

Research Paper: A Short Course Computer-assisted Cognitive Remediation in Patients with Schizophrenia Spectrum Disorders: A Randomized Clinical Trial



Samira Hatami¹ , Zahra Mirsepassi² , *Azadeh Sedighnia² , Mehdi Tehranidoost³ , Maryam Masoomi² , Vandad Sharifi²

1. Department of Psychology, School of Education and Psychology, Islamic Azad University, Kurdistan, Iran.

2. Department of Psychiatry, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran.

3. Department of Psychiatry, Research Center for Cognitive and Behavioral Sciences, Tehran University of Medical Sciences, Tehran, Iran.



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ABSTRACT

Introduction: Cognitive Remediation Therapy (CRT) is used to improve cognitive functioning in patients with Schizophrenia Spectrum Disorders (SSDs). Most of the previous studies had incorporated a long rehabilitation program. This study aimed to evaluate the effects of a short and easy to implement computer-based CRT on cognitive performance in patients with SSDs using a randomized controlled trial design.

Methods: Sixty-Two patients with SSDs were enrolled in Roozbeh Hospital (Tehran City, Iran); they were randomized to either receive a CRT program added to the standard pharmacological treatment (n=31) or the standard treatment alone (n=31). The remediation consisted of 10 sessions of CRT provided 2-3 times a week applying the Cogpack software. The cognitive performance was assessed in attention, memory, and executive functions before and after the intervention using the respective tests of the Cambridge Neuropsychological Test Automated Battery (CANTAB).

Results: This study did not demonstrate any significant improvement in attention and executive function between the experimental and control group. However, we observed modest improvements in some aspects of visual memory (first trial memory score, $F=9.152$, $P<0.001$, Cohen's $d=0.40$; mean errors to success, $F=6.991$, $P=0.011$, Cohen's $d=0.14$; stages completed on the first trial, $F=7.155$, $P=0.010$, Cohen's $d=0.71$; total errors, $F=5.730$, $P=0.020$, Cohen's $d=0.53$).

Conclusion: We observed only modest improvements in the patients' cognitive functioning after a short course of CRT. The short duration of the training and lack of a comprehensive rehabilitation plan may explain the obtained findings.

* Corresponding Author:

Azadeh Sedighnia

Address: Department of Psychiatry, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran.

Tel: +98 (21) 55412222

E-mail: azadehsedighnia@yahoo.com

Highlights

- We observed only modest improvements in the patients' cognitive functioning after short-course Cognitive Remediation.
- Psychiatrists should consider this intervention in planning a comprehensive rehabilitation program.
- The authors suggest conducting a Persian version of the Cogpack software for the Iranian population.

Plain Language Summary

Schizophrenia is a chronic mental illness with various presentations. Cognitive deficit is one of the core features that can affect patients' performance and quality of life. Despite the growth of knowledge, there is no established medication to improve cognitive performance in schizophrenia. Recently, Cognitive Remediation Therapy (CRT) has been used to improve cognitive functioning in these patients. Most of the previous studies had evaluated a long rehabilitation program. Due to limited resources in our country, this study aimed to assess the effects of a short and easy to implement computer-based cognitive remediation on cognitive performance in these patients. Sixty-two patients enrolled in Roozbeh Hospital (Tehran City, Iran); were randomized to either receive a CRT program added to the standard pharmacological treatment (n=31) or the standard treatment alone (n=31). The cognitive remediation program consisted of 10 sessions provided 2-3 times a week applying the Cogpack software. The cognitive performance was assessed before and after the intervention using the respective tests of the Cambridge Neuropsychological Test Automated Battery (CANTAB). We observed modest improvements in some aspects of visual memory, not directly trainer-dependent. Therefore, the results of this study should be interpreted with caution. Although this is a limitation, it is an advantage too. Providing services by different trainers is similar to the provision of services in the community. We observed only modest improvements in the patients' cognitive functioning after this treatment. The authors believe that this intervention should be integrated into a comprehensive rehabilitation program for these patients. Employing well-trained and motivated therapists and planning regular supervision sessions, using interesting visual tasks, holding more rehabilitation sessions in prolonged duration, and providing this intervention in the early phase of the illness is recommended. The authors also suggest conducting a Persian version of the Cogpack software for the Iranian population.

1. Introduction

Schizophrenia is a chronic mental illness with various presentations. Kraepelin and Bleuler proposed some deficits in cognitive domains in schizophrenia, including attention, memory, reasoning, problem-solving, and other cognitive skills (Chattopadhyay, Nayak, Patil, & Chate, 2012). For several decades, cognitive impairment in schizophrenia was neglected; however, recently, they have been considered as the core feature of illness and strongly correlated with social deficits and poor outcomes (Harvey, 2013; Revheim et al., 2006; Kurtz, Seltzer, Shagan, Thime, & Wexler, 2007; Keefe et al., 2011).

Furthermore, the experts agreed that 6 cognitive domains, including perception, working memory, attention, executive functions, long-term memory, and social cognition are affected in schizophrenia (Carter & Barch, 2007). Despite the growth of knowledge, there is no es-

tablished medication to improve cognitive performance in schizophrenia (Barch et al., 2009). It seems that current pharmacological interventions fail to improve these cognitive deficits (Keefe & Harvey, 2012; Choi, Wykes, & Kurtz, 2013). A novel and safe psychosocial treatment is Cognitive Remediation Therapy (CRT) using computer software. This intervention can be provided in paper-pencil or computer-based formats.

Recently, a large body of literature has consistently demonstrated the benefits of long-term CRT on cognition and psychosocial functioning with moderate effect sizes (Katsumi, Hoshino, Fujimoto, & Niwa, 2015; McGurk, Twamley, Sitzer, McHugo, & Mueser, 2007; Grynspan et al., 2011; Deste et al., 2019; Kurtz & Richardson, 2011). In 2016, a before-after study was conducted in Iran by Sharifi and associates (Sharifi, Sedighnia, Ataie, Tabatabaee, & Tehranidoost, 2016). This study demonstrated the efficacy of CRT in schizophrenia. In Iran, as a developing country, providing psychosocial interventions may be influenced by different obstacles. CRT, as psychosocial

intervention, is associated with frequent barriers. The feasibility of interventions, patients' socio-economic status, the cost of services, and poor treatment adherence are among these barriers. This study aimed to evaluate the effects of a short and easy-to-implement computer-based CRT on cognitive performance in patients with Schizophrenia Spectrum Disorders (SSDs) using a randomized control trial in a developing country setting.

2. Methods

This study was conducted in Roozbeh Hospital in Tehran City, Iran, in 2017-2018 and registered in the Iranian Registry of Clinical Trials (Code: IRCT2016011810782N2). We considered all aspects of the Declaration of Helsinki to perform this research. We compared a computerized CRT program added to the standard treatment, compared. In our settings, standard treatment consists of pharmacotherapy along with psychoeducation. The intervention was explained to the study participants. After obtaining a written informed consent form, the selected patients were assigned to the study groups by block randomization design. After an initial assessment, 62 patients were randomized to either the intervention (standard treatment & CRT program, $n=31$) or the control (standard treatment alone, $n=31$) group.

A trained psychologist and a psychiatry resident assessed the clinical and cognitive performance of all study participants. Demographic characteristics were documented in forms. After receiving 10 rehabilitation sessions in the intervention group and 30 \pm 2 days after baseline assessment in the control group, the reassessment was performed. Moreover, transportation was free for all study participants.

The research participants were enrolled in Roozbeh Hospital, a referral psychiatric center in a metropolitan city, Tehran. The inclusion criteria included meeting the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition- Third Revision (DSM IV-TR) criteria for schizophrenia or schizoaffective disorder based on the Persian version of Structured Clinical Interview for DSM-IV(SCID-I) (Sharifi et al., 2004). The study participants were clinically stable. Besides, there was no modification in their medications for ≥ 3 weeks before the study. Clinical stability was confirmed by the Positive and Negative Syndrome Scale (PANSS) scores < 50 and the Clinical Global Impression (CGI) scores below 4 throughout the project. The inclusion criteria were the age range of 18-55 years, ≥ 2 years passed since the onset of illness, providing informed consent, and having at least 8th-grade education. The exclusion criteria consisted of Intellectual

Disability (IQ < 70), substance use comorbidity except for nicotine and caffeine, being treated by Electroconvulsive Therapy (ECT) within the past 6 weeks, a history of head trauma with the loss of consciousness, neurological diseases, receiving antihistamine medications, uncorrected visual impairment, and physical disabilities interrupting the computer-based exercises. Furthermore, patients were excluded in case of exacerbated symptoms or a need to change their medication or dosage.

In the intervention group, CRT was provided using Cogpack software. The Cogpack contains 64 tasks. We selected 21 tasks based on cultural and linguistic considerations, as per the followings: ball, borders, comparison, confusion, eye witness, labyrinths, logic, math A, math B, multiply, memory, new or not, on the road, piece work, reaction, route, scan, search, sequence, UFO, and visuomotor.

These tasks were designed based on difficulties threat 3 levels: easy, intermediate, and difficult. In this study, regardless of the patient's performance, assignments were routinely initiated from the easy level; after the first 3 sessions, the patients entered the intermediate, and after 7 sessions, they conducted the difficult level. We proposed a modified shortened version of the intervention because of limited resources in Iran. Ten 60-75-minute sessions of CRT were held 2-3 times a week. During the intervention, the clinician explained the instructions for each task to the explored patients. The examined patients' performances were recorded. Besides, the study subjects received feedback during the session and throughout rehabilitation. This software allowed the therapist to have a profile of cognitive performance per patient. Three cognitive functions were involved, including attention/concentration, visual memory, and executive functions. CRT was provided by psychologists, social workers, or occupational therapists who had previously participated in a one-day workshop. All therapists received weekly supervision from an expert psychiatrist. All medical information was recorded. This information included the type and dosage of medications, the duration of administration, and any changes made in treatment.

A blind investigator assessed the study participants, using the PANSS (Kay, Fiszbein, & Opler, 1987), the CGI (Guy, 1976), and the Wechsler Adult Intelligence Scale (WAIS) (Wechsler, 1981). We used the Cambridge Neuropsychological Test Automated Battery (CANTAB) software for cognitive assessment (Robbins et al., 1994). This software can present deficits in various cognitive domains, including working memory, decision-making, attention, executive function, and visual memory. Fur-

Table 1. Baseline demographic and clinical data of patients in the CRT and control group

Variables	Mean±SD		Statistics	
	CRT Group (n=31)	Control Group (n=31)	t-test	
			t	P
Age	35.9±8.5	38.9±9.5	-1.32	0.191
WASI IQ scores	86±11	86±11	0.214	0.831
Illness duration(Month)	150.7±87.5	141.6±100.5	0.380	0.705
Duration of using antipsychotics(Month)	125.5±93.2	125±98	0.021	0.983
The equivalent dose of haloperidol for typical antipsychotics (mg)	4.5±6.1	3.5±4.6	0.736	0.465
The equivalent dose of risperidone for typical antipsychotics (mg)	2.53±2.69	3.38±3.67	0.301	1.044

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Table 2. Attention variables (CRT and SST test) at baseline and retest in the two groups

Variables	Mean±SD				p
	CRT (n=31)		Control (n=31)		
	Baseline		Retest		
CRT Percent commission trials*	0.1±0.3	0.2±0.5	0.1±0.5	0.14±0.3	0.072
CRT Percent correct trials*	99.1±1.2	98.2 ±2.7	99.5±0.8	98.6±2.1	0.185
CRT Percent omission trials*	0.07±0.2	0.2±0.7	0.07 ±0.2	0.5±1.1	0.053
CRT Mean correct latency	556.1±186.7	624.6 ±170.9	494.9 ±160.6	648.9 ±210.6	0.066
CRT Total commission errors*	0.1±0.3	0.17 ±0.4	0.0 ±0.0	0.1±0.3	0.040
CRT Total correct trials*	99.1 ±1.2	98.6 ±2.4	99.5 ±0.8	98.6±2.1	0.072
SST Direction errors on stop and go trials*	1.9±2.2	2.2 ±3.8	2±3.1	2.7±5	0.610
SST Proportion of successful stops (last half)**	0.6±0.1	0.57±0.1	0.62±0.13	0.57±0.1	0.299
SST Median correct RT on GO trials	866.8±251.2	873.8±230.9	841.4±266.3	873.2 ±231.2	0,873
SST SSD (50%) (last half)	562±131.4	579.6±126.2	581.2±127.7	559.4±163.4	0.213
SST SSRT (last half) v. 283.2 (127.4) **	283.2±127.4	296.2±140.2	260.1±127.7	313.7±163.7	0.177

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*We used Mann Whitney U Test for this variable (did not have a normal distribution); **We used t-test for these variables (did not meet assumptions required for ANCOVA).

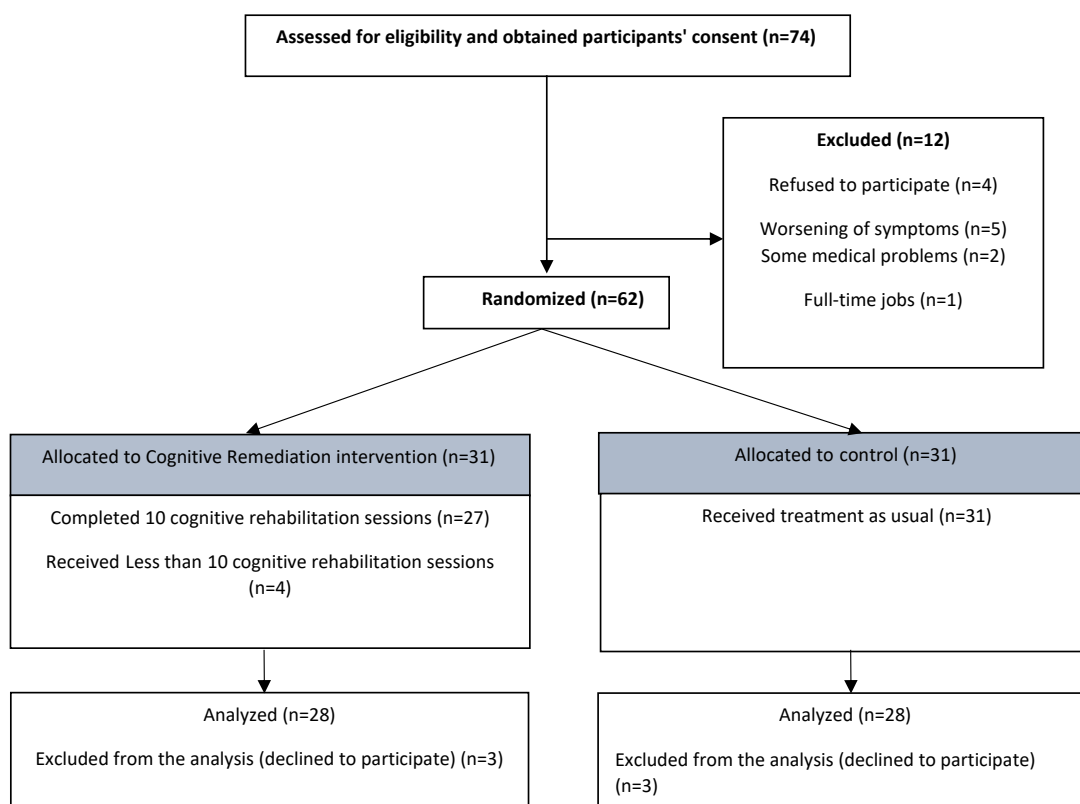


Figure 1. Flow diagram of the randomized clinical trial

Furthermore, CANTAB tests could provide an interpretation of patient performance. In this study, we used version 3.2 of CANTAB, and the software was administered by a trained psychologist.

The patient's cognitive function was evaluated by some tests of CANTAB battery. These tests consisted of the Stop-Signal Task (SST) and Choice Reaction Time (CRT) to assess attention, Pattern Recognition Memory (PRM), and Paired Associates Learning (PAL) to examine visual memory as well as the Stockings of Cambridge (SOC), SST, and Intra-Extra Dimensional (IED) set to shift to evaluate executive function. The study participants' performance was assessed by the Global Assessment of Functioning (GAF) (Hilsenroth et al., 2000), and the quality of life was assessed by the Persian version of the World Health Organization Quality of Life-Brief version (WHO-QOL-Brief) (Nejat et al., 2006).

Regardless of whether the intervention was completed or not, all analyses were performed for all patients using SPSS. First, all variables (n=88) were assessed for normal distribution using the Kolmogorov-Smirnov test. Accordingly, 36 variables presented no normal distribution. We normalized these variables using lg10; however, 15 out of 42 pretests and 13 out of posttests revealed no nor-

mal distribution; we used Mann Whitney U test for these variables. The baseline demographic and clinical characteristics were compared between the research groups by t-tests or Chi-squared tests. After comparing the study groups on demographic and baseline clinical characteristics, improvements in cognitive and social functioning and psychotic symptoms were compared between them using Analysis of Covariance (ANCOVA). We used the t-test for 3 variables that did not meet the assumptions required for ANCOVA (P-value was set at 0.05). Cohen's d was calculated for effect size estimation.

3. Results

The study subjects' recruitment was performed from August 2015 to March 2017 in Roozbeh Psychiatric Hospital. In this study, 74 clients met the inclusion criteria and provided a signed informed consent form. However, 12 patients were excluded before allocation. The reasons for this exclusion were the withdrawal of consent (4 patients), the aggravation of symptoms (5 patients), the presence of some medical problems (2 patients), and enrollment in a full-time job (one patient). Therefore, 62 clients were randomized and completed the pretest (n= 31/group). Four out of thirty-one participants in the intervention group received less than 10

Table 3. Visual memory variables (PRM and PAL test) at baseline and retest in the two groups

Variables	Mean±SD				P
	Baseline		Retest		
	CRT Group (n=31)	Control Group (n=31)	CRT Group (n=28)	Control Group (n=28)	
PRM mean correct latency	2738±777.6	3189.9±1220.7	2214.9±578.2	2447.9±917.7	0.544
PRM number correct	19.8±3	19.5±2.6	19.6±3.4	19.2±2.6	0.315
PRM percent correct	82.7±12.5	81.2±11	81.9±14.2	80±10.9	0.648
PAL first trial memory score	15.6±4.6	15.9±4.3	18.1±4.4	15.9±4.8	0.004
PAL Mean errors to success	3.7±2.7	3.9±3	2.3±2.5	3.6±2.7	0.011
PAL Mean trials to success	2.1±0.7	2.2±0.7	1.7±0.7	2.2±0.7	0.734
PAL Number of patterns*	7.1±1.6	7.2±1.6	7.5±1.2	7.2±1.6	0.469
PAL Stages completed on	first trial	5±1.2	5.1±1.1	5.7±1.3	0.010
PAL Total errors	26.8±17.6	28.6±20.7	17.6±16.8	26.9±18.1	0.020
PAL Total trials	16.3±4.6	16.7±4.9	13.5±4.2	16.7±4.7	0.617

*We used Mann Whitney U Test for these variables (did not have a normal distribution).

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rehabilitation sessions. Moreover, 6 out of 62 patients dropped out during the program (3 in the intervention group & 3 in the control group). The reasons for dropping out were exacerbated symptoms (n=3), changing the place of residence (n=1), withdrawal of consent (n=1). At the end of the study, 56 out of 62 patients were re-evaluated by the CANTAB, PANSS, GAF, CGI, and WHO-QoL-Bref (Figure 1).

There was no significant difference in age, gender, educational level, marital status, employment, prescribing first or second-generation antipsychotics, and antipsychotics' equivalent dosage between the study groups. Furthermore, there was no significant difference between the research groups at baseline in the clinical variables (Table 1).

There was no significant difference between the study groups in attention, executive function, and visual memory at baseline. In this study, CRT and SST tests were used to assess attention in the study participants. At the end of the study, there was no significant difference between the study groups concerning the CRT and SST. The attention scores (CRT & SST tests) of the two groups at baseline and retest are presented in Table 2.

The RRM and PAL tests were implemented to assess visual memory. There was no significant difference between the study groups in the PRM test data. Furthermore, ANCOVA results revealed a significant difference

in 5 out of 7 scores in the PAL test (first trial memory score, $F=9.152$, $P=0.004$, Cohen's $d=0.40$; mean errors to success, $F=6.991$, $P=0.011$, Cohen's $d=0.14$; stages completed on first trial, $F=7.155$, $P=0.010$, Cohen's $d=0.71$; total errors, $F=5.730$, $P=0.020$, Cohen's $d=0.53$) at posttest. These results are presented in Table 3.

The SOC, SST, and IED tests were used to assess executive function in the study participants. There was no significant difference between the test and control groups in the SOC, SST, and IED test data. The executive function scores (SOC & IED tests) are presented in Table 4.

In summary, this study provided no significant improvement in attention and executive function using short-term computer-based CRT in patients with SSDs. We observed only negligible to medium effects (as assessed by Cohen's d) in some aspects of visual memory in patients who received CRT, compared to standard treatment.

The secondary outcomes in this study were social functioning and psychopathology. The improvement in the global function, social functioning, and quality of life was compared between the study groups. Outcome measures are reported in Table 5. There was a significant difference in GAF ($Z=-2.125$, $P=0.034$) and CGI ($Z=-2.119$, $P=0.034$). There was no significant difference in the PANSS scores between the study groups after the termination of the study. In the assessment by the WHO-

Table 4. Executive function variables (SOC and IED test) at baseline and retest in the two groups

Variables	Mean±SD				P
	Baseline		Retest		
	CRT Group (n=31)	control Group (n=31)	CRT Group (n=28)	Control Group (n=28)	
SOC Mean initial thinking time (2 moves)*	1591.2±1905.3	1431.8±2125.2	789±718.8	1361.4±1801.7	0.570
SOC Mean subsequent thinking time (2 moves)*	375.2±872.2	630±1697	395.9±814.4	273.6±831.6	0.352
SOC Problems solved in minimum moves	6.1±1.5	6.2±1.9	7.1±3.4	6.5±2.4	0.591
IED Completed stage errors	17.9±12.4	13±7.5	12.9±9.2	15.6±10.4	0.971
IED Completed stage trials	82.3±27	69.1±20.4	69.8±22.6	77.3±23.8	0.334
IED EDS errors	12±10	15.5±11.6	13.1±11.2	11±10.3	0.262
IED Pre-ED errors	9.1±6.6	8.2±4.8	7.6±4.1	10±10.7	0.262
IED Total errors	25.5±16.7	25±10.4	23±13.4	25.1±14.6	0.342
IED Total trials	96.8±30.6	92.1±17.1	88.3±21.9	95.2±25.7	0.289

*We used Mann Whitney U Test for these variables (did not have a normal distribution).

QoL-Brief, there was a significant difference in the social relationships domain (F= 5.239, P= 0.031).

4. Discussion

This study aimed to identify the role of short-term computer-assisted CRT on cognitive improvement in patients with SSDs in a developing country. Due to limited resources, and according to our literature review, we provided the minimum number of CRT sessions. We used Cogpack software to improve 3 cognitive domains, including attention, visual memory, and executive functions in the study subjects.

In this study, attention and executive function were not improved by 10 sessions of a CRT program. Some tasks of Cogpack software are trainer dependent, and training is influenced by trainer capabilities, motivation, and personality characteristics (Bowie, 2019). However, a modest improvement in some scores of visual memory was detected, i.e., not directly trainer dependent. Therefore, the collected results should be interpreted with caution. Although being a limitation, it is an advantage. Providing services by different trainers is similar to the provision of services in the community. These findings were consistent with those of some previous studies (Dickinson et al., 2010; Keefe & Harvey, 2012; Rass et al., 2012; Murthy et al., 2012; Berry & Haddock, 2008).

Besides, we assessed the effects of computer-assisted CR on global functioning, clinical symptoms, and quality of life

in the study participants. This study supported the effects of CRT on global performance improvement and CGI. Our findings in the GAF test were consistent with those of Sanchez and colleagues (Sánchez et al., 2014). We found no significant change in the reduction of the PANSS scores. Our results in clinical symptoms were consistent with those of a systematic review (Glenthøj, Hjorthøj, Kristensen, Davidson, & Nordentoft, 2017). As some literature suggests, cognitive impairment in these patients may affect their real-world functioning and quality of life (Bell, Bryson, & Wexler, 2003). Furthermore, cognitive deficits might be related to negative symptoms (Heydebrand et al., 2004). Thus, improved memory and executive function domains of cognition may improve negative symptoms (Cella, Preti, Edwards, Dow, & Wykes, 2017). Furthermore, we observed only a modest improvement in some scores of visual memory (mean success trial, the number of patterns succeeded, stages completed on the first trial, total trial). Our results supported no significant improvement in cognition. Therefore, we observed no improvement in negative symptoms.

At the end of this study, we observed a significant improvement in only the social relationships domain of quality of life. A study proposed prolonged cognitive rehabilitation may impose improvement in the quality of life (Cavallaro et al., 2009). The duration of our study might have been inadequate to create any improvement in the quality of life. The improvement in the social domain of quality of life may be created by social interaction and communication with healthcare providers in treatment.

Table 5. Clinical and psychological assessment in the two groups

Variables	Mean±SD				P
	Baseline		Retest		
	CRT Group (n=31)	Control Group (n=31)	CRT Group (n=28)	Control Group (n=28)	
GAF*	6.5±1	6.1±.87	6.8±1.2	6.1±0.77	0.034
CGI*	2.1±0.86	2.4±0.79	1.8±0.77	2.1±0.61	0.034
PANSS Total	45.2±3.8	45.9±3.8	42.7±5.4	44.2±5.1	0.380
Positive symptoms	9.±1.8	9.9±3.6	9±1.8	9.5±2.6	0.870
Negative symptoms	9.8±2.5	9.8±1.9	9.1±2.6	9±2.1	0.515
General psychopathology	26.6±2.4	26.2±2.9	24.9±3.2	25.8±3.3	0.121
QOL Q1*	3.3±0.83	3.1±1	3.6±0.83	3.4±0.92	0.736
QOL Q2*	3.3±0.86	3.2±1.2	3.4±0.97	3.2±1	0.519
Physical health	2.8±0.59	2.8±0.54	3±0.52	2.9±0.40	0.436
Psychological	2.9±0.64	2.9±0.61	3±0.64	3±0.58	0.636
Social relationships	2.4±0.93	2.8±0.95	2.5±1	3±0.84	0.031
Environment**	3±0.91	3±0.76	3.1±0.92	3.1±.59	0.140

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*We used Mann Whitney U Test for these variables (did not have a normal distribution); **We used t-test for this variable (did not meet assumptions required for ANCOVA)

The current study results failed to support those of some previous studies (McGurk et al., 2007; d'Amato et al., 2011; Thorsen, Johansson, & Løberg, 2014; Iwata et al., 2017). Several factors may contribute to these differences. Although some reviews confirmed the efficacy of 24-36 sessions of CRT in schizophrenia (Dickinson et al., 2010; Bellack, Dickinson, Morris, & Tenhula, 2005), we provided the minimum rehabilitation sessions based on limited financial resources in our country. Maybe this intensity was not suitably efficient to create small to medium effects size as detected in the review of Wykes, Huddy, Cellard, McGurk and Czobor (2011).

In this study, CRT was the only psychosocial intervention provided to the patients. Most literature suggests that CRT should be integrated into a comprehensive rehabilitation program to create the greatest effect size, compared with CRT alone (Wykes et al., 2011; McGurk et al., 2013; Bowie, 2019).

We had some limitations in this study. The long-term effect of the intervention was not investigated, and we did not follow the results after the termination of CRT sessions. The findings may be influenced by the small

sample size and short duration of the intervention. The software design and using English might have affected the role of education status. We did not use some tools of the English version of Cogpack software based on the patient's difficulty in comprehension. Therefore, most of our patients were dependent on the trainer to understand the task instructions. The intervention was provided by different therapists with different levels of motivation and interest, personality traits, and teaching skills which can cause difficulties in the interpretation of our results. Furthermore, there was no specific indicator to evaluate the qualification of supervision sessions. There were also some strengths in this study. We used a computer-based cognitive battery to assess cognitive function, also computer-based CCR program to improve cognitive performance. Therefore, the role of subjective influence was limited. In our study, cognitive performance was decreased in some domains; the research participants felt anxious receiving feedback. This could have affected their performance. Providing feedback only in cases of cognitive improvement could be a solution.

5. Conclusion

We observed no significant improvements in patients' cognitive functioning and overall performance after a short course of CRT as an independent psychological intervention. This intervention should be integrated into a comprehensive rehabilitation program for these patients. Employing well-trained and motivated therapists along with planning for regular supervision sessions, using more interesting visual tasks, holding more rehabilitation sessions in prolonged duration, and providing this intervention in the early phase of the illness is recommended. Based on the language and cultural issues, these software packages should be adapted. The authors also suggest conducting a Persian version of the Cogpack software for the Iranian population.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article. The participants were informed of the purpose of the research and its implementation stages. They were also assured about the confidentiality of their information and were free to leave the study whenever they wished, and if desired, the research results would be available to them. Written consent has been obtained from the subjects. principles of the Helsinki Convention were also observed. This study was approved by the Ethics Committee of Tehran University of Medical Sciences (Code: IR.TUMS.REC.1394.1898).

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Authors' contributions

All authors read and approved the final manuscript.

Conflict of interest

The authors declared no conflicts of interest.

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