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Pilot Study on the Role of Computerised Cognitive Stimulation in Schizophrenia: Effects on Cognitive Function and Quality of Life

Andreea-Cătălina Moroșan
Discipline of Psychiatry, Faculty of Medicine Department of Morpho-Functional Sciences (I), Grigore T. Popa University of Medicine and Pharmacy, Iasi, Romania.
Advanced Research-Development Centre in Experimental Medicine Prof. Ostin C. Mungiu - CEMEX, Grigore T. Popa University of Medicine and Pharmacy, lasi, Romania.
andreeearus@yahoo.com,
andreea.morosan@umfiasi.ro,
https://orcid.org/0009-0001-7794-9842

George-Cătălin Moroșan*
Department of Morpho-Functional Sciences (I), Faculty of Medicine, Grigore T. Popa University of Medicine and Pharmacy, Iasi, Romania.
morosangeorgecatalin@yahoo.com,
george-catalin.morosan@umfiasi.ro;
Tel.: +40748151209
https://orcid.org/0009-0002-4025-3304

Ana-Maria Dumitrescu
Department of Morpho-Functional Sciences (I), Faculty of Medicine, Grigore T. Popa University Medicine and Pharmacy, Iasi, Romania.

Diana-Maria Ichim
Discipline of Psychiatry, Faculty of Medicine, Grigore T. Popa University of Medicine and Pharmacy, Iasi, Romania.

Lucia Corina Dima Cozma
1st Medical Department, Faculty of Medicine, Grigore T. Popa University of Medicine and Pharmacy, Iasi, Romania.
https://orcid.org/0000-0003-0897-8639

Roxana Chirița
Faculty of Medicine Discipline of Psychiatry, Grigore T. Popa University of Medicine and Pharmacy, Iasi, Romania; Advanced Research-Development Centre in Experimental Medicine Prof. Ostin C. Mungiu - CEMEX, Grigore T. Popa University of Medicine and Pharmacy, Iasi, Romania.

**Corresponding author*

Abstract: *Background/Objectives: Schizophrenia is a severe mental disorder frequently associated with cognitive impairments that negatively impact patients' functional outcomes and quality of life. Standard pharmacological treatments primarily address positive symptoms, while cognitive deficits remain insufficiently targeted. This study aimed to assess the effectiveness of computer-assisted cognitive stimulation therapy (CCST) in improving cognitive performance, psychiatric symptoms, and quality of life in patients with schizophrenia. Methods: We conducted a prospective, comparative observational study involving two groups of clinically stable patients diagnosed with schizophrenia. The studied group (n=5) underwent a 6-week individualised CCST programme using RehaCom software (12 sessions, twice weekly), while the control group (n=5) received no cognitive training and had no psychiatric conditions. Assessments were conducted at baseline and post-intervention using the Mini-Mental State Examination (MMSE), Brief Psychiatric Rating Scale (BPRS), Quality of Life Inventory (QOLI), and RehaCom cognitive screening across nine domains. Results: Participants in the studied group exhibited noticeable improvements in multiple cognitive domains (particularly in alertness, distributed attention, and working memory) as well as enhanced scores on psychiatric and quality of life assessments. Conclusions: Computer-assisted cognitive stimulation may serve as a promising complementary intervention to enhance cognitive function and psychosocial well-being in patients with schizophrenia. The individualised nature of the training supports its applicability in clinical settings. Further randomised studies with larger samples and extended follow-up periods are encouraged.*

Keywords: *schizophrenia; cognitive stimulation; CCST; RehaCom; cognitive rehabilitation; MMSE; BPRS; QOLI; social cognition; working memory; attention.*

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1. Introduction

Schizophrenia is a chronic, severe mental disorder characterised by disturbances in thought processes, perception, emotions, and behaviour (McGrath et al., 2008). This disorder can present with a range of symptoms, from positive symptoms such as hallucinations, delusions, disorganised thinking, and abnormal motor activity, to negative symptoms such as avolition, alogia, anhedonia, and affective flattening. In addition, cognitive impairments may occur, including poor concentration and memory, impaired executive function, and difficulty understanding social cues. (Vahia, 2013). The focus of the present manuscript is cognitive impairment and the therapeutic approach to address them.

The etiology of schizophrenia is still not established however, the scientific community has agreed that it is complex, multifaceted and influenced by the interactions between different factors from genetics and neurochemical imbalance to brain structure abnormalities and environmental factors (Luvsannyam et al., 2022; Moroșan et al., 2024). In addition to cognitive and affective deficits, patients with schizophrenia frequently face an increased risk of aggressive behaviours, which negatively impacts their quality of life and social integration (Bonea et al., 2024). In terms of therapeutic options, the most common approach is the therapy with antipsychotic medications, that mostly addresses the positive symptoms, coupled with psychosocial and behavioural therapies such as cognitive behavioural therapy for psychosis (CBTp), social skills training (SST), family therapy, and supported employment and rehabilitation programmes (Barlati, Nibbio, & Vita, 2024; Guaiana et al., 2022; Elis, Caponigro, & Kring, 2013). In schizophrenia, cognitive dysfunction represents a core domain of disability. Similar to evidence from mild traumatic brain injury, where impairments extend from global dysfunction to executive and memory deficits (Mavroudis et al., 2024), cognitive stimulation programmes aim to precisely target these vulnerable domains in order to improve long-term functional outcomes and quality of life.

One of the relatively new therapeutic approaches addressing the cognitive deficits associated with schizophrenia is the computerised cognitive stimulation (CCST) (Hu et al., 2024). The type of CCST used in the present study is computerised social cognitive training (CSCT) - a digital intervention designed to improve social cognition (Lim & Penn, 2018). Social cognition refers to the ability to understand and respond appropriately to social cues, emotion, and interactions, which is often impaired in schizophrenia (Green, Horan, & Lee, 2019). CSCT involves interactive, computer-based tasks that target memory, attention, executive function, and problem-solving abilities that are often impaired in schizophrenia (Kurtz et al., 2007).

CSCT programmes involve computerised exercises and digital simulations to train different aspects of social cognition such as emotion recognition training, theory of mind (ToM) training, social perception, interaction training, and cognitive bias modification (Schoeneman Patel et al., 2022; Jones & Harvey, 2020). In these training modules, patients identify and interpret facial expressions in computer-based tasks, engage in scenarios that require understanding others' perspectives, practice appropriate responses to social interactions, and hopefully help in reducing paranoia and misinterpretations of social situations (Nijman et al., 2023; Nahum et al., 2021). These programmes aim to improve social inference and empathy, reframing negative or distorted thoughts (Jones et al., 2018).

Studies have shown that CSCT improves emotion recognition and interpretation, enhances social engagement and communication skills, reduces social anxiety and misinterpretations of other's intentions, and increases confidence in real-world social interactions (Jones et al., 2018). Based on these findings, in the current study we explore whether CSCT specifically improves the cognitive deficits of schizophrenia.

For clarity, throughout this manuscript we will use the term "CCST" to describe the intervention tested, in line with previous literature. The aim of this pilot feasibility study was to evaluate the potential effects of CCST on cognitive functioning, psychiatric symptoms, and quality of life in patients with schizophrenia, and to examine the feasibility of implementing such an intervention in clinical practice.

2. Materials and Methods

2.1. Patients Selection

Patients have been selected through an initial evaluation that included medical history, psychiatry evaluation, and diagnosis confirmation according to ICD-10 criteria. Inclusion criteria were: ability to understand and complete the study procedures, diagnosis of schizophrenia clinically stable without major medication changes in the four weeks prior to the start of the study, and the ability of verbal communication and collaboration with the research team. Exclusion criteria included: having a mental disorder caused by a brain lesion, diagnoses other than schizophrenia, history of substance abuse or addiction in the last six months, and the presence of any medical or psychiatric conditions that could interfere.

2.2. Study Design

This study employed a prospective, comparative observational design, serving as a pilot study of the potential use of CSCT as a therapy option and was conducted in a specialised psychiatric care clinic. The objective was to assess the efficacy of computer-assisted cognitive stimulation therapy using RehaCom software (HASOMED GmbH, Germany) in improving cognitive function, psychiatric symptoms, and quality of life in patients diagnosed with schizophrenia.

Participants were divided into two groups:

- ***Group 1*** (Control group): Healthy individuals with no psychiatric conditions, without any type of pharmaceutical treatment. They were selected on a voluntary basis and they only underwent the baseline cognitive assessment.
- ***Group 2*** (Studied group): Patients with schizophrenia who received the same baseline assessment, followed by a structured 6-week cognitive stimulation programme using RehaCom. The patients were selected on a voluntary basis where 10 agreed to do the screening but only five agreed to continue with the CSCT therapy sessions. The intervention consisted of 12 individual sessions (two 30-minute sessions per week), administered in an outpatient setting. Post-intervention, patients were re-evaluated using the same battery of assessments (MMSE, BPRS, QOLI, and RehaCom screening).

Cognitive function was assessed using the RehaCom screening tool, which evaluates nine specific domains: alertness, distributed attention, selective attention, spatial association in numerical cognition, working memory/short-term memory, semantic memory/long-term memory, logical reasoning, campimetry, and visual field. These domains were measured at baseline and after the intervention, enabling comparison of pre- and post-therapy performance. The RehaCom software uses standardised normative data adjusted for age and sex to generate individualised cognitive profiles and recommend appropriate training modules.

In parallel, psychiatric symptoms and general functioning were monitored using three validated instruments: MMSE for global cognitive screening, BPRS for psychotic symptom severity, and QOLI for subjective quality of life. These scales were applied at both time points (baseline and end of study).

The RehaCom modules were individually selected based on each patient's cognitive profile as determined by the initial screening. The programme adapts difficulty dynamically depending on performance, allowing for personalised progression. The primary outcomes were the changes in cognitive function (MMSE and RehaCom scores) from baseline to post-intervention.

RehaCom has previously demonstrated efficacy in cognitive rehabilitation and is validated for clinical use (Fernández-Calvo et al., 2011).

2.3. Statistical Analysis

Statistical analysis was performed using GraphPad Prism version 11. One-way ANOVA and Student's t-tests were applied to assess the effectiveness of cognitive stimulation therapy across the nine cognitive domains evaluated by RehaCom, as well as changes in psychiatric scales (MMSE, BPRS, QOLI).

The analyses were conducted to determine whether the intervention produced significant improvements and whether the 6-week therapy period was sufficient to induce measurable cognitive and clinical changes. A p-value < 0.05 was considered statistically significant.

All personal data were collected and stored in accordance with the General Data Protection Regulation (GDPR), based on signed informed consent. No identifiable patient data were used in this publication.

2.4. Ethical Considerations

The study was approved by the Ethic Committee of Grigore T. Popa University of Medicine and Pharmacy (Approval No. 465/9.07.2024). All procedures were carried out in compliance with the applicable national and institutional laws and regulations.

3. Results

In total, 60% of participants were male and originated from urban areas. Ages ranged from 32 to 50 years, with a mean of 42.9 years (SD = 6.0). Educational levels ranged from primary school to university degrees, with both groups presenting a similar distribution. The distribution of participants according to sex, urbanicity, and age is illustrated in Figure 1.

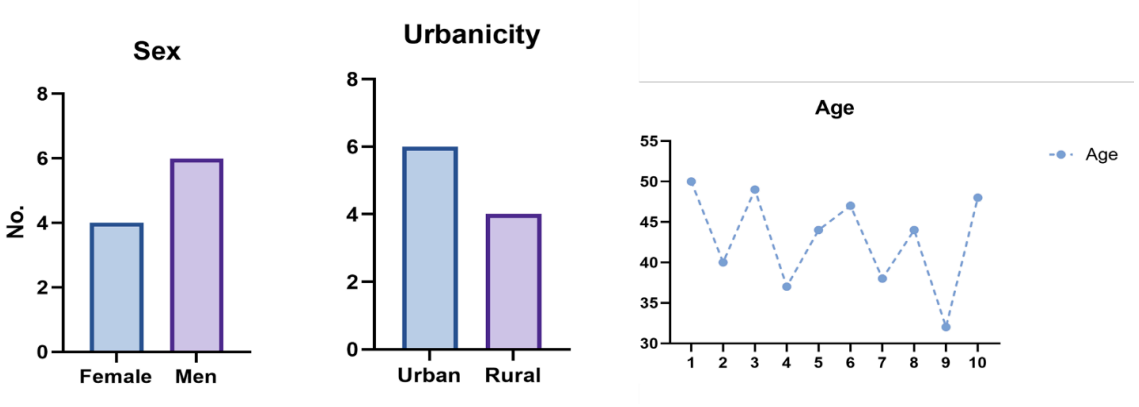


Figure 1. Distribution of participants (study group) based on sex, urbanicity, and age

As expected, baseline analyses confirmed that patients with schizophrenia performed significantly worse than healthy controls across several cognitive domains. After the 6-week CCST intervention, patients demonstrated numerical improvements in alertness, distributed attention, and working memory, along with higher quality-of-life scores and lower psychiatric symptoms. However, due to the exceedingly small sample size, these differences did not reach statistical significance and should be interpreted as exploratory trends rather than conclusive evidence.

All included patients were undergoing pharmacological treatment with combinations of antipsychotic agents, including second-generation (atypical) antipsychotics such as olanzapine, risperidone, paliperidone, clozapine, quetiapine, and aripiprazole, as well as first-generation antipsychotics like levomepromazine. Additional psychotropic agents included valproic acid, gabapentin, tiapride, trazodone (administered at a hypnoinductive dose), and zopiclone. Some antipsychotic agents, including risperidone and paliperidone, were administered in long-acting injectable (LAIs) formulations, ensuring consistent therapeutic coverage and adherence throughout the study period.

Group 2 received a structured six-week cognitive stimulation programme using RehaCom software, consisting of 12 individual sessions (30 minutes each). Group 1 did not receive any cognitive intervention. The cognitive domains targeted by RehaCom were selected based on each patient's initial screening results, which were compared to normative data stratified by age and sex. The software automatically suggested the most appropriate training modules based on identified cognitive deficits.

Figure 2 illustrates how the screening results are displayed by the RehaCom platform, using an example from a participant's performance in the alertness. Based on these results, the software recommends the training module likely to yield the greatest therapeutic benefit.

HASOMED
RehaCom Alertness

Condition	Correct	Omissions	Outliers	Anticipations	Avg. Reac. Time [ms]	Median Reac. Time [ms]	SD Reac. Time [ms]	Z Value
without warning sound	20 (100%)	0 (0%)	0	0	392	398	37	-1.77 (3.8%)
with warning sound	20 (100%)	0 (0%)	0	0	406	400	76	-2.02 (2.2%)

Norm Alertness without warning sound (Average value: 274 ms; Standard deviation: 70 ms) - Median reaction time
Norm Alertness with warning sound (Average value: 268 ms; Standard deviation: 65 ms) - Median reaction time

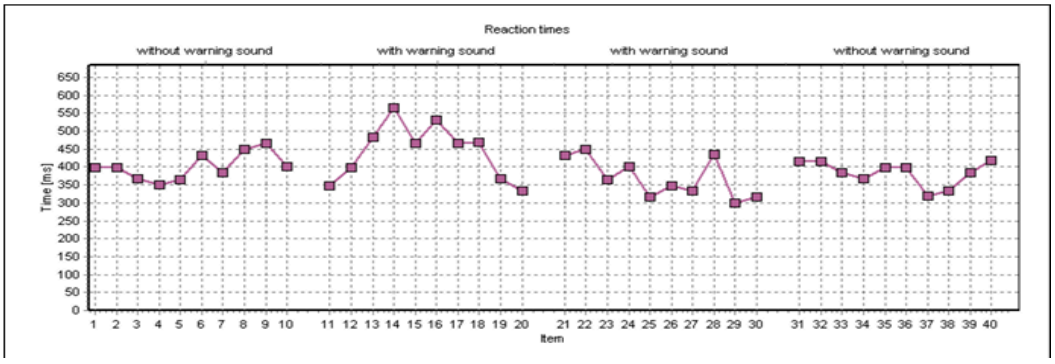
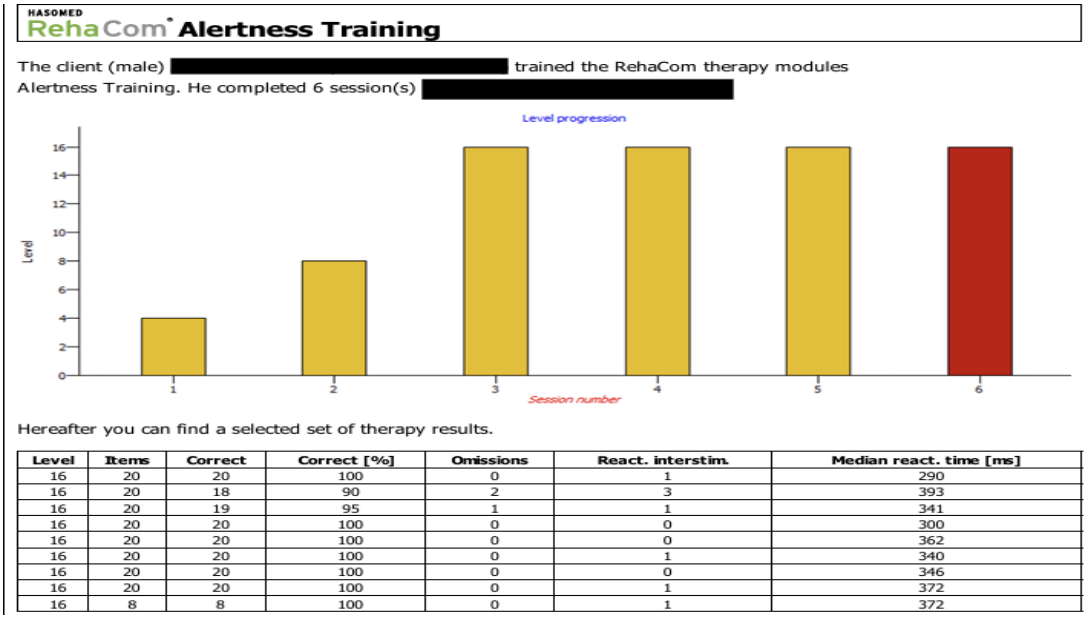


Figure 2. Example of screening results for alertness (results obtained by one of the participants)

Moreover, the software provides dynamic analysis during therapy sessions, monitoring parameters such as the number of correct and incorrect responses, anticipatory errors, statistical outliers, average and median reaction times, and z-scores. While basic feedback is provided to the patient in real time (e.g., response validation and progress indicators), detailed metrics are accessed and interpreted by the therapist. This allows for adaptive difficulty adjustment and individualised therapeutic progression based on performance trends. An example of these parameters can be observed in Figure 3 where the results of one of the patients included are illustrated.



Level	Items	Correct	Correct [%]	Omissions	React. interstim.	Median react. time [ms]
16	20	20	100	0	1	290
16	20	18	90	2	3	393
16	20	19	95	1	1	341
16	20	20	100	0	0	300
16	20	20	100	0	0	362
16	20	20	100	0	1	340
16	20	20	100	0	0	346
16	20	20	100	0	1	372
16	8	8	100	0	1	372

Figure 3. Example of a training module and the results obtained after each session. This figure illustrates the results of an alertness training module of one of the participants from this study

The cognitive screening results obtained after the six-week intervention revealed measurable improvements across all nine evaluated domains in the intervention group. Increases in performance were particularly evident in alertness, selective attention, and working memory (Figure 4).

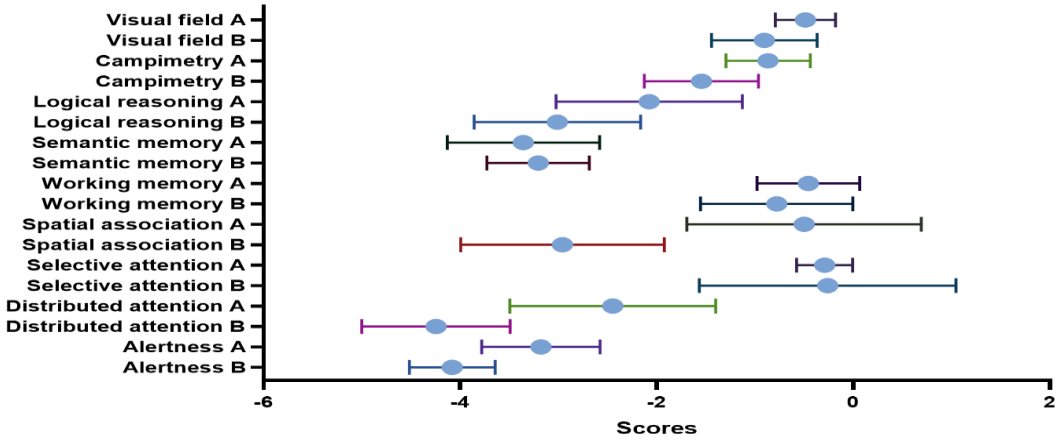


Figure 4. Trends in cognitive domain scores before (B) and after (A) the intervention

We performed an analysis to determine whether the computerised cognitive stimulation had a significant effect on the cognitive domains that were individually selected for training, based on each patient's baseline screening results. The selection of targeted domains was guided by the initial RehaCom cognitive profile, which identifies deficits in relation to age- and sex-adjusted normative data.

The overall ANOVA model was statistically significant ($F=3.261$, $R^2=0{,}4350$, $p < 0.001$), indicating that the intervention produced measurable variance across cognitive outcomes. However, post-hoc comparisons revealed no significant differences between pre- and post-therapy scores for individual parameters. Thus, improvements in alertness, distributed attention, spatial association in numerical cognition, working memory, local reasoning, campimetry, and visual field should be interpreted as non-significant numerical trends rather than definitive effects (Figure 5).

Post-intervention assessments using the psychiatric scales also showed improvement. Participants in the intervention group demonstrated higher MMSE scores, reduced psychotic

symptom severity as measured by the BPRS, and better perceived quality of life as reflected in the QOLI scores (Figure 4).

In contrast, no significant changes were observed in the study group between baseline and end-of-study assessments. Between-timelines comparison confirmed that patients who underwent cognitive stimulation showed greater improvement in both cognitive and clinical outcomes compared to those who did not receive the intervention (Figure 4).

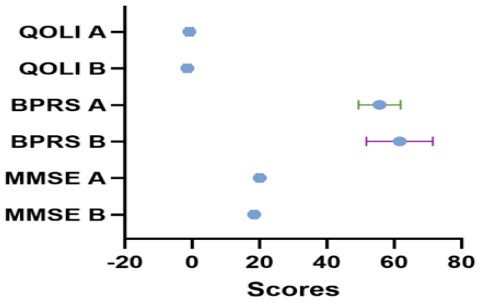


Figure 5. Statistical analysis of the scores obtained on three psychiatric scales. QOLI – Quality of Life Inventory, BPRS – The Brief Psychiatric Rating Scale, MMSE – The Mini-Mental State Examination, A – after therapy session, B – before the therapy sessions. There are no significant differences

Since both the Brown-Forsythe Test (F(DFn, DFd)=2.901 (5.24), $p<0.035$) and Bartlett test (Bartlett statistic=40.46, $p<0.001$) indicated heterogeneity of variances, we applied Welch's ANOVA test followed by Games-Howell post-hoc analysis. The analysis was statistically significant (W(DFn, DFd)=88.23 (5.000; 10.99), $p<0.001$). However, post-hoc pairwise comparison did not reveal significant differences between baseline and post-intervention scores. Therefore, the observed improvements in quality of life, cognitive function, and psychiatric symptoms should be regarded as non-significant numerical trends (Figure 5).

The next analysis was performed on the pharmaceutical treatments and whether there are significant differences in treatments between the group that underwent therapy sessions and the one that did not. We performed a Fisher's exact test to verify if the treatment distribution is significantly different between groups and the results we obtained were not statistically significant ($p=0.313$).

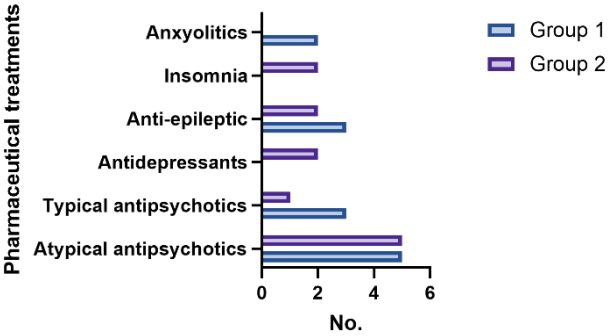


Figure 6. The pharmaceutical treatments followed by the participants. There were no significant differences in terms of treatment distribution between groups (p=0.313) and no significant differences between treatments (p>0.05, 95% CI of differences -2.022 to 1.759)

The individual pharmacological treatments followed by each of the participants can be visualised in Table 1.

Table 1. The pharmaceutical treatments of each participant

Patient	*Atypical antipsychotics*	*Typical antipsychotics*	*Antidepressants*	*Anti-epileptics*	*Insomnia*	*Anxyolitics*
1.	Olanzapine			Valproic acid		
2.	Risperidone	Levomepromazine		Valproic acid		
3.	Olanzapine, Risperidone					Lorazepam
4.	Aripiprazole	Haloperidol		Gabapentin		
5.	Paliperidone	Haloperidol				Alprazolam
6.	Paliperidone, Quetiapine		Trittico			
7.	Olanzapine, Tiapride			Gabapentin		
8.	Risperidone		Trazodone	Valproic acid		
9.	Aripiprazole, Olanzapine				Zopiclone	
19.	Quetiapine	Haloperidol			Zolpidem	

The next analyses performed were multiple linear regression in which we verified whether factors such as age, sex, and urbanicity could influence the cognitive improvements, as well as the psychometric scale scores. In Figure 7A there are represented the parameter values for the influence of sex, age, and urbanicity of alertness improvement with no significant independent influence (*p>0,*05) and no significant model. Similar results were obtained for distributed attention (Figure 7B), selective attention (Figure 7C), and spatial association (Figure 7D). On the other hand, the analysis of the influence of these parameters on working memory improvement was statistically significant (F(3.1)=22.3097, *p=0.0016*) (Figure 7E). More precisely, sex was a significant predictor of improvement (*β=-1.149, p=0.0012, 95% CI=-1.121 to 1.178*), indicating that females improved substantially more than males, age was a notable predictor of improvement (*β=-0.04878, p=0.0018, 95% CI=-0.05044 to -0.04696)*, and lastly, urbanicity considerably predicted the improvements with people from urban areas showing greater improvements than the ones from the rural areas (*β=0.6228, p=0.0022, 95% CI=0.5950 to 0.6506).* The prediction model for semantic memory (Figure 7F), logical reasoning (Figure 7G), and campimetry (Figure 7H) were not substantial. The prediction model for the improvements in visual field based on age, sex, and urbanicity was statistically meaningful (F(3.1)=2678, *p=0.0142*). In this case, females showed greater improvements than males (*β=0.3079, p=0.0371, 95% CI=0.07992 to 0.5358)*: the age was a good predictor factor (*β=-0.07459, p=0.0094, 95% CI=-0.08851 to -0.06066),* whereas people from urban areas showed less improvement compared to the ones in the rural areas (*β=-0.2325, p=0.0478, 95% CI=-0.4549 to -0.01018)* (Figure 7I). In terms of psychiatric scales, the prediction models for MMSE ((F3.1)=0.5792, *p=0.7197*) (Figure 7J), BPRS (F(3, 1)=18.4, *p=0.1693*) (Figure 7K), and QOLI (F(3.1)=0.8289, *p=0.6477*) (Figure 7L) were insignificant.

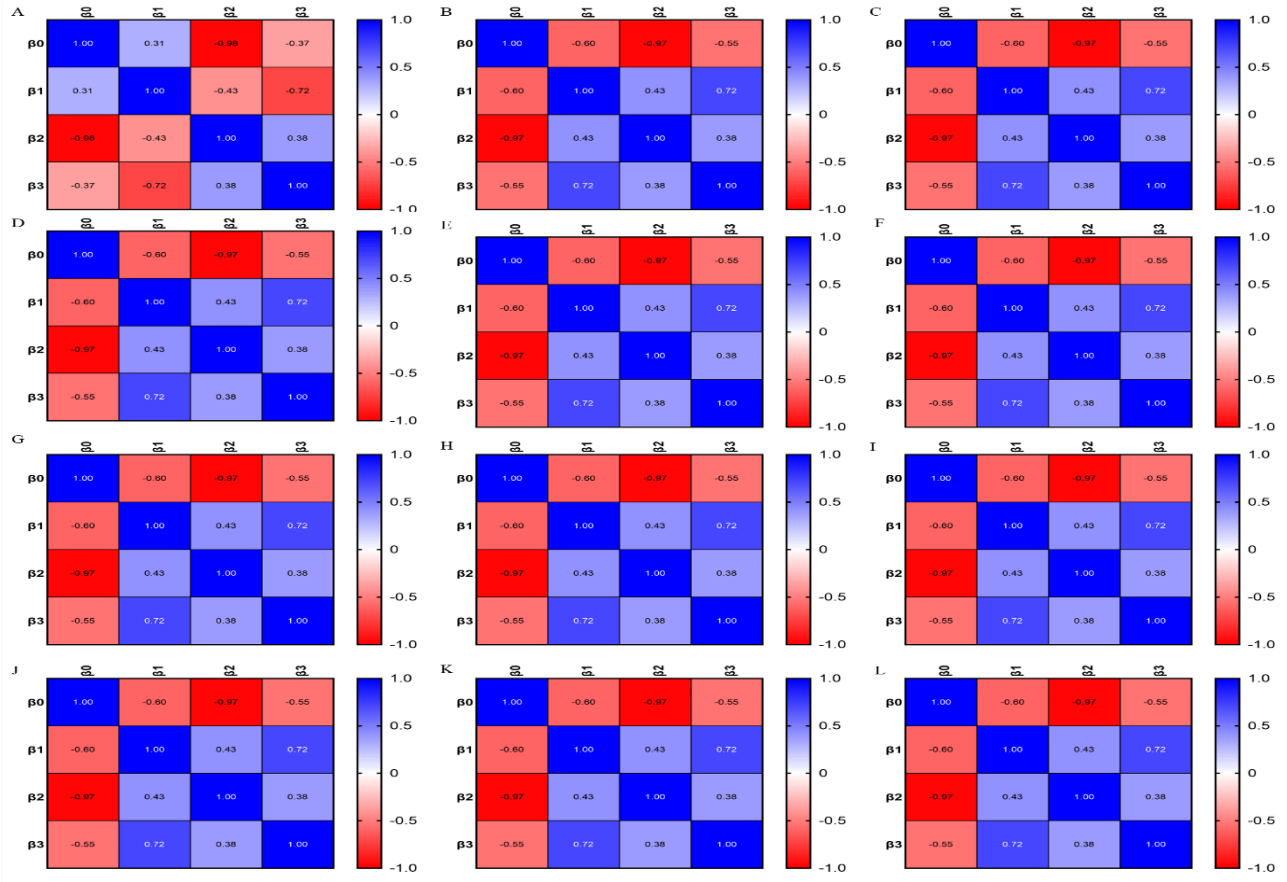


Figure 7. Multiple linear regression models to verify whether sex, age, and urbanicity can predict the improvements in each outcome with standardised beta coefficients. A – alertness (outcome), B – distributed attention (outcome), C – selective attention (outcome), D – spatial association (outcome), E – working memory (outcome), F – semantic memory (outcome), G – logical reasoning (outcome), H – campimetry (outcome), I – visual field (outcome), J – MMSE (outcome), K – BPRS (outcome), L – QOLI (outcome), β1 – sex (female is the reference value), β2 – age, β3 – urbanicity (urban is the reference value)

The last analysis of interest was to verify how patients of schizophrenia score in the cognitive domains compared to healthy individuals, both before and after the therapy sessions. The results can be visualised in Figure 8A and Figure 8B.

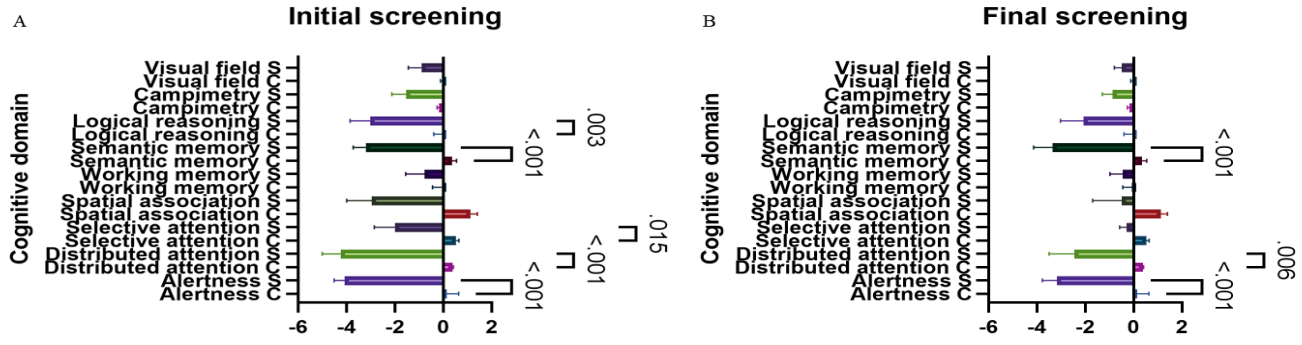


Figure 8. Analysis of differences between a healthy control and the study group at the initial screening and at the final screening. C – control group results, S – study group results. Results were statistically notable ($p<0.05$)

The analysis of the initial screening was statistically significant (F=9.607, $p<0.001$, R^2=0.6940), with considerable differences in terms of alertness ($p<0.001$), distributed attention ($p<0.001$), selective attention ($p=0.015$), semantic memory ($p<-0.001$), and logical reasoning ($p=0.003$) (Figure 8A). Moreover, the final screening results across the nine cognitive domains were substantial (F=5.197, $p<0.001$, R^2=0.5510), with significant differences observed in alertness ($p<0.001$), distributed attention ($p=0.006$), and semantic memory ($p<0.001$). These results were smaller compared to the initial screening, suggesting that the improvements in the cognitive domains were sufficient for the study group to reach values closer to those of the healthy control group.

4. Discussion

This pilot study provides preliminary evidence that CCST may enhance certain cognitive functions and quality-of-life in patients with schizophrenia. Improvements were most apparent in attention and working memory, which are critical for daily functioning. Although statistical significance was not achieved, the observed positive trends align with findings from previous cognitive remediation studies and suggest that CCST is both feasible and well tolerated in this patient group.

The present findings support existing evidence, suggesting that cognitive stimulation can lead to progress in specific cognitive domains among psychiatric populations, including patients with schizophrenia, dementia, and ADHD (Woods et al., 2012; Hall et al., 2013; Chen, 2022; Westwood et al., 2023; Zoupa et al., 2022). Studies have shown benefits particularly in attention, working memory, and processing speed, while results are mixed regarding the executive function, long-term memory, and verbal fluency (Hall et al., 2013; Chang et al., 2023; Chiang, Jhong, & Wang, 2023; Hogarty, et al., 2004; Penadés et al., 2013; Dickinson et al., 2010).

Our results are consistent with those reporting positive outcomes in short-term attention and alertness, but no significant enhancement in long-term memory or selective attention—highlighting the need for personalised, domain-targeted interventions. Furthermore, intervention frequency and duration appear to play an important role in outcomes, as more intensive or prolonged cognitive training has been linked to greater and more lasting effects (Fernández-Calvo et al., 2011; Fisher et al., 2010).

The combination of cognitive stimulation with psychiatric rehabilitation or neuromodulation techniques (such as tDCS or rTMS) has yielded mixed findings in schizophrenia, with some studies showing promising effects and others suggesting limited neuroplasticity or no added benefit beyond cognitive training alone (Li et al., 2024; Ke & Tseng, 2024; Wykes et al., 2011; Sreeraj et al., 2020).

Our study reinforces the potential of computer-assisted cognitive stimulation in enhancing attention, semantic memory, and processing speed in schizophrenia, in line with recent findings (d'Amato et al., 2011; Grynszpan et al., 2011). These advances are clinically relevant and may contribute to better psychosocial functioning and daily life performance.

Moreover, computer-assisted cognitive stimulation has been shown to improve selective attention in individuals with schizophrenia. A study comparing two cognitive stimulation programmes found that the participants from the group using the RECOS programme showed notable progress in selective attention. However, the GAIA s-face programme led to substantial progress (Gaudelus et al., 2016). Interestingly, our study has shown no improvement in selective attention, but it did enhance the distributed attention.

Studies indicate that cognitive stimulation can lead to significant enhancements in working memory tasks, whereas intensive computerised cognitive training has been associated with increased activation in the middle frontal gyri (Subramaniam et al., 2014). The current study has also shown improvements in short-term memory, although non-significant.

Computer-assisted cognitive stimulation has been shown to enhance various cognitive functions in individuals with schizophrenia. Some of these programmes incorporate visual modules specifically designed to increase the speed and accuracy of visual processing, aiming to facilitate

perception, enhance visual memory, and reduce response times (Surti et al., 2011; Rass et al., 2012). However, the direct impact of these trainings on visual field deficits, such as those assessed by campimetry, has not been extensively studied. While improvements in visual processing are a goal of certain programmes, evidence supporting significant enhancements in visual field measures specifically remains limited (Rass et al., 2012).

Studies suggest that cognitive stimulation acts by influencing cortical connectivity, brain structure, and neuroplasticity (Lett et al., 2014). Moreover, studies are suggesting that group sessions could bring even more benefits in terms of improving the quality of life, cognition, and social interactions (Woods et al., 2012).

While this study provides preliminary insights into the potential of CCST, its findings must be interpreted in the context of several important limitations. First, and most notably, the choice of a healthy control group, rather than a matched patient group receiving treatment-as-usual (TAU), represents significant design constraints. This choice was primarily motivated by the pilot nature of this investigation. Our initial objective was to establish a clear, uncontested baseline of cognitive performance between healthy individuals and patients with schizophrenia using the RehaCom software, assessing the feasibility and acceptability of the intervention protocol itself. While this design confirms the expected significant cognitive deficits as baseline, it limits our ability to unequivocally attribute the observed improvements solely to the CCST intervention, as factors such as practice effects from repeated testing or the natural course of the disease in a stable cohort cannot be ruled out. Second, the exceedingly small sample size, though common in pilot studies, drastically reduces the statistical power and limits the generalisability of the results. Third, the non-randomised, non-blinded design introduces the potential of selection and observer bias. Finally, the short duration of both the intervention and the follow-up period precludes assessment of the long-term sustainability of the cognitive benefits.

Notwithstanding these limitations, this pilot study serves as a crucial foundational brick for future research in this domain. It successfully demonstrated feasibility of the protocol and provided promising trend-level data that warrant further investigation. Therefore, the primary and most logical future direction is a larger-scale, randomised controlled trial that directly compares schizophrenia patients receiving CCST plus TAU against a carefully matched active control group of patients only receiving TAU. This design would effectively isolate the specific effects of the cognitive intervention. Furthermore, future studies should incorporate longer intervention periods, extended follow-up to assess durability, and explore the integration of neurobiological markers. (e.g., fMRI, EEG, or blood-based biomarkers of neuroplasticity) to elucidate the mechanistic underpinnings of any observed cognitive improvements. This translational approach will be essential for validating CCST as an evidence-based complementary therapy for cognitive impairment in schizophrenia.

The current study highlights the potential benefits of a non-invasive therapy methodology that can improve different cognitive domains alongside the quality of life, psychiatric symptoms, and the effects of pre-existing anxiety and depression. In our future studies, our group will focus on testing longer training periods, different frequencies of the therapy sessions, including more psychiatric disorders that present an overall decrease in cognitive function, affecting the daily activities and quality of life.

5. Conclusions

The results provide preliminary evidence that CCST has potential to support improvements in core cognitive functions in schizophrenia. Our findings demonstrate promising progress across a spectrum of domains, most notably in alertness, distributed attention, working memory, logical reasoning, and visuospatial processing (encompassing spatial association in numerical cognition, campimetry, and visual field).

Conversely, the intervention yielded no positive impact on selective attention and semantic memory. This divergent outcome is of considerable clinical relevance, as these domains are critically implicated in daily functioning, specifically in sustaining focus and facilitating the recall of words, concepts, and numerical information. By delineating this specific response profile, our research not only corroborates the existing evidence base but also expands it, by highlighting a nuanced, domain-specific effect of CCST that has been underexplored in literature. This underscores the necessity for future investigations to move beyond a one-size-fit-all approach and instead, develop and evaluate more refined, component-specific therapy methodologies capable of addressing these resilient deficits.

Consequently, this work delineates a clear trajectory for subsequent research. There is a pressing need for more targeted studies to deconstruct the mechanisms underlying the effects on visual and spatial processing. Furthermore, exploring synergistic treatment paradigms, such as the combination of CCST with neuromodulation techniques (e.g., tDCS or rTMS), represents a promising avenue for potentiating cognitive gains and could unveil new therapeutic pathways for ameliorating cognitive outcomes in schizophrenia, ultimately aiming to enhance functional recovery and quality of life.

Ethical Approval: The study was conducted in accordance with the ethical standards and approved by the Ethics Committee of Grigore T. Popa University of Medicine and Pharmacy, Iasi, Romania (Approval No. 456/9.07.2024). A copy of the approval document can be provided upon reasonable request for clarification or further information.

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

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

- **BPRS** – Brief Psychiatric Rating Scale
- **CBTp** – Cognitive Behavioural Therapy for Psychosis
- **CCST** – Computer-Assisted Cognitive Stimulation Therapy
- **CSCT** – Computerised Social Cognitive Training
- **GDPR** – General Data Protection Regulation
- **ICD-10** – International Classification of Diseases, 10th Revision
- **MMSE** – Mini-Mental State Examination
- **QOLI** – Quality of Life Inventory
- **rTMS** – Repetitive Transcranial Magnetic Stimulation
- **SST** – Social Skills Training
- **tDCS** – Transcranial Direct Current Stimulation
- **ToM** – Theory of Mind
- **TAU** - Treatment-As-Usual

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