CG	12.32	2.67			

Legend/*Legenda*: SG - study group/*eksperimentalna grupa*; CG - control group/*kontrolna grupa*

recall, delayed recall, visuospatial ability, attention and verbal fluency, the effect was large, suggesting great differences between the two groups.

Discussion

Similar to the results of previous studies, our study shows that patients with schizophrenia exhibit neurocognitive deficits in different domains [14]. The application of the ARCS enabled us to analyze in which domains the deficits were most pronounced. Also, it took less than 1 h to assess impairments in five domains, which is attractive for clinical application [24]. Determination of the specificity of the neurocognitive profile in schizophrenia is made by comparison with controls, whether they are healthy subjects or patients with some other mental disorder (unipolar and bipolar affective disorders). All studies found significant differences in all domains, with the effect size varying from 0.75 to 1.5 [25], which was also confirmed in our study where all cognitive domains were affected by schizophrenia and the effect size ranged from moderate to severe. In patients with schizophrenia, we found prominent deviations in all domains, whereas differences greater than standard deviations were found in the domains of memory, attention and language. These data are in line with previous studies in which these domains were identified as the most affected areas in these patients [14]. Memory is the most frequently analyzed domain, being one of the most problematic ones, because it is manifested by rapid deterioration. Observing memory as a complex function, previous research has shown that schizophrenia usually seriously affects functional memory, and working memory deficits can be several standard deviations below normal [26]. Furthermore, it has shown that working memory has the strongest relationship with functional disability [27]. The overall cognitive functioning and deficits in memory, attention and executive functions in particular, along with the present symptomatology, are in a direct correlation with the functional outcome of treatment, i.e., social functioning of people suffering from schizophrenia [28]. In regard to visuospatial ability, unlike other studies which reported a small difference in the performance among subjects [28], our data indicate significantly lower achievement in subjects with schizophrenia compared with controls. Although there is evidence in the literature that this domain is the least impaired in schizophrenia, our study showed lower achievement also in the domain of attention, which could in part justify poorer functioning in tasks requiring visuospatial analysis and organization and constructive abilities. Sanz and associates [28] found a moderate correlation between years of education and visuospatial/constructive abilities and attention. In addition, cognitive abilities, functions such as language, are relatively preserved in patients with schizophrenia; however, in our study they were deficient compared with the control group.

Taking into account the limited size of our sample, as well as the low educational level among the subjects, this aspect should certainly be further examined and the results should be interpreted with caution. It should be kept in mind that in the group of patients with schizophrenia, the patterns of deficit depend on both the premorbid functioning and positive or negative symptomatology.

Conclusion

Cognitive function has gained a paramount importance in studying the etiology, course and treatment outcome of schizophrenia. Recognition of functional effects of cognitive deficits is important for planning therapeutic guidelines so that, in addition to pharmacotherapy, attention should be paid to cognitive rehabilitation in order to reduce the degree of functional disability of the patients. In relation to the application of the Audio Recorded Cognitive Screen for the detection of cognitive impairment in schizophrenia, our results show that this instrument has good and reliable characteristics and is useful in the clinical practice.

References

1. Palmer BW, Dawes SE, Heaton RK. What do we know about neuropsychological aspects of schizophrenia? Neuropsychol Rev. 2009;19(3):365-84.

2. Gil-Berrozpe GJ, Sánchez-Torres AM, García de Jalón E, Moreno-Izco L, Fañanás L, Peralta V, et al. Utility of the MoCA for cognitive impairment screening in long-term psychosis patients. Schizophr Res. 2020;216:429-34.

3. Ilonen T, Taiminen T, Karlsson H, Lauerma H, Leinonen KM, Wallenius E, et al. Neuropsychological subtyping of schizophrenia. Psychiatry Res. 2004;129(2):191-9.

4. Nieuwenstein MR, Aleman A, De Haan EH. Relationship between symptom dimensions and neurocognitive functioning in schizophrenia: a meta-analysis of WCST and CPT studies. J Psychiatr Res. 2001;35(2):119-25.

5. Zorlu P, Bilgic O, Sahin T, Zorlu N. Associations of psychiatric symptoms and neurocognition with clinical insight in schizophrenia. Dusunen Adam. 2017;30(2):79-85.

6. Addington J, Addington D, Maticka-Tyndale E. Cognitive functioning and positive and negative symptoms in schizophrenia. Schizophr Res. 1991;5(2):123-34.

7. Totić-Poznanović S, Pavlović DM, Đorđević JR, Pavlović AM, Marinković D. Neuropsychological assessment and treatment possibilities of cognitive deficit in schizophrenic patients. Vojnosanit Pregl. 2012;69(6):510-6.

8. Sharma T, Antonova L. Cognitive function in schizophrenia. Deficits, functional consequences and future treatment. Psychiatr Clin North Am. 2003;26(1):25-40.

9. Schuepbach D, Keshavan MS, Kmiec JA, Sweeney JA. Negative symptom resolution and improvements in specific

cognitive deficits after acute treatment in first-episode schizophrenia. Schizophr Res. 2002;53(3):249-61.

10. Fusar-Poli P, Bechdolf A, Taylor MJ, Bonoldi I, Carpenter WT, Yung AR, et al. At risk for schizophrenic or affective psychoses? A meta-analysis of DSM/ICD diagnostic outcomes in individuals at high clinical risk. Schizophr Bull. 2013;39(4):923-32.

11. Ordemann GJ, Opper J, Davalos D. Prospective memory in schizophrenia: a review. Schizophr Res. 2014;155(1-3):77-89.

12. Rund BR, Borg NE. Cognitive deficits and cognitive training in schizophrenic patients: a review. Acta Psychiatr Scand. 1999;100(2):85-95.

13. Loughland CM, Lewin TJ, Carr VJ, Sheedy J, Harris AW. RBANS neuropsychological profiles within schizophrenia samples recruited from non-clinical settings. Schizophr Res. 2007;89(1-3):232-42.

14. Pu S, Nakagome K, Itakura M, Iwata M, Nagata I, Kaneko K. Association of fronto-temporal function with cognitive ability in schizophrenia. Sci Rep. 2017;7:1-9.

15. McKenna PJ, Tamlyn D, Lund CE, Mortimer AM, Hammond S, Baddeley AD. Amnesic syndrome in schizophrenia. Psychol Med. 1990;20(4):967-72.

16. Lahera G, Ruiz A, Brañas A, Vicens M, Orozco A. Tiempo de reacción, velocidad de procesamiento y atención sostenida en esquizofrenia: impacto sobre el funcionamiento social. Rev Psiquiatr Salud Ment. 2017;10(4):197-205.

17. Bae SM, Lee SH, Park YM, Hyun MH, Yoon H. Predictive factors of social functioning in patients with schizophrenia: exploration for the best combination of variables using data mining. Psychiatry Investig. 2010;7(2):93-101.

18. De la Torre GG, Perez MJ, Ramallo MA, Randolph C, González-Villegas MB. Screening of cognitive impairment in schizophrenia: reliability, sensitivity, and specificity of the repeatable battery for the assessment of neuropsychological status in Spanish sample. Assessment. 2015;23(2):221-31.

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19. Alessandrini M, Lançon C, Fond G, Faget-Agius C, Richieri R, Faugere M, et al. A structural equation modelling approach to explore the determinants of quality of life in schizophrenia. Schizophr Res. 2016;171(1-3):27-34.

20. World Health Organization. The ICD-10 classification of mental and behavioural disorders: clinical descriptions and diagnostic guidelines. Geneva: WHO; 1992.

21. Schofield PW, Lee SJ, Lewin TJ, Lyall G, Moyle J, Attia J, et al. the Audio Recorded Cognitive Screen (ARCS): a flexible hybrid cognitive test instrument. J Neurol Neurosurg Psychiatry. 2010;81(6):602-7.

22. Loughland CM, Allen J, Gianacas L, Schofield PW, Lewin TJ, Hunter M, et al. Brief neuropsychological profiles in psychosis: a pilot study using the Audio Recorded Cognitive Screen (ARCS). Acta Neuropsychiatr. 2010;22(5):243-52.

23. George D, Mallery P. SPSS for Windows step by step: a simple guide and reference, 17.0 update. 10th ed. Boston: Pearson; 2010.

24. Sagar R, Sahu A, Pattanayak RD, Chatterjee B. Assessment of cognitive functions in bipolar I disorder: a 1-year naturalistic follow-up study. Bipolar Disord. 2018;20(3):248-59.

25. Heinrichs RW, Zakzanis KK. Neurocognitive deficit in schizophrenia: a quantitative review of the evidence. Neuropsychology. 1998;12(3):426-45.

26. Green MF, Kern RS, Braff DL, Mintz J. Neurocognitive deficits and functional outcome in schizophrenia: are we measuring the „right stuff"? Schizophr Bull. 2006;26(1):119-36.

27. Zaragoza Domingo S, Bobes J, García-Portilla MP, Morralla C. Cognitive performance associated to functional outcomes in stable outpatients with schizophrenia. Schizophr Res Cogn. 2015;2(3):146-58.

28. Sanz JC, Vargas ML, Marin JJ. Battery for assessment of neuropsychological status (RBANS) in schizophrenia: a pilot study in the Spanish population. Acta Neuropsychiatr. 2009;21(1):18-25.