Efficacy of Cognitive Rehabilitation Using Computer Software With Individuals Living With Schizophrenia: A Randomized Controlled Trial in Japan

Kazuhiko Iwata
Osaka Psychiatric Medical Center, Osaka, Japan

Yasuhiro Matsuda
Nara Medical University

Sayaka Sato
National Institute of Mental Health, National Center of Neurology and Psychiatry, Tokyo, Japan

Shunichi Furukawa
Tokyo Metropolitan Police Hospital, Tokyo, Japan

Yukako Watanabe, Norifumi Hatsuse, and Emi Ikebuchi
Teikyo University School of Medicine

Objective: Cognitive impairment is common in schizophrenia, and is associated with poor psychosocial functioning. Previous studies had inconsistently shown improvement in cognitive functions with cognitive remediation therapy. This study examined whether cognitive remediation is effective in improving both cognitive and social functions in schizophrenia in outpatient settings that provide learning-based psychiatric rehabilitation. This study is the first randomized controlled trial of cognitive remediation in Japan.

Method: Study participants were individuals with schizophrenia from 6 outpatient psychiatric medical facilities who were randomly assigned either a cognitive remediation program or treatment as usual. The cognitive remediation intervention includes Cognitive training using computer software (CogPack; Japanese version) administered twice a week and a weekly group over 12 weeks and was based on the Thinking Skills for Work program. Most study participants were attending day treatment services where social skills training, psychocultural education for knowledge about schizophrenia, group activities such as recreation and sport, and other psychosocial treatment were offered. Cognitive and social functioning were assessed using the Brief Assessment of Cognition in Schizophrenia (BACS) and Life Assessment Scale for Mentally Ill (LASMI) at pre- and postintervention.

Results: Of the 60 people with schizophrenia enrolled, 29 were allocated to the cognitive remediation group and 31 were allocated to the treatment as usual group. Processing speed, executive function, and the composite score of the BACS showed significantly greater improvement for the cognitive remediation group than the treatment as usual group. In addition, there was significant improvement in interpersonal relationships and work skills on the LASMI for the cognitive remediation group compared with the treatment as usual group. Changes from pretreatment to posttreatment in verbal fluency and interpersonal relationships were significantly correlated, as well as changes in attention and work skills.

Conclusions and Implications for Practice: The present findings showed that providing cognitive remediation on addition to psychiatric rehabilitation contributed to greater improvement in both cognitive and social functioning than psychiatric rehabilitation alone. Cognitive remediation may enhance the efficacy of psychiatric rehabilitation improving social functioning.

Keywords: schizophrenia, cognition, social functioning, cognitive remediation, psychosocial treatment

Most people with schizophrenia continue to have cognitive deficits even after their psychotic symptoms improve. Previous studies (Green & Nuechterlein, 1999) have demonstrated an association between poor cognitive functioning and poor functional outcomes. Therefore, improving both social and cognitive functioning is a very important goal in the treatment of schizophrenia.
Many different methods for cognitive rehabilitation or cognitive remediation have been implemented by different researchers. Some researchers have used puzzles (e.g., Tower of Hanoi), while others have used neuropsychological tests (e.g., the Wisconsin Card Sorting Test; Bell, Bryson, Greig, Corcoran, & Wexler, 2001; Young & Freyslinger, 1995). In recent years there has also been the increasing use of computer software programs for cognitive remediation (Garrido et al., 2013; Kurtz, Seltzer, Shagan, Thime, & Wexler, 2007; Lee, 2013; Rass et al., 2012).

Some studies have already shown that cognitive remediation is effective in improving cognitive functioning in schizophrenia. However, it remains unclear whether cognitive remediation improves social functioning in schizophrenia. Social functioning means real world competence to live effectively and adaptably, which includes several domains: social and interpersonal relationships, work and school activities, independent community living skills, enduring family activities, and so on. Bowie, McGurk, Mausbach, Patterson, and Harvey (2012) presented the results that cognitive remediation produces robust improvements in neurocognition and generalization to functional competence and real-world behavior was more likely when supplemental skills training and cognitive remediation was combined. Therefore our study was planned so that cognitive remediation added to psychiatric rehabilitation. Kiwanuka et al. (2014) showed that neuropsychological impairment was associated with vocational outcomes, whereas most of the self-reported measures were related to social outcomes. Green et al. (2015) discussed the determinants of daily functioning in schizophrenia: nonsocial and social cognition, which were mediated with defeatist beliefs and experimental negative symptoms influencing functional outcomes. Further studies are needed to make clear influences of neurocognitive functioning in a variety of domains of social functioning.

There have been some interventional studies of cognitive remediation recently in urban areas of East Asia. Au et al. (2015) reported that supported employment and cognitive remediation demonstrated improvement in vocational, clinical, psychological, and neurocognitive outcomes. However, there was no evidence to show that cognitive improvement in these domains beyond gains associated with supported employment alone. A meta-analysis on working memory training studies suggested activation of the dorsolateral prefrontal cortex in patients with schizophrenia (Li et al., 2015). Another meta-analysis of prospective controlled trials conducted in Singapore, Japan, and other nations showed that patients receiving cognitive remediation had better work outcomes than those not receiving cognitive remediation (Chan, Hirai, & Tsoi, 2015). There have been few interventional studies in Japan that have used comparison groups in examining the efficacy of cognitive remediation with computer software (Ikezawa et al., 2012; Sato et al., 2014). Therefore we conducted a randomized controlled trial to evaluate whether cognitive remediation using cognitive training software improves both cognitive and social functions in people with schizophrenia. In Japan, social skills training, psychoeducation for patients, group meetings, individual work therapy, and group activities such as recreation, sports, and cooking were widely disseminated services in day treatment programs. We sought to evaluate whether cognitive remediation would enhance the effects of rehabilitation on improving social functioning in this enriched learning environment. We also sought to evaluate the associations between changes in cognitive functioning and changes in social functioning.

**Method**

**Participants**

Inclusion criteria for participation in this study were: (a) diagnosis of schizophrenia, based on the ICD-10 diagnostic criteria for research (World Health Organization, 1990); (b) age from 20 to 50; (c) outpatients of psychiatric medical facilities participating in this study; (d) willingness and capability to give informed consent to participate in this study; (e) clients not receiving old and conventional antipsychotics as their primary medication; and (f) clients who have hope to work in the real world setting, and have not worked yet during participation of the study. Antipsychotic medications can affect cognitive functioning, especially the older, conventional antipsychotics. For this reason, we limited study participation to clients receiving second generation antipsychotics as their primary medication.

Exclusion criteria for participation were: (a) other comorbid mental illness, (b) history of organic brain disorder, (c) comorbid substance use disorders, (d) complicating congenital mental retardation, and (e) existence of severe psychiatric symptoms that would preclude regular attendance at sessions.

Participants were recruited through referrals from attending psychiatrists or clinical staff at the psychiatric medical facilities where the study was conducted. Almost all of the participants were attending day treatment services in both groups, where social skills training, psychoeducation for patients (teaching information about schizophrenia in an interactive way), community meetings, individual work therapy, and group activities such as recreation, sports, and cooking were provided for 6 hr/day, 5 days per week. Clients can choose to attend these programs after discussion with their care-manager, and the total number of hours they attended depended on individual preferences and conditions. These learning-based rehabilitation programs are popular in Japan. Efforts were made to avoid changing clients’ pharmacological treatment during the study unless it was clinically necessary.

**Design and Setting**

This study was designed as a multicenter randomized controlled trial, conducted at six psychiatric facilities in Japan: two sites in Osaka (one hospital and one clinic), and one hospital each in Fukushima, Tokyo, Saitama, and Niigata prefecture. After completion of the baseline evaluations, clients were randomly assigned to either the cognitive remediation group or control treatment as usual group after stratification by age and sex. To minimize potential disappointment for people assigned to the control group, they served as a “waiting list” control group, and were provided the cognitive remediation after 12 weeks.

**Interventions**

**Cognitive remediation group.** Cognitive remediation was provided using the computer software: CogPack (Marker software, Germany). This program was developed for rehabilitation of higher brain dysfunction, and it contains 64 cognitive tasks to train...
verbal memory, working memory, attention/vigilance, psychomotor speed, and executive function. Marker software gave us permission to develop a Japanese language version of the program for use in research settings.

Our cognitive remediation method is theoretically based on the Thinking Skills for Work program (McGurk, Mueser, et al., 2007; McGurk, Mueser, & Pascaris, 2005). We conducted 24 cognitive training sessions using CogPack, twice a week, with each session lasting about 45–60 min. We also conducted a weekly group session designed to promote the transfer of improved cognitive functioning to real-world situations. The trained therapists described below also provided participants teaching compensation strategy or prompting additional practice if needed.

We developed a cognitive remediation manual for practitioners in order to standardize treatment across sites. Additionally, at least one therapist at each site had to take two 1-day training courses to learn the cognitive remediation program before the study was started. Therapists involved in the intervention were psychologists, nurses, social workers, and occupational therapists who were familiar with psychiatric rehabilitation for schizophrenia, and supervised during the study period by members of the research team who had several years of experience with cognitive remediation. Internet conferences between members of the research team were also held during the study period. Using computer software and the manual also minimizes the disparity of efficacy in cognitive remediation.

In the computer cognitive training, participants were directed to practice a wide range of cognitive domains in both the early and later phases of remediation with adherence to the Thinking Skills for Work program, and each participant could choose either preferable tasks or unskilled tasks to enhance their interests or self-efficacy in the later phase. In the groups, participants talked about their weak tasks, and discussed with each other strategies to complete tasks using some cognitive functioning in the early phase. In the middle and later phases, they also discussed social goals and how to transfer gained cognitive skills to achieve their goals.

Treatment as usual group. All participants received standard (treatment as usual) outpatient treatment.

Outcomes

Both the cognitive remediation group and the treatment as usual group were evaluated using the following assessments in the pre-and postintervention phases (after 4 months from baseline) within 1 month.

Primary outcome. We assessed cognitive functioning as the primary outcome in this study. Cognitive functioning was assessed using the Brief Assessment of Cognition in Schizophrenia—Japanese version (BACS-J) preintervention. The BACS-J includes six measures of cognitive functioning in the following domains: verbal memory, attention, verbal fluency, working memory, executive functioning, and psychomotor processing. Composite score of overall cognitive performance is also provided.

The BACS-J has established reliability and validity and has good sensitivity for the types of cognitive deficits associated with schizophrenia. Normalized standard scores of the BACS-J for each age category have already been reported in Japan (Kaneda et al., 2007; Keefe, Poe, Walker, Kang, & Harvey, 2006).

Secondary outcome. Social functioning and psychopathology were assessed as secondary outcomes. Social functioning was assessed with the LASMI (Ikebuchi, Iwasaki, Miyachi, Oshima, & Sugimoto, 1995; Iwasaki et al., 1994), which was rated based on reports from clients, information of caregivers, and therapist observations during this study in day treatment activities or other outpatient programs over the previous month. The LASMI yields rating functioning in five domains: daily living, interpersonal relations, work, endurance and stability, and self-recognition. We used the Interpersonal Relations and Work subscales of the LASMI in this study (Kay, Opler, & Fiszbein, 1991), because the aim of the study was improving vocational abilities through cognitive remediation. The Interpersonal Relations subscale consists of 13 items which are derived from basic communication skills such as facial expression to informal relations with family or friends. The Work subscale consists of 10 items, which include abilities of work skills and the employee’s role which might be expected in a company. These abilities were rated in a simulation setting of outpatients’ programs. Each item of the LASMI is evaluated on a 5-point Likert scale, and more score points mean more need for support for each activity. The score of each subscale is calculated by summing all of the items in the subscale.

Symptom severity was rated using the Positive and Negative Syndrome Scale (PANSS), which was scored according to the three-factor model (Positive scale, Negative scale, and General Psychopathology scale). The PANSS is composed of 30 items, and each item is rated on a 7-point Likert scale from 1 (Absent) to 7 (Extreme).

We conducted two training sessions for the raters at each site who assessed the primary and secondary outcomes.

Statistical Analysis

Analyses were performed on an intention-to-treat basis. Participants who had at least one assessment made up the intention-to-treat sample. First we compared baseline demographic and clinical characteristics between the cognitive remediation group and the treatment as usual group with $t$ tests or chi-square tests. After comparing the two groups on demographic and baseline clinical characteristics, we performed following analyses as described below. For the statistical analysis, we used JMP ver.10 (SAS Institute Japan, Tokyo Japan).

Comparing primary and secondary outcomes between the two groups. At first, improvements in cognitive and social functioning and psychotic symptoms were compared between two groups. The groups were compared using analysis of covariance (ANCOVA) with group as the independent variable, changes in cognitive or social functioning of posttreatment as the dependent variables, and baseline functioning and age as covariates. The linear regression model of the analysis is used. We entered five baseline characteristics as covariates (age, duration of illness, premorbid IQ, dose of antipsychotics, and baseline score of clinical scales). We found no significant group difference of demographic and clinical variables by random allocation. However, “allocation bias” remains because four variables (age, duration of illness, premorbid IQ, dose of antipsychotics) and baseline score of clinical scales have some effect on primary and secondary outcomes. Thus, adjusting these factors could minimize the allocation bias and boosted the statistical power for the efficacy of the
cognitive remediation. Finally, we set up the parameter (β) of “allocation group” and its 95% confidence interval (95% CI) to determine the efficacy of cognitive rehabilitation.

**Correlational analysis.** The objective of the correlational analyses was to explore whether changes in cognitive functioning from pretreatment to posttreatment were correlated with changes in social functioning, and, if so, which areas of cognitive functioning were most strongly associated with improvement in social functioning. Therefore we calculated Spearman correlations between the changes of each domain in the BACS-J and LASMI.

**Study Ethics**

We administered this trial in accordance with Declaration of Helsinki and Ethical Guidelines for Clinical Studies of the Ministry of Health, Labor, and Welfare. This study was approved by the institutional review board or ethics committee at each site, and oral and written informed consent was obtained from all participants. We registered this study in UMIN Clinical trial registration (UMIN CTR ID: UMIN000002775).

**Results**

**Patient Flow and Baseline Characteristics**

Among clients of the six hospitals, 61 clients met the inclusion/exclusion criteria and provided informed consent. However, one patient declined to complete the pretest, therefore 60 clients were randomized. Of these, 29 clients were assigned to receive cognitive remediation, and 31 were assigned to the treatment as usual group. Figure 1 shows a flow diagram of the clients through the study.

Table 1 shows the patient characteristics and baseline scores in both groups before intervention. There was no significant difference in baseline characteristics between the groups. In addition, the baseline evaluation scores for cognitive functioning, social functioning, and psychiatric symptoms did not differ between the groups. Fifty-five clients (91.7% of participants) were using the day treatment program or psychosocial treatment programs for outpatients, which were open to attendance every day. The percentage of attendance did not differ between the groups.

**The Efficacy of Cognitive Remediation in Improving**

**Cognitive Functioning**

Analyses were performed on an intention-to-treat basis. Participants who had at least one assessment made up the intention-to-treat sample. We used the last observation carried forward method, and we assigned the pretest data into missing posttest data of four participants who declined to posttest. Table 2 shows the changes in cognitive functioning on the BACS-J before and after the intervention with cognitive remediation. ANCOVA indicated that there was a significantly greater improvement for the cognitive remediation group on three domains of the BACS-J: composite score ($F = 8.209, df = 59, p = .006$), processing speed ($F = 6.345, df = 59, p = .015$), and executive functioning ($F = 4.203, df = 59, p = .045$).

**The Efficacy of Cognitive Remediation in Improving**

**Social Functioning and Psychotic Symptoms**

Table 3 shows the changes in social functioning and psychotic symptoms evaluated with the LASMI and PANSS at baseline and posttreatment for both groups. The evaluation of changes in social functioning indicated significantly greater improvements in interpersonal relationships on the LASMI ($F = 12.817, df = 59, p < .001$) and work skills ($F = 8.037, df = 59, p = .007$) in the cognitive remediation group compared with the treatment as usual group. In addition, psychiatric symptoms including the total PANSS score and all of these subscales also showed significantly greater improvements in the cognitive remediation group compared with the treatment as usual group (see Table 3).

![Figure 1. CONSORT diagram of patient flow through study.](image-url)
Changes in BACS-J executive functioning and changes in LASMI work skills (Spearman’s correlation coefficient; $p = 0.315$, $p = 0.049$). Between changes in BACS-J attention/vigilance and changes in LASMI interpersonal relationships (Spearman’s $p = 0.263$, $p = 0.049$), between changes in LASMI interpersonal relationships (Spearman’s $p = 0.263$, $p = 0.049$), between changes in BACS-J attention/vigilance and changes in LASMI interpersonal relationships (Spearman’s $p = 0.263$, $p = 0.049$), between changes in BACS-J verbal memory and changes in LASMI interpersonal relationships (Spearman’s $p = 0.263$, $p = 0.049$), between changes in LASMI interpersonal relationships (Spearman’s $p = 0.263$, $p = 0.049$), and between changes in BACS-J executive functioning and changes in LASMI work skills (Spearman’s $p = 0.265$, $p = 0.049$).

### Discussion

Providing cognitive remediation in addition to the usual treatment involving psychiatric rehabilitation approaches such as social skills training and other learning-based rehabilitation programs was associated with greater improvement in cognitive functioning, social functioning, and psychiatric symptoms in people with schizophrenia, compared with the usual services alone. Research has previously established the effectiveness of traditional psychiatric rehabilitation methods such as social skills training and psychoeducation programs (Dixon et al., 2010), which are widely used today in psychiatric practice in Japan. However, many clients who receive psychiatric rehabilitation have difficulty achieving their treatment goals. Cognitive remediation may impose cognitive functioning which could enhance the benefits of rehabilitation programs. Our findings are consistent with previous research on cognitive remediation showing significant improvements in cognitive functioning, as well as improvements in social functioning, when cognitive remediation was added to psychiatric rehabilitation compared with psychiatric rehabilitation alone (McGurk et al., 2013; McGurk et al., 2015).

In our analysis, significant correlation between improvement in cognitive functioning and improvement in social functioning were observed for some outcomes. As previously reviewed (Green, Kern, Braff, & Mintz, 2000; Green & Nuechterlein, 1999), neurocognition strongly influences psychosocial functioning. However, this interpretation does not take into account the fact that cognitive remediation programs that are provided in the absence of psychiatric rehabilitation (e.g., social skills training) tend to produce weaker (or nonsignificant) effects on psychosocial functioning, despite showing beneficial effects on cognitive functioning. Although previous studies of cognitive remediation report efficacy in improving cognitive functioning, the findings have been inconsistent that improvement of cognitive functioning did not translate into improved social functioning directly (Lu et al., 2012; Medalia & Saperstein, 2013). However, some studies that added cognitive remediation to psychiatric rehabilitation showed the greatest impact on psychosocial functioning (Franck et al., 2013; Krabben-dam & Aleman, 2003; Wykes, Huddy, Cellard, McGurk, & Czobor, 2011). It is possible that cognitive remediation improves capacity to learn through increased verbal memory or executive functioning, and in the absence of concerted learning opportunities, improved cognitive functioning does not automatically lead to improved psychosocial functioning, as discussed in McGurk et al. (2013, 2015). The present results suggest that improved cognitive functioning could facilitate improvement in social functioning in the context of a social learning environment through transferring skills from laboratory to real world. Subramaniam et al. (2014) showed that task performance of cognitive training of working memory and brain activity within the bilateral middle frontal gyri predicted better occupational functioning at 6-month follow-up.

### Table 1

**Baseline Characteristics: Demographic Data**

<table>
<thead>
<tr>
<th>Baseline data</th>
<th>Cognitive remediation group ($N = 29$)</th>
<th>Treatment as usual group ($N = 31$)</th>
<th>ANCOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Avg.  SD</td>
<td>Avg.  SD</td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>34.2 7.11</td>
<td>34.5 6.73</td>
<td></td>
</tr>
<tr>
<td>Sex (male/female)</td>
<td>7/22</td>
<td>8/23</td>
<td></td>
</tr>
<tr>
<td>Duration of Illness (month)</td>
<td>140.9 96.8</td>
<td>144.5 83.1</td>
<td></td>
</tr>
<tr>
<td>IQ (JART Score)</td>
<td>98.7 9.59</td>
<td>97.2 10.2</td>
<td></td>
</tr>
<tr>
<td>Dose of antipsychotics* (mg)</td>
<td>672.6 618.3</td>
<td>674 417.5</td>
<td></td>
</tr>
</tbody>
</table>

*Chlorpromazine equivalent.

**Note.** No significant differences between groups on any variables with $t$ test or chi square test.

### Table 2

**The Changes of Cognitive Functions After Intervention**

<table>
<thead>
<tr>
<th></th>
<th>Cognitive remediation group ($N = 29$)</th>
<th>Treatment as usual group ($N = 31$)</th>
<th>ANCOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre (SD)</td>
<td>Post (SD)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.18 (.82)</td>
<td>.63 (.82)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.10 (.99)</td>
<td>.49 (1.01)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.11 (.74)</td>
<td>.64 (.99)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.19 (1.02)</td>
<td>.53 (.94)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.25 (1.09)</td>
<td>.54 (1.12)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.08 (1.08)</td>
<td>.32 (.74)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.15 (.48)</td>
<td>.55 (.64)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.18 (.12)</td>
<td>.07 (.09)</td>
<td>3.150 .314 .082</td>
</tr>
<tr>
<td></td>
<td>.09 (.02)</td>
<td>.11 (.14)</td>
<td>1.487 .227 .228</td>
</tr>
<tr>
<td></td>
<td>.10 (.20)</td>
<td>.09 (.28)</td>
<td>3.129 .353 .087</td>
</tr>
<tr>
<td></td>
<td>.18 (.96)</td>
<td>.18 (.88)</td>
<td>6.345 .466 .015†</td>
</tr>
<tr>
<td></td>
<td>.24 (.86)</td>
<td>.10 (.00)</td>
<td>1.467 .190 .231</td>
</tr>
<tr>
<td></td>
<td>.08 (.93)</td>
<td>.05 (.88)</td>
<td>4.203 .239 .045†</td>
</tr>
<tr>
<td></td>
<td>.14 (.70)</td>
<td>.01 (.69)</td>
<td>8.209 .300 .006†</td>
</tr>
</tbody>
</table>

*Note.** Analysis by analysis of covariance (ANCOVA) and last observation carried forward (LOCF). $df = 59$. $^†p < .01$. $^†p < .05$. $BACS =$ Brief Assessment of Cognition in Schizophrenia (Japanese version).
The program of this study also focused on enhancing executive functioning and working memory, and transferring learned abilities to the real world with group sessions and daily activities of day treatment programs. Therefore, not only cognitive remediation but also traditional psychiatric rehabilitation focused on social functioning may be necessary for some clients with schizophrenia. To achieve social goals such improvements in both cognitive and social functioning may be critical to facilitate the reintegration of persons with schizophrenia in the community.

Psychiatric symptoms assessed on the PANSS also improved significantly more in the cognitive remediation group than the treatment as usual group. Meta-analyses of controlled studies of cognitive remediation have shown small effect sizes on the reduction of psychiatric symptoms (Kurtz, 2012; McGurk, Twamley, et al., 2007; Medalia & Choi, 2009). It is possible that the reduction in psychiatric symptoms found in this study were influenced by the improvement in social functioning.

In this study, a standardized cognitive remediation program provided for about 24 sessions over 12 weeks was found to be effective at improving cognitive and social functioning. This result is consistent with the findings from Bowie et al. (2012) that real-world behavior was more likely when supplemental skills training and cognitive remediation were combined. It is possible that some clients in the cognitive remediation group who did not improve in cognitive or social functioning would have improved from a longer program.

Strengths and Limitations of This Study

Some strengths of this study should be noted. The computer software program used to engage clients in cognitive exercises was designed to improve cognitive functioning. Moreover, the cognitive remediation procedures, which were mainly strategy coaching and compensating methods by trained therapists, were formulated such that they could be implemented by following a manual based on the Thinking Skills for Work. This design reduced the extent to which the effectiveness of the cognitive remediation intervention was influenced by the skills of individual clinical practitioners. Cognitive remediation can be implemented with uniform quality in any medical facility by trained staff using a standardized manual.

In randomized controlled trials, generalizability of the results can be a problem. However, this study was conducted in medical settings combining both public and private hospitals, and research cooperation was obtained from various psychiatric medical facilities, including a national center, psychiatric hospitals, general hospital, and psychiatric clinic in the community. Demonstrating the efficacy of cognitive remediation across a range of different settings will increase the generalizability of the study findings to other settings.

Medication dose and type were not controlled in this study. Further research is needed under control of medication because it is expected to influence cognitive functioning. We observed that a combination of psychiatric rehabilitation and cognitive remediation demonstrated improvement in clinical and neurocognitive outcomes. However, there was no explicit evidence to show that cognitive improvement beyond gains of social outcomes is associated with psychiatric rehabilitation alone in real-world settings.

Which standardized psychiatric rehabilitation program may play a significant role of synergistic effect with cognitive remediation remains unclear, and there is a room for future research. In addition, a further period for observing the trajectory of improvement of social outcome is also needed. It is well known that changing

Table 3
The Changes of Social Functions and Psychotic Symptoms After Intervention

<table>
<thead>
<tr>
<th>The changes after intervention</th>
<th>Cognitive remediation group (N = 29)</th>
<th>Treatment as usual group (N = 31)</th>
<th>ANCOVA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre (SD)</td>
<td>Post (SD)</td>
<td>F</td>
</tr>
<tr>
<td>LASMI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interpersonal relationship</td>
<td>14.14 (5.47)</td>
<td>9.69 (5.41)</td>
<td>12.817</td>
</tr>
<tr>
<td>Work</td>
<td>12.93 (5.17)</td>
<td>9.41 (5.52)</td>
<td>8.037</td>
</tr>
<tr>
<td>PANSS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive scale</td>
<td>12.93 (4.95)</td>
<td>11.38 (4.78)</td>
<td>7.996</td>
</tr>
<tr>
<td>Negative scale</td>
<td>14.83 (4.80)</td>
<td>12.66 (4.52)</td>
<td>5.215</td>
</tr>
<tr>
<td>General Psychopathology Scale</td>
<td>29.48 (8.83)</td>
<td>26.72 (9.10)</td>
<td>9.015</td>
</tr>
<tr>
<td>Total</td>
<td>57.27 (16.53)</td>
<td>50.76 (17.03)</td>
<td>9.407</td>
</tr>
</tbody>
</table>

Note. Analysis by analysis of covariance (ANCOVA) and last observation carried forward (LOCF), df = 59. LASMI = Life Assessment Scale for Mental Illness; PANSS = Positive and Negative Syndrome Scale. † p < .01.

Table 4
Correlation Between Improvements of Cognitive and Social Functions

Change of subscales in LASMI

<table>
<thead>
<tr>
<th>Change of subscales in BACS (N = 60)</th>
<th>Interpersonal relationship (N = 60)</th>
<th>Work (N = 60)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Spearman’s ρ</td>
<td>p value</td>
</tr>
<tr>
<td>Verbal memory</td>
<td>−.315</td>
<td>.018*</td>
</tr>
<tr>
<td>Digit sequencing</td>
<td>−.158</td>
<td>.246</td>
</tr>
<tr>
<td>Verbal fluency</td>
<td>−.263</td>
<td>.049*</td>
</tr>
<tr>
<td>Token Motor Task</td>
<td>−.138</td>
<td>.309</td>
</tr>
<tr>
<td>Symbol-Coding Task</td>
<td>−.106</td>
<td>.438</td>
</tr>
<tr>
<td>Tower of London</td>
<td>−.045</td>
<td>.740</td>
</tr>
</tbody>
</table>

Note. Analysis by correlational analysis and last observation carried forward (LOCF). LASMI = Life Assessment Scale for Mental Illness; BACS = Brief Assessment of Cognition in Schizophrenia Japanese version. * p < .05.
social outcomes after psychosocial interventions requires much more time, such as one year or more.

Conclusions and Implications for Practice

Participants in a multicenter randomized controlled trial who were assigned to receive cognitive remediation plus traditional psychiatric rehabilitation showed significantly greater improvements in cognitive and social functioning than those assigned to receive traditional psychiatric rehabilitation alone. The results suggest that cognitive remediation may enhance the clinical effectiveness at psychiatric rehabilitation programs for improving social functioning. However, there remains room for further investigation about the evidence of real-world improvement of social functioning.

References


Received October 14, 2015
Revision received August 25, 2016
Accepted September 23, 2016

E-Mail Notification of Your Latest Issue Online!

Would you like to know when the next issue of your favorite APA journal will be available online? This service is now available to you. Sign up at https://my.apa.org/portal/alerts/ and you will be notified by e-mail when issues of interest to you become available!