

Darii V. I., Safonov D. M. Comparison of basic neurocognitive violations in patients with residual schizophrenia with and without history of ischemic stroke. *Journal of Education, Health and Sport.* 2023;47(1):84-94. eISSN 2391-8306. DOI <http://dx.doi.org/10.12775/JEHS.2023.47.01.008> <https://apcz.umk.pl/JEHS/article/view/46294> <https://zenodo.org/record/8368546>

The journal has had 40 points in Ministry of Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Education and Science of 17.07.2023 No. 32318. Has a Journal's Unique Identifier: 201159. Scientific disciplines assigned: Physical Culture Sciences (Field of Medical sciences and health sciences); Health Sciences (Field of Medical Sciences and Health Sciences). Punkty Ministerialne z 2019 - aktualny rok 40 punktów. Załącznik do komunikatu Ministra Edukacji i Nauki z dnia 17.07.2023 Lp. 32318. Posiada Unikatowy Identyfikator Czasopisma: 201159. Przynależność dyscypliny naukowej: Nauki o kulturze fizycznej (Dziedzina nauk medycznych i nauk o zdrowiu); Nauki o zdrowiu (Dziedzina nauk medycznych i nauk o zdrowiu).

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Received: 29.07.2023. Revised: 21.08.2023. Accepted: 28.08.2023. Published: 29.08.2023.

## COMPARISON OF BASIC NEUROCOGNITIVE VIOLATIONS IN PATIENTS WITH RESIDUAL SCHIZOPHRENIA WITH AND WITHOUT HISTORY OF ISCHEMIC STROKE

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### Abstract

**Relevance.** The cognitive symptoms associated with schizophrenia have been a subject of controversy and are often viewed through a dualistic lens. According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), these cognitive symptoms can be further elucidated within specific neurocognitive domains.

Many of the symptoms of schizophrenia manifest behaviorally and can be challenging to differentiate from the consequences of organic brain impairment, especially when these symptoms involve the frontal and temporal cortex or have a diffuse presentation.

**Aim** – to evaluate neurocognitive deficit in patients with residual schizophrenia with history of ischemic stroke.

**Materials and methods.** A comprehensive study was conducted involving 100 patients diagnosed with recurrent schizophrenia (ICD-10: F20.5) at the Communal Non-Profit

Enterprise "Regional Clinical Institution for the Provision of Psychiatric Care". We selected 59 patients: 32 patients with residual schizophrenia without history of stroke (Group 1, G1) and 27 patients with residual schizophrenia with history of stroke (Group 2, G2). Neuropsychological testing was used to evaluate neurocognitive violations. Due to massive distortions that brought to testing results by schizophrenia negative symptoms, only general evaluation was made to reflect critical or non-critical to no violations in separate functions. Statistical method of chi-square test was used to compare results in groups.

**Study results.** To compare neurocognitive violations in G1 and G2 we performed neuropsychological testing in basic neurocognitive domains. G2 patients, diagnosed with both schizophrenia and a stroke, generally exhibit heightened cognitive impairments compared to G1 patients with only schizophrenia. Notably, deficits in Sustained Attention, Divided Attention, Processing Speed, Working Memory, Mental Flexibility, immediate memory, implicit learning, and both expressive and receptive language are more pronounced in G2 patients. However, for functions like Selective Attention, Planning, Decision-Making, recent and very-long-term memory, and interpersonal understanding, the added influence of a stroke in G2 doesn't drastically differentiate them from G1. In essence, while schizophrenia inherently poses cognitive challenges, the co-occurrence of a stroke amplifies certain deficits but not others. This data suggests a complex interplay between schizophrenia and stroke in influencing cognitive function.

**Conclusions.** The coexistence of schizophrenia and a history of stroke in G2 patients frequently exacerbates certain cognitive impairments when compared to those diagnosed solely with schizophrenia. This underlines the compounded cognitive challenges faced by patients with comorbid conditions. However, for some cognitive domains, the severity of impairments is primarily governed by schizophrenia, irrespective of the presence of an additional stroke history. This comprehensive analysis underscores the complex interplay of multiple conditions on cognitive function and emphasizes the importance of individualized care and intervention strategies tailored to the specific cognitive challenges faced by each patient group.

**Key words: schizophrenia; ischemic stroke; stroke; neurocognitive domains; neurocognitive functions.**

**Relevance.** The cognitive symptoms associated with schizophrenia have been a subject of controversy and are often viewed through a dualistic lens. According to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), these

cognitive symptoms can be further elucidated within specific neurocognitive domains [1, 3, 7, 8].

On one hand, cognitive symptoms are considered as part of a negative complex of symptoms, where cognitive dysfunction appears to be a secondary complication stemming from emotional and motivational dysregulation. These cognitive impairments can be categorized within various neurocognitive domains as outlined in the DSM-5, such as attention, executive function, working memory, and processing speed [1, 4, 5].

On the other hand, cognitive symptoms are regarded as a distinct category of manifestations within schizophrenia, comprising a significant portion of the residual condition. These cognitive deficits, as per the DSM-5, can encompass deficits in areas like verbal memory, visual memory, reasoning and problem-solving, and social cognition [1, 2, 3, 7, 8].

It is worth noting that common diagnostic tools employed to evaluate schizophrenia symptoms typically pay limited attention to cognitive symptoms, partly because they are thought to have a relatively lower impact on the overall clinical condition. Consequently, comprehensive data on cognitive impairment in schizophrenia necessitates more than just an analysis of case histories [8].

Recent studies have identified several risk factors for organic brain impairment that are particularly relevant to individuals with schizophrenia. These factors include the chronic use of antipsychotic medications, a reduced likelihood of early engagement in preventive treatment programs, irregular lifestyle choices, eating habits, levels of physical activity, and various behavioral risks [2, 3, 7, 8].

Many of the symptoms of schizophrenia manifest behaviorally and can be challenging to differentiate from the consequences of organic brain impairment, especially when these symptoms involve the frontal and temporal cortex or have a diffuse presentation.

**Aim** – to evaluate neurocognitive deficit in patients with residual schizophrenia with history of ischemic stroke.

**Materials and methods.** A comprehensive study was conducted involving 100 patients diagnosed with recurrent schizophrenia (ICD-10: F20.5) at the Communal Non-Profit Enterprise "Regional Clinical Institution for the Provision of Psychiatric Care" under the jurisdiction of the Zaporizhzhia Regional Council. This research spanned the years from 2010 to 2023 and aimed to shed light on the characteristics of this complex disorder.

Among the participants, there was a notable gender distribution, with 71% being male and 29% being female patients. The average age of the patients was 55,0 years, with a

standard deviation of 13,1 years. The mean duration of the disease was approximately 31,2 years, and the average age at which clinical manifestations first appeared was 24,1 years.

The study also delved into the basic characteristics of the disease course, drawing from known medical history within the study cohort. These characteristics encompassed various diagnostic forms based on the ICD-10 classification, with the majority having a prior diagnosis of the paranoid form (92%). Other forms included the simple form (3%), catatonic form (2%), and hebephrenic form (1%). The study also identified different dynamic types, with 57% characterized as constantly progressive, 35% as paroxysmal-progressive, and 8% as paroxysmal. Hospitalization patterns varied, with 24% having a stereotype of 2 or more annual hospitalizations, 34% having 1 annual hospitalization, and 40% having less than 1 annual hospitalization.

History of cerebrovascular catastrophes in study contingent: single ischemic stroke in the anterior meningeal area: 6 cases; single ischemic stroke in the medial meningeal area: 9 cases; single ischemic stroke in the posterior meningeal area: 5 cases; single ischemic stroke in the vertebrobasilar area: 5 cases; multiple ischemic strokes: 4 cases.

To organize study groups some patients were excluded by criteria of diffuse CV pathology: cerebral atherosclerosis was observed in 8 cases; arterial hypertension of stage 1 was identified in 5 cases; arterial hypertension of stage 2 was noted in 13 cases; arterial hypertension of stage 3 was detected in 2 cases. Furthermore, in the context of specific brain conditions: traumatic brain injuries were documented in 28 cases; instances of asphyxia were identified in 8 cases; minor diffuse brain impairment (encephalopathy) was noted in 27 cases.

We selected 59 patients: 32 patients with residual schizophrenia without history of stroke (Group 1, G1) and 27 patients with residual schizophrenia with history of stroke (Group 2, G2).

Neuropsychological testing was used to evaluate neurocognitive violations. Due to massive distortions that brought to testing results by schizophrenia negative symptoms, only general evaluation was made to reflect critical or non-critical to no violations in separate functions. Statistical method of chi-square test was used to compare results in groups.

**Study results.** To compare neurocognitive violations in G1 and G2 we performed neuropsychological testing in basic neurocognitive domains (tables 1–6).

Upon examining cognitive functions associated with attention and processing, G2 patients, who have both schizophrenia and a history of stroke, manifest more pronounced deficits in certain areas compared to G1 patients with only schizophrenia.

Table 1.

## Complex attention critical violations in study groups.

Function	Critical impairment criteria	G1 (n=32)	p( $\chi^2$ )	G2 (n=27)
Sustained Attention	An inability to focus on a task or maintain attention for even short periods, leading to severe difficulty in completing daily activities.	9	0,03	15
Divided Attention	Extreme difficulty multitasking or managing more than one task simultaneously, resulting in frequent errors or inability to perform routine tasks.	12	0,01	19
Selective Attention	Severe difficulty in filtering out irrelevant information, causing significant distractibility.	21	0,93	18
Processing Speed	A marked decrease in processing speed, significantly impacting the ability to understand and respond to information in real-time.	9	0,01	17

G2 patients, with a combined diagnosis of schizophrenia and a history of stroke, display significant impairments in Sustained Attention, Divided Attention, and Processing Speed compared to G1 patients who only have schizophrenia. These findings suggest that the co-occurrence of a stroke with schizophrenia might further deteriorate the patient's attention and processing abilities. However, when it comes to Selective Attention, both groups seem similarly affected, indicating that this particular deficit might be more influenced by the presence of schizophrenia itself rather than the combined effects of schizophrenia and stroke.

When evaluating cognitive functions related to executive abilities, G2 patients, with both schizophrenia and a history of stroke, display varied degrees of deficits compared to G1 patients who only have schizophrenia.

Considering the data, it can be hypothesized that while both G1 and G2 patients show challenges across various executive functions, the combined effects of schizophrenia and a stroke in G2 patients appear to particularly exacerbate impairments in areas like Working Memory and Mental Flexibility. Conversely, for functions like Planning, Decision-Making,

Responding to Feedback, and Overriding Habits, the additional stroke history in G2 doesn't seem to contribute to statistically significant differences from G1.

Table 2.

Executive functioning critical violations in study groups.

Function	Critical impairment criteria	G1 (n=32)	p( $\chi^2$ )	G2 (n=27)
Planning	Inability to plan daily activities, make simple decisions, or follow a routine.	26	0,68	23
Decision-Making	Difficulty in making choices or decisions, even for routine matters.	27	0,19	19
Working Memory	Severe deficits in remembering and using information for immediate tasks.	7	0,01	18
Responding to Feedback/Error Correction	An inability to learn from mistakes or adjust behavior based on feedback.	11	0,93	9
Overriding Habits/Inhibition	Impulsive behavior and difficulty inhibiting inappropriate responses.	20	0,73	18
Mental Flexibility	Extreme inflexibility in adapting to changes in routine or environment.	17	0,01	23

Table 3.

Learning and Memory critical violations in study groups.

Function	Critical impairment criteria	G1 (n=32)	p( $\chi^2$ )	G2 (n=27)
Immediate Memory	Difficulty in remembering and using information presented in the short term.	4	0,01	14
Recent Memory	Significant deficits in recalling recent events, conversations, or tasks.	5	0,32	7
Very-Long-Term Memory	Profound impairment in recalling semantic (general knowledge) or autobiographical (personal) information.	3	0,09	7
Implicit Learning	An inability to acquire new skills or knowledge through exposure or practice.	11	0,01	21

Upon examining memory and learning functions, G2 patients consistently demonstrate more pronounced deficits compared to G1 patients.

Given this data, it can be hypothesized that G2 patients, having both schizophrenia and a history of stroke, face significantly greater challenges in immediate memory and implicit learning when compared to G1 patients, who are only diagnosed with schizophrenia. For other memory-related functions like recent and very-long-term memory, the added presence of a stroke in G2 does not seem to exacerbate the impairments drastically.

Table 4.

Language critical violations in study groups.

Function	Critical impairment criteria	G1 (n=32)	p( $\chi^2$ )	G2 (n=27)
Expressive Language	Severe deficits in the ability to communicate effectively, including difficulty finding words, forming coherent sentences, or maintaining a conversation.	17	0,02	22
Receptive Language	Struggles in understanding spoken or written language, including difficulty following instructions or comprehending complex language.	8	0,01	19

Table 5.

Perceptual-Motor critical violations in study groups.

Function	Critical impairment criteria	G1 (n=32)	p( $\chi^2$ )	G2 (n=27)
Visual Perception	Difficulty recognizing or interpreting visual information, such as objects, shapes, or faces.	7	0,11	11
Visuoconstructional	Inability to copy or construct visual patterns, drawings, or designs accurately.	4	0,02	10

When evaluating language-related cognitive functions, G2 patients show significantly greater impairments compared to G1 patients.

Considering the data, it can be hypothesized that G2 patients, those with both schizophrenia and a history of stroke, are at a heightened risk for both expressive and receptive language impairments when compared to G1 patients, who only have schizophrenia. This suggests that the co-occurrence of stroke in schizophrenic patients might intensify language-related cognitive challenges.

In perceptual-Motor domain, G2 patients seem to exhibit a more pronounced impairment compared to G1 patients.

Based on this data, it can be hypothesized that the combined effects of schizophrenia and a stroke in G2 patients might contribute to greater visual cognitive impairments, especially in tasks requiring visuoconstructional abilities, compared to the impairments faced by G1 patients with only schizophrenia.

Table 6.

Social Cognition critical violations in study groups.

Function	Critical impairment criteria	G1 (n=32)	p( $\chi^2$ )	G2 (n=27)
Recognition of Emotions	An inability to recognize or understand others' emotions based on facial expressions or body language.	27	0,61	24
Theory of Mind	Severe deficits in understanding and predicting others' thoughts, feelings, or intentions.	27	0,19	19

In examining the cognitive aspects related to interpersonal understanding, both Recognition of Emotions and Theory of Mind present notable challenges for both G1 and G2 patients.

While both G1 and G2 patients display significant impairments in their capacity to recognize emotions and understand others' mental states, the additional complication of a stroke in G2 patients does not seem to exacerbate these challenges significantly more than in G1 patients. This implies that the deficits in interpersonal understanding, as measured by these two domains, might be more prominently influenced by the presence of schizophrenia itself rather than the combined effects of schizophrenia and a stroke.

The study presented some useful findings, yet there were several limitations that need to be considered while interpreting the results. The relatively small sample size for both G1 and G2 groups might not offer comprehensive statistical insights, potentially leading to



overlooked discrepancies. This sample was also not randomly selected, introducing potential selection bias and raising questions about the broader applicability of the results to the general population of individuals with schizophrenia and/or stroke. Other potential confounding variables, such as underlying conditions or external factors impacting cognitive function, were not thoroughly addressed, potentially influencing the outcomes. The measurement tools employed for assessing cognitive functions might have inherent biases and might not be exhaustive in their assessment range. This limitation casts uncertainty on the depth and breadth of cognitive domains evaluated. Moreover, the study's findings may not be readily generalizable across diverse demographics, comorbidities, or different cultural contexts. The cross-sectional nature of the research makes it difficult to infer causal relationships or the trajectory of cognitive challenges over time. Finally, potential variations in examiner interpretations during cognitive assessments introduce an element of subjectivity, which might have led to inconsistent evaluations. It's also worth noting that the study didn't sufficiently factor in the effects of medications or treatments that participants might have been undergoing.

**Conclusions.** Through a comprehensive analysis of cognitive functions across various domains, clear distinctions have emerged between G1 patients, diagnosed solely with schizophrenia, and G2 patients, diagnosed with both schizophrenia and a history of stroke.

G2 patients, with both schizophrenia and a stroke history, generally displayed more pronounced cognitive deficits across multiple domains than G1 patients with only schizophrenia. Especially notable were the intensified challenges in sustained attention, divided attention, processing speed, immediate memory, implicit learning, working memory, mental flexibility, and language functions. However, certain areas, such as selective attention and specific executive functions, seemed mainly influenced by schizophrenia, with the presence of stroke showing minimal added impairment. The data reveals the intricate cognitive effects of comorbid conditions.

The coexistence of schizophrenia and a history of stroke in G2 patients frequently exacerbates certain cognitive impairments when compared to those diagnosed solely with schizophrenia. This underlines the compounded cognitive challenges faced by patients with comorbid conditions. However, for some cognitive domains, the severity of impairments is primarily governed by schizophrenia, irrespective of the presence of an additional stroke history. This comprehensive analysis underscores the complex interplay of multiple conditions on cognitive function and emphasizes the importance of individualized care and

intervention strategies tailored to the specific cognitive challenges faced by each patient group.

### **Author Contributions**

Conceptualization, Darii V.I. and Safonov D.M.; methodology, Safonov D.M.; formal analysis, Darii V.I. and Safonov D.M.; investigation, Safonov D.M.; resources, Darii V.I. and Safonov D.M.; data curation, Safonov D.M.; writing—original draft preparation, Safonov D.M.; writing—review and editing, Safonov D.M.; supervision, Darii V.I.; project administration, Darii V.I.; funding acquisition, Darii V.I.

All authors have read and agreed to the published version of the manuscript.

### **Funding**

This study funded by authors private initiative.

### **Institutional Review Board Statement**

The study was conducted in accordance with the Declaration of Helsinki and approved by the department of psychiatry, psychotherapy, general and medical psychology, narcology and sexology of Zaporizhzhya state medical-pharmacological university.

### **Informed Consent Statement**

Informed consent was obtained from all subjects involved in the study.

### **Data Availability Statement**

The data presented in this study are available on request from the corresponding author.

### **Acknowledgments**

The authors would like to thank Chuhunov Vadym from the department of psychiatry, psychotherapy, general and medical psychology, narcology and sexology of Zaporizhzhya state medical-pharmacological university for discussions on topic.

### **Conflicts of Interest**

The authors declare no conflict of interest.

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