Introduction

In recent years, cognitive impairment has been considered the core impediment of schizophrenia [1, 2], and cognitive rehabilitation aimed at improving this is attracting attention. Schizophrenia’s cognitive impairments include (a) disorders of neurocognitive function, such as attention, memory, working memory, verbal fluency, executive function, and processing speed; and (b) cognitive biases such as tending to seek causes in external factors, rushing to conclusions, and passing judgment with only minimal information and becoming strongly convinced of it. Patients with schizophrenia are liable to hold erroneous beliefs due to these cognitive impairments that are deemed to affect their social functioning, such as daily living, interpersonal relations, and employment [3, 4].

Moritz and Woodward [5] developed metacognitive training (MCT) to correct cognitive bias in schizophrenia. MCT regards metacognition as “thinking about thinking” or “cognition about cognition,” and positions it as the ability to monitor one’s own cognitive bias and control it [5–8]. MCT is a psychoeducational program conducted individually or in groups, using the basic theory of cognitive behavioral therapy as the background, with learning tasks presented, using a PowerPoint file. Participants complete their learning tasks and...
engage in group discussions while enjoying them, and aim to generalize the lessons gained in the sessions to their daily lives and expand their problem-solving repertoires [5]. It includes 8 modules prepared in 2 cycles, which are implemented over 16 weeks or 4 months.

A series of studies conducted by Moritz et al. confirmed that MCT is effective in mitigating the positive symptoms of schizophrenia patients [5–8]. The Japanese language edition of MCT was developed in 2012 by Ishigaki [9], and is currently at the stage of having the effects verified in Japan. Until now, improvements in the stress handling of those with schizophrenia and mitigation of positive symptoms have been reported as its training effects [10, 11]. Ishikawa et al. stated that the Japanese edition of MCT helped improve schizophrenia patients’ positive symptoms (especially delusion) as well as overall functioning and cognitive bias [12]. Improvement of elemental neurocognitive functions, such as attention and memory, is believed to be related to the improvement of positive symptoms and cognitive bias. However, no reports have thus far been published about MCT’s effectiveness in improving neurocognitive function in schizophrenia; its efficacy against long-term hospitalized schizophrenia patients [13] has not been investigated, either. Therefore, this study aimed to explore the possibility of using MCT with long-term hospitalized patients with schizophrenia in Japan as well as its efficacy in improving their neurocognitive function.

Methods

Participants

Participating in this study were patients who were diagnosed with schizophrenia by a psychiatrist, based on the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-5) [14], were admitted to a psychiatric hospital’s long-term care ward, and were undergoing occupational therapy. As part of the enrollment criteria for participation, individuals had to be between the ages of 20 and 65 years. The following individuals were excluded: those with intellectual disability and a history of substance abuse and/or dependence, dementia, epilepsy, head injury, and cerebrovascular diseases. Those with unstable disease condition, e.g. those with refusal and/or significant loss of motivation, and those whom either a psychiatrist or an occupational therapist had determined as unfit for the study were also excluded. We explained the purpose of the study to all the participants, both in writing and orally, and obtained their consent to participate. This study was conducted after receiving the approval of Shinshu University’s Medical Ethics Committee (Approval No. 3517).

Study design

A crossover trial was performed, with the participants being allocated to two groups (A and B) via stratified randomization that took their sex and age into consideration. In the first half of the follow-up period, Group A had MCT added to their occupational therapy (OT) sessions, while Group B received the usual OT only. In the latter half of the follow-up period, MCT was added to Group B’s OT sessions, while Group A received the usual OT only. Because the carryover effects of MCTs were anticipated from the outset, no washout period was established in this crossover design. The start of the follow-up was based on the baseline assessment of outcome indicators. Assessment 2 was implemented in both groups four months after Group A had completed their MCT, and Assessment 3 was implemented in both groups eight months after Group B had completed their MCT.

Interventions

MCT was conducted in a group setting. A 60-minute weekly session was conducted 16 times over a period of four months. MCT modules included tasks that handled “causal attribution (simplistic attribution),” “jumping to conclusions,” “correction of beliefs,” “taking perspectives of others (the theory of mind),” “memory (erroneous overconfidence),” and “self-esteem.” In each session, two occupational therapists assumed the role of a leader and a co-leader, and used a projector to present PowerPoint teaching materials, encouraged verbal interactions among the participants in accordance with the MCT implementation manual [9], and ensured that the participants could tackle the tasks while enjoying them. By way of information, in the usual OT, either an individual or a group program lasting 1 to 2 hours per session was offered 4–5 times a week according to the participants’ individual wishes and goals. The program included light physical exercises, arts and crafts, psychoeducation, and other subjects.

Measures

At baseline, an occupational therapist used the participants’ medical records to gather data including basic information: age, sex, number of years of education, age of onset, disease duration, length of hospital stay, and the dose of antipsychotic drug(s) being taken (“medication”). At the baseline, four measures were used: the Brief Assessment of Cognition in Schizophrenia (BACS), the Positive and Negative Syndrome Scale (PANSS), the Global Assessment of Functioning (GAF), and the Beck Cognitive Insight Scale (BCIS). The BACS is a cognitive function evaluation scale developed by Keefe et al. [15]. It comprises six sub-tests that measure verbal
memory, working memory, motor speed, verbal fluency, attention and processing speed, and executive function. The results were evaluated using a standard score (z-score) that used 0 as the typically functioning participants’ population mean. The larger the z-score, the higher is the person’s cognitive function. As a yardstick for severity, \(-0.5 \leq -1.0\) was judged as mild disorder, \(-1.0 \leq -1.5\) was judged as a moderate disorder, and \(-1.5 \leq 5\) was judged to be a severe disorder. In this study, the Japanese language edition standardized by Kaneda et al. [16] was used and evaluated by occupational therapists.

The PANSS, created by Kay et al. [17], is a scale for assessing the mental state during schizophrenia. A total of 30 items comprising 7 positive symptom items, 7 negative symptom items, and 16 general psychopathology items were evaluated, ranging from 30 to 210 (1 = the mildest and 7 = most severe). The PANSS was assessed by occupational therapists and psychiatrists.

The GAF is a scale featured in DSM-IV-TR [18], and evaluates a participant’s mental health and disease condition based on the degree of severity and functional level (the role played in society and occupation), using a score ranging from 1 to 100. The higher the score, the healthier one’s functional level is judged to be. The GAF was evaluated by occupational therapists. The BCIS, created by Beck et al. [19], is a self-report evaluation scale that measures cognitive bias. The respondents were asked to rate how much they agreed with each of the 15 items by using a 4-point scale, (0 = do not agree at all and 3 = agree completely). Self-Reflectiveness (SR) was compiled from nine items (range: 0–27), and Self-Certainty (SC), from six items (range: 0–18). The higher the SR score, the higher-level insight a person has toward their thoughts, and the higher the SC score, the stronger a person is convinced of their own thinking. A composite index is calculated by subtracting the SC score from the SR score (range: −18−27), and the higher the score, the more appropriate a person’s cognitive tendencies are judged to be. In this study, the Japanese language edition of the BCIS produced by Uchida et al. [20] was used, and was evaluated by occupational therapists.

Statistical analyses

An inter-group comparison was made among the demographic characteristics and evaluation scale scores at baseline as well as the scores of scales at Assessments 2 and 3. These scores of Groups A and B were also compared before and after MCT. Because the Shapiro-Wilk test showed no normality of population, a nonparametric method was adopted. The Mann-Whitney U test was used to compare Groups A and B, the Friedman test was used for making before and after MCT comparisons in each group, the Scheffe method was used for multiple comparisons, and the Wilcoxon signed-rank test was used to compare the scores before and after MCT. Effect size\(^{8}\) was also calculated to confirm the size of the differences that were not affected by sample size. Bell Curve for Excel Ver.3.21 was used for statistical analysis, and the significance level was less than 5%.

Results

Of the 43 patients hospitalized inside the long-term care ward, 22 took part in this study. Eleven individuals were randomly allocated to Groups A and B. During the follow-up period, one individual in Group A was discharged from the hospital, and another individual withdrew their consent, while two individuals in Group B were discharged, and another individual withdrew their consent. In the end, nine individuals in Group A (male-to-female ratio = 6 : 3), and eight in Group B (male-to-female = 4 : 4) were analyzed (Figure 1).

Table 1 compares the two groups’ demographic data and the results of assessments at baseline. No significant differences were seen in a comparison between Groups A and B in terms of the demographic data and the scale scores of the baseline, and Assessments 2 and 3.

Table 2 shows a comparison of Group A’s assessment scores before and after MCT. Compared to baseline scores, Assessments 2 and 3 (Friedman test), a significant increase in scores was seen in the BACS’ verbal memory \((p < .05, r = .75)\), attention \((p < .05, r = .81)\), executive function \((p < .05, r = .75)\), and composite scores \((p < .01, r = .81)\). In the post-hoc test, a significant increase was seen between Assessments 2 and 3 in the score for executive function \((p < .05, r = .84)\). In a comparison of the PANSS scores via repeated measurement, a significant decrease in score was seen in positive symptoms \((p < .01, r = .84)\), negative symptoms \((p < .05, r = .75)\), general psychopathology \((p < .05, r = .75)\), and the PANSS total scores \((p < .01, r = .89)\), and, in the post-hoc test, a significant difference was seen between baseline and Assessment 2 in positive symptoms \((p < .05, r = .84)\), negative symptoms \((p < .05, r = .67)\), general psychopathology \((p < .05, r = .77)\), and the PANSS total scores \((p < .01, r = .89)\). No significant differences were seen between medication and the scores for the GAF and BCIS.

Table 3 shows Group B’s comparison of assessment scores between before and after MCT. In a comparison among baseline, Assessments 2 and 3, a significant increase in scores was seen in the BACS verbal memory \((p < .01, r = .84)\) and attention \((p < .05, r = .84)\), and, in the post-hoc test, a significant increase was seen between Assessments 2 and 3 in both verbal memory \((p
< .05, \( r = .89 \)) and attention (\( p < .05, \ r = .74 \)). Moreover in a comparison of the PANSS scores via repeated measurement, a significant decrease in scores was seen in negative symptoms (\( p < .05, \ r = .57 \)), and, in a multiple comparison, a significant decrease in scores was seen between baseline and Assessment 1 in negative symptoms (\( p < .05, \ r = .78 \)), general psychopathology (\( p < .05, \ r = .84 \)), and total score (\( p < .05, \ r = .89 \)). No significant differences were seen among dosage, the GAF, and BCIS.

The scores of various scales were compared before and after MCT implementation for all participants (Table 4). A significant increase in scores was seen in the BACS verbal memory (\( p < .01, \ r = .73 \)), attention (\( p < .01, \ r = .64 \)), and composite scores (\( p < .05, \ r = .63 \)), but no significant differences were seen in the GAF, PANSS, BCIS, or medication.

**Discussion**

The participants were patients with schizophrenia whose disease duration exceeded 30 years, and who had been hospitalized for a long time in a psychiatric department’s long-term care ward. At baseline, the BACS composite score was below −2.0 for both groups, showing severe cognitive impairment. Moreover, from their GAF, PANSS, and BCIS scores, the participants were assumed to have low-level psychosocial functioning, relatively severe psychiatric symptoms, and low SR. The large dosage of antipsychotic drugs was believed to reflect the participants’ unstable mental and physical function. During the follow-up period, of the 19 participants a total of 17 individuals, or 89.47%, managed to complete the OT program that included MCT. This relatively high completion rate indicates the potential of using MCT in patients with chronic-stage schizophrenia who are being admitted to a psychiatric hospital’s long-term care ward. There is a possibility that the advantages of MCT, allowing the participants to tackle the tasks while enjoying them, may have contributed to maintaining the participants’ motivation.

Past studies have reported improvement of positive symptoms and cognitive bias with the use of MCT [5–8, 10–12], but no reports have thus far focused on the improvement of neurocognitive function. Our study’s repeated measurements performed at baseline, Assessments 2 and 3, showed improvement tendencies for verbal memory, attention, executive function, and composite score in Group A, and improvements for verbal memory and attention in Group B (Tables 2 and 3). The
Table 1  Demographic characteristics and baseline assessments results by treatment group (A; B)

| Variable | Group A (n = 9) | Group B (n = 8) | Statistic | p | r |
|----------|----------------|----------------|-----------|---|---|
| Age (years) | 54.00 (7.60) | 54.50 (8.63) | 33 | 0.77 | 0.07 |
| Sex | | | | | |
| Male, n (%) | 6 (66.7) | 4 (50.0) | χ² = 0.48 | 0.49 | 0.17 |
| Female, n (%) | 3 (33.3) | 4 (50.0) | | | |
| Age at onset (years) | 22.22 (4.71) | 21.13 (4.23) | 30.5 | 0.59 | 0.13 |
| Disease duration (years) | 31.78 (6.16) | 33.38 (10.43) | 29.5 | 0.53 | 0.15 |
| Education (years) | 12.17 (1.97) | 12.63 (1.80) | 32.5 | 0.72 | 0.09 |
| Length of hospital stays (months) | 71.67 (89.79) | 103.75 (106.87) | 30 | 0.56 | 0.14 |
| Medication (mg/day) | 1117.24 (868.94) | 1033.25 (419.74) | 36 | 1.00 | 0.00 |
| The BACS | | | | | |
| • Verbal memory | −2.29 (1.13) | −1.74 (0.69) | 25 | 0.29 | 0.11 |
| • Working memory | −2.47 (1.47) | −2.55 (0.87) | 32.5 | 0.74 | 0.07 |
| • Motor speed | −2.55 (1.60) | −3.15 (0.83) | 24 | 0.25 | 0.15 |
| • Verbal fluency | −1.18 (1.40) | −1.69 (1.00) | 27 | 0.39 | 0.41 |
| • Attention | −3.68 (1.49) | −3.90 (1.01) | 36 | 1.00 | 0.14 |
| • Executive function | −2.11 (2.42) | −1.44 (1.35) | 31.5 | 0.66 | 0.01 |
| • PANSS total | −2.38 (1.15) | −2.41 (0.37) | 32 | 0.70 | 0.05 |
| The GAF | 18.89 (4.84) | 21.63 (5.17) | 26.5 | 0.36 | 0.41 |
| The PANSS | | | | | |
| • Positive | 28.00 (5.98) | 23.50 (6.26) | 21.5 | 0.16 | 0.20 |
| • Negative | 27.33 (9.82) | 28.75 (7.19) | 33.5 | 0.81 | 0.16 |
| • General psychopathology | 53.33 (10.56) | 54.75 (11.71) | 35.5 | 0.96 | 0.08 |
| • PANSS total | 108.67 (22.87) | 107.00 (22.91) | 30 | 0.56 | 0.02 |
| The BCIS | | | | | |
| • Self-reflectiveness | 11.00 (3.43) | 12.38 (4.18) | 29 | 0.50 | 0.16 |
| • Self-certainty | 6.11 (2.47) | 6.25 (4.15) | 35 | 0.92 | 0.20 |
| • Composite index | 4.89 (5.22) | 6.13 (4.54) | 35 | 0.92 | 0.18 |

Note. Mann-Whitney U test. SD, standard deviation. r, Effect size
BACS, Brief Assessment of Cognition in Schizophrenia; GAF, Global Assessment of Functioning; PANSS, Positive and Negative Syndrome Scale; BCIS, Beck Cognitive Insight Scale; Medication, Antipsychotic medication (chlorpromazine equivalence).

Table 2  Comparison of the BACS, GAF, PANSS, and BCIS Scores of Group A

| Variable | Baseline | Assessment 2 | Assessment 3 | p | r |
|----------|----------|--------------|--------------|---|---|
| Mean (SD) | Mean (SD) | Mean (SD) | p0 | p1 | p2 | r0 | r1 | r2 |
| The BACS | | | | | | | | |
| • Verbal memory | −2.29 (1.13) | −1.55 (0.93) | −1.31 (1.17) | * | .75 | .65 | .22 |
| • Working memory | −2.47 (1.47) | −2.18 (1.31) | −2.06 (1.27) | * | .47 | .38 | .11 |
| • Motor speed | −2.55 (1.60) | −2.83 (1.33) | −2.64 (1.19) | * | .10 | .30 | .57 |
| • Verbal fluency | −1.18 (1.40) | −0.70 (1.27) | −0.70 (1.25) | * | .40 | .42 | .22 |
| • Attention | −3.68 (1.49) | −2.64 (1.75) | −2.59 (1.59) | * | .81 | .65 | .30 |
| • Executive function | −2.11 (2.42) | −1.96 (2.77) | −1.4 (1.82) | * | .75 | .14 | .84 |
| • Composite score | −2.38 (1.15) | −1.98 (1.15) | −1.78 (0.93) | ** | .81 | .61 | .57 |
| The GAF | 18.89 (4.84) | 20.78 (3.94) | 22.44 (4.06) | | | | |
| The PANSS | | | | | | | | |
| • Positive | 28.00 (5.98) | 23.33 (5.64) | 22.78 (5.61) | ** | * | .84 | .84 | .23 |
| • Negative | 27.33 (9.82) | 22.89 (5.65) | 22.89 (8.27) | * | * | .89 | .67 | .06 |
| • General psychopathology | 53.33 (10.56) | 47.00 (11.59) | 46.56 (12.39) | * | * | .75 | .77 | .14 |
| • PANSS total | 108.67 (22.87) | 93.22 (20.33) | 92.22 (22.89) | ** | ** | .89 | .89 | .14 |
| The BCIS | | | | | | | | |
| • Self-reflectiveness | 11.00 (3.43) | 11.33 (3.40) | 12.22 (4.26) | | | .16 | .02 | .23 |
| • Self-certainty | 6.11 (2.47) | 6.00 (2.21) | 5.44 (2.22) | | | .16 | .04 | .28 |
| • Composite index | 4.89 (5.22) | 5.33 (5.16) | 6.78 (5.59) | | | .21 | .08 | .42 |
| Medication (mg/day) | 1117.2 (868.9) | 985.9 (629.5) | 1039.1 (623.1) | | | .39 | .53 | .53 |

Note. n = 9. Friedman test. SD, standard deviation. r, Effect size
*p < 0.05, ** p < 0.01. p0 is a comparison of the three assessments by the Friedman test. p1 shows a comparison between baseline and assessment 2, and p2 shows a comparison between assessments 2 and 3 (Scheffé). r0 represents the effect size for the comparison of the three assessments, r1 represents the comparison between the baseline and the second assessment, and r2 represents the effect size for the comparison between the second and third assessments.
BACS, Brief Assessment of Cognition in Schizophrenia; GAF, Global Assessment of Functioning; PANSS, The positive and negative syndrome scale; BCIS, Beck Cognitive Insight Scale; Medication, Antipsychotic medication (chlorpromazine equivalence).
METACOGNITIVE TRAINING FOR SCHIZOPHRENIA PATIENTS

**Table 3** Comparison of the BACS, GAF, PANSS, and BCIS Scores of Group B

| Variable                  | Baseline  | Assessment 2 | Assessment 3 | p0 | p1 | p2 | r0 | r1 | r2 |
|---------------------------|-----------|--------------|--------------|----|----|----|----|----|----|
| **The BACS**              |           |              |              |    |    |    |    |    |    |
| • Verbal memory           | −1.74 (0.69) | −1.65 (1.01) | −0.94 (1.13) | ** | *  |     | .84 | .24 | .89 |
| • Working memory          | −2.55 (0.87) | −2.47 (0.76) | −2.19 (1.27) | .04 | .31 | .05 | .78 | .48 | .24 |
| • Motor speed             | −3.15 (0.83) | −2.62 (1.14) | −2.30 (0.92) |    |    |    | .78 | .48 | .24 |
| • Verbal fluency          | −1.69 (1.00) | −1.99 (1.33) | −2.03 (1.35) |    |    |    | .42 | .36 | .42 |
| • Attention               | −3.90 (1.01) | −3.72 (1.15) | −2.71 (1.00) | *  | *  |     | .84 | .24 | .74 |
| • Executive function      | −1.44 (1.35) | −1.42 (1.23) | −1.52 (2.37) | .05 | .00 | .05 | .64 | .35 | .50 |
| • Composite score         | −2.41 (0.37) | −2.31 (0.39) | −1.95 (0.78) | .06 | .27 | .11 | .57 | .78 | .15 |
| **The GAF**               |           |              |              |    |    |    |    |    |    |
| Positive                  | 23.50 (6.26) | 21.88 (6.37) | 22.38 (4.72) |    |    |    | .06 | .27 | .11 |
| Negative                  | 28.75 (7.19) | 23.75 (4.84) | 24.25 (5.12) | *  | *  |     | .57 | .78 | .15 |
| General psychopathology   | 54.75 (11.71) | 47.25 (7.66) | 48.88 (6.81) | *  |     |    | .42 | .84 | .30 |
| The PANSS total           | 107.00 (22.91) | 92.88 (15.28) | 95.50 (12.59) | *  |     |    | .45 | .89 | .08 |
| **The BCIS**              |           |              |              |    |    |    |    |    |    |
| Self-certainty            | 12.38 (4.18) | 12.25 (4.41) | 12.50 (3.77) |    |    |    | .05 | .03 | .00 |
| Self-reflectiveness        | 6.25 (4.15) | 4.5 (2.78) | 3.88 (2.89) |    |    |    | .37 | .67 | .05 |
| Composite index           | 6.13 (4.54) | 7.75 (4.84) | 8.63 (3.97) |    |    |    | .15 | .47 | .27 |
| Medication (mg/day)       | 1033.3 (419.7) | 968.8 (521.5) | 1014.9 (521.1) |    |    |    | .05 | .43 | .05 |

**Note.** n = 8. Friedman test. SD, standard deviation. r, Effect size
*p < 0.05, **p < 0.01. p0 is a comparison of the three assessments using the Friedman test. p1 shows a comparison between baseline and assessment 2, and p2 shows a comparison between assessments 2 and 3 (Scheffe). r0 represents the effect size for the comparison of the three assessments, r1 represents the comparison between the baseline and the second assessment, and r2 represents the effect size for the comparison between the second and third assessments.

BACS, Brief Assessment of Cognition in Schizophrenia; GAF, Global Assessment of Functioning; PANSS, Positive and Negative Syndrome Scale; BCIS, Beck Cognitive Insight Scale; Medication, Antipsychotic medication (chlorpromazine equivalence).

**Table 4** Changes in the BACS, GAF, PANSS, and BCIS Scores before and after the MCT period

| Variable                  | Before (n = 17) | | | | | | | | |
|---------------------------|-----------------|---|---|---|---|---|---|---|
| **The BACS**              | Baseline  | Assessment 2 | Assessment 3 | p | r |
| • Verbal memory           | −1.99 (1.12) | −1.26 (1.07) | 13 | 0.003** | 0.73 |
| • Working memory          | −2.47 (1.19) | −2.19 (1.29) | 59 | 0.41 | 0.20 |
| • Motor speed             | −2.58 (1.41) | −2.58 (1.18) | 68 | 1.00 | 0.00 |
| • Verbal fluency          | −1.56 (1.42) | −1.33 (1.47) | 62 | 0.76 | 0.08 |
| • Attention               | −3.7 (1.34) | −2.67 (1.45) | 21 | 0.009** | 0.64 |
| • Executive function      | −1.78 (1.98) | −1.75 (2.60) | 66 | 0.62 | 0.12 |
| • Composite score         | −2.35 (0.88) | −1.96 (1.00) | 22 | 0.01** | 0.63 |
| **The GAF**               | Baseline  | Assessment 2 | Assessment 3 | p | r |
| Positive                  | 25.12 (6.88) | 22.88 (5.25) | 27 | 0.11 | 0.39 |
| Negative                  | 25.65 (8.08) | 23.53 (5.45) | 33 | 0.13 | 0.37 |
| General psychopathology   | 50.47 (9.79) | 47.88 (9.68) | 48 | 0.13 | 0.33 |
| The PANSS total           | 101.24 (21.19) | 94.29 (17.17) | 35.5 | 0.05 | 0.47 |
| **The BCIS**              | Baseline  | Assessment 2 | Assessment 3 | p | r |
| Self-certainty            | 11.59 (3.97) | 11.88 (3.63) | 66.5 | 0.94 | 0.02 |
| Self-reflectiveness        | 5.35 (2.74) | 5.00 (2.77) | 50.5 | 0.90 | 0.03 |
| Composite index           | 6.24 (5.24) | 6.88 (4.92) | 57.5 | 0.59 | 0.13 |
| Medication (mg/day)       | 1047.4 (619.1) | 999.5 (581.2) | 62 | 0.76 | 0.08 |

**Note.** Wilcoxon signed-rank test. SD, standard deviation. r, Effect size
*p < 0.05, **p < 0.01

In Group A, the score change from baseline to Assessment 2 was compared, and in Group B, the score change from Assessment 2 to Assessment 3 was compared.

BACS, Brief Assessment of Cognition in Schizophrenia; GAF, Global Assessment of Functioning; PANSS, Positive and Negative Syndrome Scale; BCIS, Beck Cognitive Insight Scale; Medication, Antipsychotic medication (chlorpromazine equivalence).
effect size, which represents the amount of changes in verbal memory, attention, and composite score, was large between baseline and Assessment 1 for Group A ($r_1 = .65, r_1 = .65, r_1 = .61$), while it had a tendency to be large between Assessments 2 and 3 for Group B (Table 3; $r_2 = .89, r_2 = .74, r_2 = .50$). These results show that, with the intervention of MCT, items such as verbal memory and attention, in particular, were liable to become activated, and a comparison made between before and after the MCT intervention period (Table 4) also suggested MCT’s effects in improving verbal memory and attention.

In the MCT learning program, tasks are presented repeatedly on PowerPoint slides. Participants are assumed to turn their attention to the tasks that are being shown, explore the detailed information, memorize information, and, by constructing a story or listening to other participants’ opinions, see the activation and application of their cognitive functions. Improvement of verbal memory and attention may have been affected by the activation of cognitive functions such as these. Moreover, in Group A, even in Assessment 3, which took place four months after the end of MCT, the participants’ cognitive function was maintained or showed tendencies toward improvement, suggesting the possibility that the improvement of neurocognitive function by MCT may be maintained by the continuation of OT. Further consideration of OT interventions will be needed to promote working memory, motor speed, verbal fluency, and executive function.

As shown in Tables 2 and 3, changes in the PANSS scores tended to be large between the baseline and Assessment 1 for both Groups A and B. No significant differences were seen in a comparison between before and after the MCT intervention (Table 4). Participants in Group B showed a reduction in the PANSS scores before intervention with MCT, so there is a possibility that factors other than MCT may have worked to improve their psychiatric symptoms. Previous studies have reported that MCT is effective in improving delusion and other positive symptoms [21]. In this study, as shown in Table 4, although tendencies toward improvement for verbal memory and attention were seen after intervention with MCT, no significant changes were seen in psychiatric symptom scores. Further investigation is therefore needed to examine the relationship between the improvement of psychiatric symptoms and neurocognitive function.

Cognitive bias governs a person’s judgment and decision-making, and affects their social functioning [19, 20]. Lam et al. [22] performed MCT in patients with schizophrenia at a frequency of two times a week and reported that, compared to the control group, the MCT intervention group saw a significant improvement in the BCIS SR scale and comprehensive evaluation scores. Ochoa et al. [23] implemented either MCT or psychoeducation with patients having recent-onset psychosis and reported that the BCIS performance results were superior in the group with which MCT had been implemented. In our study, the composite index of the BCIS showed an increasing tendency for both groups, suggesting the mitigation of cognitive bias. However, no statistically significant differences were seen in the changes in the scores. The participants of this study were patients with schizophrenia who were hospitalized in a long-term care ward and suffered severe neurocognitive disorder and moderate psychiatric symptoms. A reduction in reactivity, frequently seen in schizophrenia patients who follow a chronic course, may be related to the lack of improvements in cognitive bias.

**Study limitations and future research**

A limitation of this study is its small sample size. Another limitation is that interventions and assessments were not blinded. A third limitation is the possibility that other psychiatric services, which included daily living inside a ward during the follow-up period, were not controlled, so confounding factors may have influenced the results. There is also a need to recognize that the tendency for verbal memory and attention to improve, seen by the intervention of MCT, is not the single-handed effect of MCT, but was obtained by the concurrent use of OT. It is therefore necessary to position this study as a preliminary research. Future studies should increase the sample size, control the method of interventions to the extent possible, and investigate, in detail, MCT’s efficacy on neurocognitive functioning, psychiatric symptoms, and cognitive bias, including the influence of age, sex, length of hospital stay, disease duration, and other factors.

**Conclusion**

This study showed that MCT can be used with long-term hospitalized patients with schizophrenia. The use of MCT indicated a tendency for schizophrenia patients’ neurocognitive function (especially verbal memory and attention) to improve, and the improvement effects continued even after four months. No significant improvements were seen in the PANSS, GAF, and BCIS scores before and after MCT interventions. No improvements in cognitive bias attributable to MCT were seen. Going forward, there is a need to increase the sample size and, at the same time, control the confounding factors, and investigate in detail the efficacy of MCT in neurocognitive function, psychiatric symptoms, and cognitive bias.
Conflict of Interest

The authors declare no conflicts of interest.

Acknowledgements

The authors thank all the participants involved in this study. They also thank the Medical Corporation Murai Hospital for their support with this study. We would like to thank Editage (www.editage.com) for English language editing.

References

[1] Green MF. What are the functional consequences of neurocognitive deficits in schizophrenia? Am J Psychiatry. 1996; 153(3): 321–30.
[2] Green MF, Kern RS, Braff DL, Mintz J. Neurocognitive deficits and functional outcome in schizophrenia: are we measuring the “right stuff”? Schizophr. Bull. 2000; 26(1): 119–36.
[3] Keef RS, Goldberg TE, Harvey PD, Poe MP, Coughenour L. The brief assessment of cognition in schizophrenia: reliability, sensitivity, and comparison with a standard neurocognitive battery. Schizophr Res. 2004; 68(2–3): 283–97.
[4] Nicolò G, Dimaggio G, Popolo R, Carcione A, Procacci M, Hamm J, et al. Associations of metacognition with symptoms, insight, and neurocognition in clinically stable outpatients with schizophrenia. J Nerv Ment Dis. 2012; 200(7): 644–7.
[5] Moritz S, Woodward TS. Metacognitive training in schizophrenia. From basic research to knowledge translation and intervention. Curr Opin Psychiatry. 2007; 20: 619–25.
[6] Moritz S, Kerstan A, Veckenstedt R, Randjbar S, Vitzhum F, Schmidt C, et al. Further evidence for the efficacy of a metacognitive group training in schizophrenia. Behav Res Ther. 2011; 49(3): 151–7.
[7] Moritz S, Veckenstedt R, Andreou C, Bohn F, Hottenrott B, Leighton L, et al. Sustained and “sleeper” effects of group metacognitive training for schizophrenia. A randomized clinical trial. JAMA Psychiatry. 2014; 71(10): 1103–11.
[8] Moritz S, Thoering T, Kuhn S, Willenberg B, Westermann S, Nagel M. Metacognition-augmented cognitive remediation training reduces jumping to conclusions and overconfidence but not neurocognitive deficits in psychosis. Front Psychol. 2015; 6: 1048.
[9] Ishigaki T. Developing the Japanese version of metacognitive training. Psychiatry. 2012; 54: 939–47 (in Japanese).
[10] Hosono M, Yamazaki S, Ishigaki T. The usability of the Japanese version of metacognitive training (MCT) in day care service. Psychiatry. 2013; 55: 1165–71 (in Japanese).
[11] Morimoto T, Hujita U, Nakamura N, et al. A preliminary study of the Metacognitive training in a psychiatric ward. Hokkaido Occupational Therapy. 2015; 32: 113–21 (in Japanese).
[12] Ishikawa R, Ishigaki T, Shimada T, Tanoue H, Yoshinaga N, Oribe N, et al. The efficacy of extended metacognitive training for psychosis: a randomized controlled trial. Schizophr Res. 2020; 215: 399–407.
[13] Iwano K, Kobayashi M. Neurocognitive dysfunction of long-term hospitalization of patients with schizophrenia; Comparison with outpatients. Japanese Occupational Therapy Research. 2018; 37: 403–9 (in Japanese).
[14] American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, DSM–5. American Psychiatric Association, Washington, D. C., 2013.
[15] Keef RS, Goldberg TE, Harvey PD, Gold JM, Poe MP, Coughenour L. The brief assessment of cognition in schizophrenia: reliability, sensitivity, and comparison with a standard neurocognitive battery. Schizophr Res. 2004; 68(2–3): 283–97.
[16] Kaneda Y, Sumiyoshi T, Keefe RS, Ishimoto Y, Numata S, Ohmori T. Brief assessment of cognition in schizophrenia: validation of the Japanese version. Psychiatry Clin Neurosci. 2007; 61(6): 602–9.
[17] Kay SR, Fiszbein A, Opler LA. The positive and negative syndrome scale (PANSS) for schizophrenia. Schizophr Bull. 1987; 13(2): 261–76.
[18] Jones SH, Thornicroft G, Coffey M, Dunn G. A brief mental health outcome scale-reliability and validity of the Global Assessment of Functioning (GAF). Br J Psychiatry. 1995; 166(5): 654–9.
[19] Beck AT, Baruch E, Balter JM, Steer RA, Warman DM. A new instrument for measuring insight: the Beck Cognitive Insight Scale. Schizophr Res. 2004; 68(2–3): 319–29.
[20] Uchida T, Matsumoto K, Kikuchi A, Miyakoshi T, Ito F, Ueno T, et al. Psychometric properties of the Japanese version of the Beck Cognitive Insight Scale: relation of cognitive insight to clinical insight. Psychiatry Clin Neurosci. 2009; 63(3): 291–7.
[21] Liu Y, Tang C, Hung T, Tsai P, Lin M. The efficacy of metacognitive training for delusions in patients with schizophrenia: a meta-analysis of randomized controlled trials informs evidence-based practice. Worldviews Evid Based Nurs. 2018; 15(2): 130–9.
[22] Lam KC, Ho CP, Wa JC, Chan SM, Yam KK, Yeung OS, et al. Metacognitive training (MCT) for schizophrenia improves cognitive insight: a randomized controlled trial in a Chinese sample with schizophrenia spectrum disorders. Behav Res Ther. 2015; 64: 38–42.
[23] Ochoa S, López-Carrilero R, Barriguán ML, Poussa E, Barajas A, Lorente-Rovira E, et al. Randomized control trial to assess the efficacy of metacognitive training compared with a psycho-educational group in people with a recent-onset of psychosis. Psychol Med. 2017; 47(9): 1573–84.