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The effect of cognitive behavioral therapy for insomnia in schizophrenia patients with sleep Disturbance: A non-randomized, assessor-blind trial

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ABSTRACT

This non–randomized, assessor blind study evaluated the effects of cognitive behavioral therapy for insomnia (CBT-I) delivered in a group format on insomnia symptoms as well as psychotic, depressive, and anxiety symptoms in schizophrenia patients (n = 63) recruited from residential or rehabilitative facilities in Seoul, South Korea. Thirty-one patients received four sessions of CBT-I in groups of 2–9 patients in addition to usual care, while the control group (n = 32) received no additional intervention. The Insomnia Severity Index (ISI) and Pittsburgh Sleep Quality Index (PSQI), Psychotic Symptoms Rating Scale (PSYRATS), Anxiety Sensitivity Index (ASI), and Beck Depression Inventory (BDI) were administered at baseline, week 4, and week 8. Both groups showed significant time-group interactions on the ISI and PSQI. Post hoc testing showed that, compared to the control group, the CBT-I group showed significant reductions in ISI and PSQI at both week 4 and week 8. For the PSYRATS, ASI, and BDI scores, the CBT-I and control groups showed significant time-group interactions, but post hoc testing revealed no significant group differences at either week 4 or week 8. Therefore, CBT-I was effective for reducing insomnia symptoms in patients with schizophrenia and the effect lasted for 4 weeks after the intervention.

1. Introduction

Schizophrenia is a mental disorder characterized by “positive symptoms,” such as auditory hallucinations and delusions, and “negative symptoms,” such as social withdrawal, poverty of thought, and blunted affect. The global lifetime prevalence rate of schizophrenia is 0.7% and the disorder often has a chronic, degenerative course (McGrath et al., 2008).

Thirty-six to eighty percent of patients diagnosed with schizophrenia satisfy the clinical diagnostic criteria for insomnia disorder (Cohrs, 2008; Palmese et al., 2011; Xiang et al., 2009), which is much higher than the 5–10% clinical prevalence of insomnia in the general population (Ohayon, 2002). Insomnia symptoms may also persist in schizophrenia patients whose psychotic symptoms have stabilized with medication (Haffmans et al., 1994).

Insomnia in schizophrenia patients is related to poorer social and functional outcomes (Hofstetter et al., 2005), quality of life (Xiang et al., 2009), and cognitive performance (Gruber et al., 2009; Waters et al., 2011), as well as more severe psychopathology (Chemerinski et al., 2002). While the precise neurobiological basis for the interaction between insomnia and psychotic symptoms has not been elucidated, one possible basis is the over-activation of dopamine receptors in the corpus striatum (which is related to the positive symptoms of schizophrenia). Such over-activation may induce arousal (Monti and Monti, 2005), which could cause patients to experience insomnia during psychotic episodes or positive symptoms (Benson, 2015). Another possible biological connection pertains to the structure of the thalamus—one study showed that a smaller thalamus predicted sleep problems in those at risk for schizophrenia (Lunsford-Avery et al., 2013). Insomnia is also considered one of the antecedent symptoms predicting imminent psychotic episodes in schizophrenia (Chemerinski et al., 2002), and is suggested to play a role in the occurrence and worsening of psychotic symptoms (Eisner et al., 2013; Lunsford-Avery and Mittal, 2013; Reeve et al., 2015; Zanini et al., 2013), possibly through the mediating effect of changes in negative affect (Reeve et al., 2018). Several longitudinal studies have indicated that insomnia symptoms predict psychotic symptoms at 6- to 18-month follow-ups (Freeman et al., 2012; Freeman et al., 2013; Sheaves et al., 2016).

In the general population, cognitive behavioral therapy for insomnia (CBT-I) which targets the cognitive distortions and maladaptive behaviors that reinforce the persistence of insomnia, is nowadays the

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recommended primary therapy for chronic insomnia (Qaseem et al., 2016; Wilson et al., 2010). Behavioral therapy for psychiatric patients have demonstrated decreased use of sleep medication (Dashevsky and Kramer, 1998). Schizophrenia patients report a substantial gap in knowledge regarding healthy sleep (Chiu et al., 2015), suggesting that they may require a cognitive behavioral approach in the treatment of insomnia. However, there is scant research on the effectiveness of CBT-I in patients with psychotic disorders or schizophrenia. Two prior studies—a preliminary study of 15 patients with delusions (Myers et al., 2011) and the BEST (Better Sleep Trial) study (Freeman et al., 2015)—attempted to demonstrate the effectiveness of individual CBT-I for patients with psychotic symptoms. In Freeman et al., 41% of participants in the CBT-I group ($n = 22$) demonstrated resolution of insomnia by week 12 (Freeman et al., 2015). In Myers et al. (2011), psychotic symptoms, depressive and anxiety symptoms, and sleep quality all improved after 4 sessions of individual CBT-I (Myers et al., 2011). The efficacy of CBT-I has also been tested in psychiatric inpatient ward settings, including among patients with psychosis. Among these patients, 45% showed rapid and large improvements in insomnia (Sheaves et al., 2018). The cost-effectiveness of CBT-I in schizophrenia patients has also been demonstrated—that is, individual CBT-I (according to the BEST study) led to increased quality–adjusted life year (QALYs) and lower health costs (Tsiachristas et al., 2018).

Traditional CBT-I, which has been used in most past studies, comprises 5 to 8 sessions delivered face-to-face to individual patients. However, recent efforts to increase the availability of CBT-I have produced alternative methods of CBT-I, such as group-based methods or self-administered internet-based methods; these methods have proven to be effective as well (Freeman et al., 2017; Koffel et al., 2015). Furthermore, at least one study has determined that a reduced number of CBT-I sessions is effective for insomnia patients (Edinger et al., 2007). However, no study has yet evaluated the effectiveness of group CBT-I for patients with schizophrenia.

Insomnia is strongly related to depressive or anxiety symptoms in a bidirectional manner (Taylor et al., 2005). The significance of comorbid insomnia in the aggravation of depressive, anxiety, or psychotic symptoms has been acknowledged, and the effect of targeting insomnia symptoms per se in reducing these symptoms or the likelihood of relapse has achieved substantial support in current clinical practice (Sánchez-Ortuño and Edinger, 2012; Suh, 2015). Depressive episodes are highly prevalent in schizophrenia patients, with rates of up to 60% in patients with acute schizophrenia and 20% in those with chronic schizophrenia (Upthegrove et al., 2010). Furthermore, negative symptoms such as anergia, anhedonia, or flattened affect may manifest as or as a result of depression. The high comorbidity rates and overlapping symptoms can make it a challenge to differentiate schizophrenia from schizoaffective disorder (Upthegrove et al., 2017).

In South Korea, approximately 12.4% of patients with severe mental disorder—are enrolled voluntarily in government-managed mental health facilities (which comprise residential facilities and daytime rehabilitation facilities). Middle-aged patients and schizophrenia patients constitute 52.5% and 37.4%, respectively, of the total enrolled patients in these institutions. Social workers and psychotherapists work in collaboration to deliver close and intensive management of patients' symptoms as well as achieve relatively objective assessment of their functioning (Seoul, 2016).

The aim of the present study was firstly, to evaluate the effectiveness of group CBT-I for insomnia, and secondly, to evaluate its effectiveness for psychotic, depressive, and anxiety symptoms in Korean schizophrenia patients who reside or utilize mental rehabilitation facilities. All patients maintained their standard psychotropic medication for symptoms of schizophrenia, and we compared insomnia, psychotic, depressive, and anxiety symptoms between those who did and those who did not receive a concurrent group CBT-I intervention for 4 weeks. We hypothesized that group-based CBT-I would effectively reduce insomnia symptoms and possibly psychotic and neurotic symptoms among patients with schizophrenia.

2. Methods

2.1. Participants and allocation

This study utilized a single-blind, non-randomized controlled study design. Participants were recruited from ten daytime rehabilitative facilities and residential care facilities from a local province of Seoul, South Korea. A researcher visited each facility and after the aims and methods of the study were explained, those who voluntarily consented to participation were assessed for eligibility. Participants were considered for inclusion if they met the following criteria: (1) diagnosed with schizophrenia according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (APA, 2013), (2) ≥ 2 on the distress item of the Psychotic Symptoms Rating Scale (PSYRATS) for either delusions or hallucinations that have persisted for the past ≥ 3 months (assessed by a psychiatrist through clinical interview), (3) a total score of ≥ 15 on the Insomnia Severity Index (ISI), (4) aged 18–65 years, and (5) had no change in psychotropic medication dosage over the past month. Psychiatric evaluations were conducted by a psychiatrist who was also the evaluator of the scales used for this study. Excluded patients included those who (1) had been diagnosed with sleep apnea, alcohol or substance use disorder, organic syndrome, or intellectual disability; (2) were currently participating in individual CBT; and (3) were prescribed with sleeping pills. Those prescribed with concurrent benzodiazepines or mood stabilizers were not excluded from the study. The dosage of psychiatric medication that participants were taking at the time of the study was converted to an equivalent dose of chlorpromazine (Gardner et al., 2010) for analysis. The study was approved by the Institutional Review Board of Seoul Metropolitan Eunpyeong Hospital, Korea, and informed consent was obtained from all of the participants in accordance with the Declaration of Helsinki.

In addition to their original psychiatric drug therapy, participants received either group CBT-I (CBT-I group) or no intervention (control group). The group CBT-I was conducted with participants from the same facilities; accordingly, the number in each CBT-I group varied from 2 to 9 according to the number of participants from a single facility. The allocation to the CBT-I or control groups was conducted to rehabilitative/residential facilities in a sequential manner according to the enrollment order of the facilities from July to October 2015, and thus did not utilize randomization (Fig. 1). The first enrolled facility was allocated to the CBT-I group, the second to the control group, and the third facility to the CBT-I group: alternating up to the tenth facility to enroll. The allocation process was blinded to the evaluator. Precautionary methods to prevent unblinding included reminding participants not to tell the evaluator about their treatment allocation during each evaluation session, which was further emphasized by the facility staff members daily throughout the study period. Contact between the CBT-I therapist and the evaluator was prohibited.

2.2. CBT-I

Patients were assigned to the CBT-I group ($n = 31$), which received group CBT-I in addition their original psychiatric drug therapy, or the control group ($n = 32$), which received only their original psychiatric drug therapy. A modified CBT-I intervention (Edinger and Carney, 2007) was conducted by a mental health social worker trained for CBT. All participants assigned to the CBT-I group received four group CBT-I sessions for four weeks. Each CBT-I session was conducted for 45 minutes in principle, but lasted up to one hour depending on the clinical group (e.g., in the case of sessions with nine participants, each session required about one hour to maximize the therapeutic effect). The first session focused on psychoeducation for sleep difficulties, while cognitive therapy, sleep hygiene, stimulus control therapy, sleep restriction therapy, and sleep diary writing were performed in all

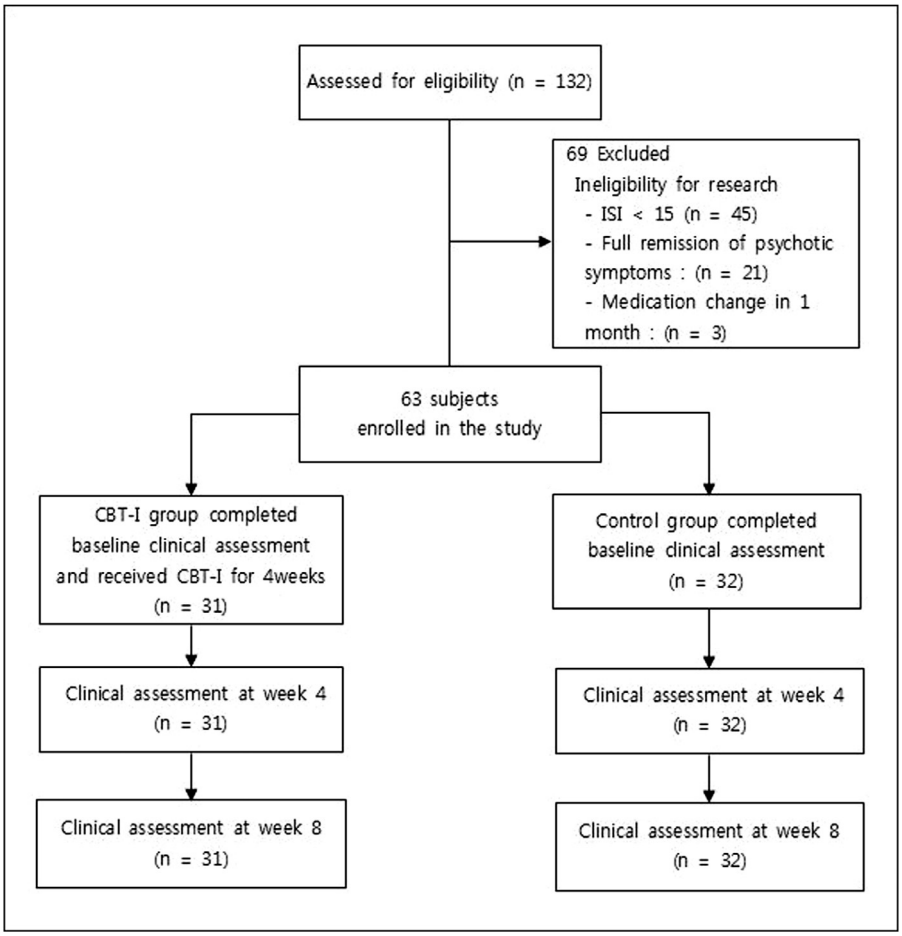

Fig. 1. Flow diagram of procedures. Abbreviations: CBT-I, cognitive behavioral therapy for insomnia.

sessions. Participants wrote sleep diary entries from 7 days before the first session of CBT-I through to the last session of CBT-I. In these sleep diaries, participants recorded actual time-in-bed, sleep latency, total sleep time, wake time after sleep onset, and sleep efficiency (ratio of total sleep time to time-in-bed, expressed as a percentage). Stimulus control was to some extent achieved by asking participants to go to bed only when feeling sleepy, and to get out of bed whenever they were unable to fall asleep. The participants were also asked to wake up at the same time every morning and to limit napping. Sleep restriction was achieved by restricting the participant's sleep time to their individual time-in-bed window, which was prescribed based on their sleep efficiency from the prior week. This time-in-bed window was prescribed at the end of each session, and was titrated up or down by 15 minutes if their sleep efficiency was ≥90% or <85%, respectively. Cognitive therapy focused on correcting dysfunctional thoughts and beliefs regarding sleep. Participants were provided with written information in a newly revised manual form as a part of the intervention so that they could read between sessions and after sessions had ended.

2.3. Outcomes

The primary outcome measures used in this study were the total scores of the ISI (Bastien et al., 2001) and Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989). PSQI component scores were also assessed. The secondary outcome measures were the total and subscale scores of the PSYRATS (Haddock et al., 1999) and the scores of the Anxiety Sensitivity Index (ASI) (Reiss et al., 1986) and Beck Depression Inventory (BDI) (Beck et al., 1996). All outcome measures were evaluated at weeks 0 (baseline), 4 (post-intervention), and 8 (follow-up).

2.3.1. Insomnia severity index

The ISI includes seven self-rated items evaluating the perceived severity of insomnia. All items are rated a five-point scale, ranging from 0 (not at all) to 4 (very much) according to the perceived degree of severity (Bastien et al., 2001). The total scores on the ISI range from 0 to 28. A higher score indicates greater severity of insomnia; scores of 0–7 indicate the absence of clinically significant insomnia, 8–14 indicate subthreshold insomnia, 15–21 indicate moderate clinical insomnia, and 22–28 indicate severe clinical insomnia. The cutoff score for clinical insomnia is 15.

2.3.2. Pittsburgh sleep quality index

The PSQI provides a measure of sleep quality and can discern between “good” and “poor” sleepers (Buysse et al., 1989). The PSQI consists of 18 items spanning seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Scores for each question range from 0 (no difficulty) to 3 (severe difficulty). Component scores are combined to produce a global score (range: 0–21). Global scores greater than 5 reflect poorer sleep quality. In this study, the component related to use of sleeping medication was excluded from the analysis.

2.3.3. Psychotic symptoms rating scale

The PSYRATS is a clinician-administered scale used to quantify the severity of delusions and hallucinations, and is used in research and clinical settings involving people with psychosis and schizophrenia (Woodward et al., 2014). The PSYRATS comprises 17 items, each rated on scale ranging from 0 (absent) to 4 (severe). It consists of both

auditory hallucination (11 items) and delusion (6 items) subscales (Haddock et al., 1999).

2.3.4. Anxiety sensitivity index

The ASI is a self-report rating scale used to measure the degree of anxiety symptoms. The ASI comprises 16 questions, with scores ranging from 0 to 4. Higher scores indicate higher levels of anxiety (Reiss et al., 1986).

2.3.5. Beck depression inventory

The BDI is a self-report rating inventory that measures the characteristic attitudes and symptoms of depression (Beck et al., 1996). The BDI consists of 21 items rated on a scale of 0 to 3. Higher scores indicate higher levels of depressive symptomatology.

2.4. Statistical analysis

The sociodemographic characteristics of the CBT-I and control groups were compared using independent sample *t*-tests and Chi-square tests. Sociodemographic variables that showed significant differences between groups were used as covariates in the analysis of covariance (ANCOVA) carried out to compare the primary and secondary outcome measures between groups at the baseline. A repeated-measures analysis of variance (ANOVA) was conducted to determine interactions between time points (baseline, post-intervention, follow-up) and groups (CBT-I and control). If time and group interactions existed and significant differences were observed between groups, post-hoc tests with Bonferroni corrections ($p < 0.017$ was considered significant) was carried out for detecting significant differences between groups at each time points (baseline, post-intervention, follow-up) using ANCOVA. Cohen's d was used to calculate effect size; 0.3, 0.5, and 0.8 were considered small, medium, and large effect sizes, respectively. All the analyses were carried out after the final follow-up evaluation. The statistical significance level was set at $p < 0.05$. IBM SPSS Statistics 20.0 (IBM Corp., Armonk, NY) was used for data analysis.

3. Results

All participants completed the study. There were no significant sociodemographic differences between the CBT-I and control groups at baseline, except for the higher proportion of women in the CBT-I group (Table 1). At baseline, no significant differences were observed between the two groups for total ISI scores, total PSQI scores, PSYRATS total and subscale scores, ASI scores, or BDI scores when sex was included as a covariate. The PSQI subscale scores did not differ between the CBT-I and control groups except for the sleep latency subscale (CBT-I group vs. control group; 2.2 ± 0.1 vs. 2.7 ± 0.1; $p = 0.002$) (Table 2).

3.1. ISI and PSQI

ISI scores showed significant time and group interactions (ISI; $F = 56.184$, $p < 0.001$) (Fig. 2 and Table 3). ISI scores in the CBT-I group showed significant improvements at weeks 4 and 8 compared to the control group, with a medium effect size ($d = 0.5$) at both time-points (Table 4).

PSQI total and component scores showed significant time and group interactions (PSQI total score; $F = 28.869$, $p < 0.001$, subjective sleep quality; $F = 19.075$, $p < 0.001$, sleep duration; $F = 24.476$, $p < 0.001$, sleep efficiency; $F = 13.419$, $p < 0.001$, and daytime dysfunction; $F = 6.237$, $p = 0.003$) (Fig. 3 and Table 3). In the post-hoc analysis, significant improvements were seen in PSQI total score for the CBT-I group at both weeks 4 and 8 compared to the control group, with a small effect size at week 4 ($d = 0.4$) and a medium one at week 8 ($d = 0.5$) (Table 4). Subjective sleep quality showed small effects ($d = 0.4$) at both weeks 4 and 8, and sleep duration showed small and medium effects at weeks 4 ($d = 0.4$) and 8 ($d = 0.5$), respectively. Sleep efficiency and daytime dysfunction showed small effects at week 4 ($d = 0.1$ and $d = 0.2$ for habitual sleep efficiency and daytime dysfunction, respectively) and week 8 ($d = 0.2$ and $d = 0.3$ for habitual sleep efficiency and daytime dysfunction, respectively) (Table 4).

Table 1
Comparison of the baseline sociodemographic characteristics of the CBT-I and control groups.

	CBT-I group ($n = 31$)	Control group ($n = 32$)	p
Age (years)	45.7 (10.5)	44.2 (11.0)	0.569
Sex			0.027
Male	16 (51.6)	25 (78.1)	
Female	15 (48.4)	7 (21.9)	
Age of onset (years)	25.1 (7.3)	26 (8.6)	0.643
Duration of illness (years)	20.5 (11.2)	17.9 (10.1)	0.340
Education (years)			0.095
1–6	1 (3.2)	1 (3.1)	
7–9	6 (19.4)	13 (40.6)	
10–12	14 (45.2)	15 (46.9)	
≥13	10 (32.3)	3 (9.4)	
Job status			0.681
Employed	26 (83.9)	28 (87.5)	
Unemployed	5 (16.1)	4 (12.5)	
Marital status			0.066
Single	24 (77.4)	31 (87.3)	
Married	6 (19.4)	1 (3.1)	
Divorced/Widowed	1 (3.2)	0	
Facility type			0.738
Rehabilitative facility	2 (40)	2 (40)	
Residential facility	3 (60)	3 (60)	
Monthly cost ($)	275 (58)	252 (8)	0.403
Staff per patient	0.20 (0.07)	0.24 (0.04)	0.349
Antipsychotics dosage*	804.4 (769.1)	876.4 (589.8)	0.678

Data for age, age of onset, duration of illness, education, monthly cost, staff per patient, and antipsychotics dosage are expressed as means (SDs), while other data are presented as percentages.

* Adjusted to chlorpromazine equivalents.

Abbreviations: CBT-I, cognitive behavioral therapy for insomnia.

Table 2
Baseline clinical characteristics between CBT-I and control groups.

	CBT-I group ($n = 31$)	Control group ($n = 32$)	p
ISI	17.7 (0.5)	18.5 (0.5)	0.300
PSQI			
Total	11.8 (0.4)	12.3 (0.4)	0.306
Subjective sleep quality	2.1 (0.1)	2.3 (0.1)	0.170
Sleep latency	2.2 (0.1)	2.7 (0.1)	0.002*
Sleep duration	1.3 (0.1)	1.4 (0.1)	0.643
Sleep efficiency	2.4 (0.1)	2.1 (0.1)	0.086
Sleep disturbance	1.3 (0.1)	1.4 (0.1)	0.382
Daytime dysfunction	2.2 (0.1)	2.5 (0.1)	0.101
PSYRATS			
Total	29.2 (1.3)	28.8 (1.3)	0.820
Auditory hallucinations	18.3 (1.4)	19.4 (1.4)	0.558
Delusions	10.9 (0.8)	9.3 (0.8)	0.178
ASI	18.4 (2.4)	15.3 (2.4)	0.383
BDI	16.4 (2.2)	12.2 (2.1)	0.181

All data are expressed as means (SDs), which were adjusted for sex.

* $p < 0.05$.

Abbreviations: CBT-I, cognitive behavioral therapy for insomnia; ISI, Insomnia Severity Index; PSQI, Pittsburgh Sleep Quality Index; PSYRATS, Psychotic Symptom Rating Scales; ASI, Anxiety Sensitivity Index; BDI, Beck Depression Inventory.

3.2. PSYRATS

PSYRATS total score showed significant time and group interactions ($F = 30.840$, $p < 0.001$), but the difference between the groups at both

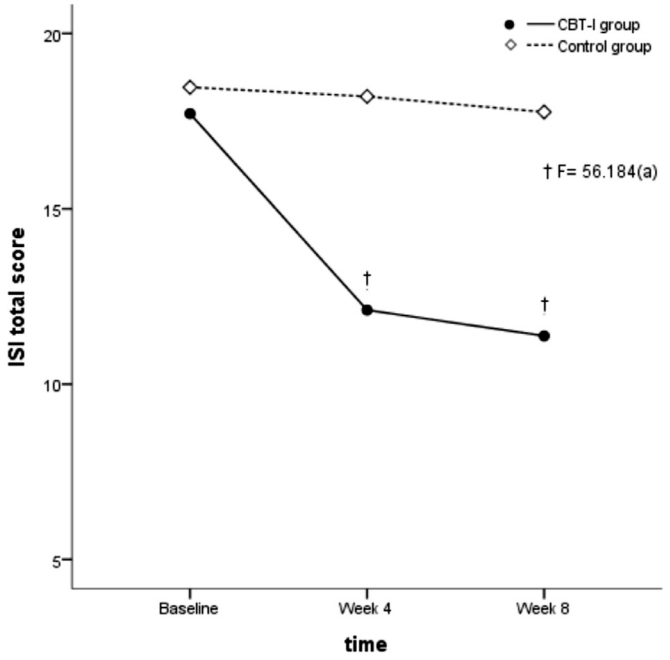

Fig. 2. Significant changes in ISI score according to time and group. Between groups comparisons by ANCOVA at weeks 4 and 8 and time–group interaction by repeated-measures ANOVA (a). *Abbreviations*: CBT-I, cognitive behavioral therapy for insomnia; ISI, Insomnia Severity Index; ANCOVA, analysis of covariance; ANOVA, analysis of variance. † $p < 0.001$.

Table 3
Time-group interaction for ISI, PSYRATS, PSQI, ASI, and BDI.

Scales	*F*	*p*
ISI	56.184	<0.001
PSQI		
Total	28.869	<0.001
Subjective sleep quality	19.075	<0.001
Sleep latency	11.956	<0.001
Sleep duration	24.476	<0.001
Sleep efficiency	13.419	<0.001
Sleep disturbance	0.102	0.873
Daytime dysfunction	6.237	0.003
PSYRATS		
Total	30.840	<0.001
Auditory hallucinations	10.543	<0.001
Delusions	28.184	<0.001
ASI	6.502	0.003
BDI	11.310	<0.001

Abbreviations: CBT-I, cognitive behavioral therapy for insomnia; ISI, Insomnia Severity Index; PSQI, Pittsburgh Sleep Quality Index; PSYRATS, Psychotic Symptom Rating Scales; ASI, Anxiety Sensitivity Index; BDI, Beck Depression Inventory.

weeks 4 and 8 were nonsignificant. The auditory hallucinations and delusions subscale scores also showed significant time and group interactions (auditory hallucinations: $F = 10.543$, $p < 0.001$, delusions: $F = 28.184$, $p < 0.001$), but again the differences between the groups at weeks 4 and 8 were nonsignificant (Table 4).

3.3. ASI and BDI

ASI and BDI scores showed significant time and group interactions (ASI; $F = 6.502$, $p = 0.003$, BDI; $F = 11.310$, $p < 0.001$), but the differences between the groups at weeks 4 and 8 were nonsignificant (Table 4).

Table 4
Clinical outcomes comparison between CBT-I and control groups.

	CBT-I group(n = 31)	Control group(n = 32)	*p*	Effect size (*d*)
ISI				
Baseline	17.7 (0.5)	18.5 (0.5)	0.300	–
4 weeks	12.2 (0.6)	18.2 (0.6)	<0.001	0.5
8 weeks	11.4 (0.6)	17.7 (0.6)	<0.001	0.5
PSQI				
Total				
Baseline	11.8 (0.4)	12.3 (0.4)	0.306	–
4 weeks	7.4 (0.5)	11.8 (0.5)	<0.001	0.4
8 weeks	6.0 (0.5)	11.2 (0.5)	<0.001	0.5
Sleep quality				
Baseline	2.1 (0.1)	2.3 (0.1)	0.167	–
4 weeks	1.3 (0.1)	2.1 (0.1)	<0.001	0.4
8 weeks	1.2 (0.1)	2.1 (0.1)	<0.001	0.4
Sleep latency				
Baseline	2.2 (0.1)	2.7 (0.1)	0.002	–
4 weeks	1.4 (0.1)	2.5 (0.1)	<0.001	0.4
8 weeks	1.2 (0.1)	2.5 (0.1)	<0.001	0.5
Sleep duration				
Baseline	1.3 (0.1)	1.4 (0.1)	0.643	–
4 weeks	0.5 (0.1)	1.4 (0.1)	<0.001	0.1
8 weeks	0.2 (0.1)	1.2 (0.1)	<0.001	0.2
Sleep efficiency				
Baseline	2.4 (0.1)	2.1 (0.1)	0.086	–
4 weeks	1.4 (0.2)	2.0 (0.2)	0.013	–
8 weeks	1.0 (0.2)	1.8 (0.2)	0.001	–
Sleep disturbance				
Baseline	1.3 (0.1)	1.4 (0.1)	0.382	–
4 weeks	1.2 (0.1)	1.3 (0.1)	0.222	0.2
8 weeks	1.1 (0.1)	1.3 (0.1)	0.103	0.3
Daytime dysfunction				
Baseline	2.4 (0.1)	2.5 (0.1)	0.101	
4 weeks	1.7 (0.1)	2.4 (0.1)	<0.001	
8 weeks	1.4 (0.1)	2.3 (0.1)	<0.001	
PSYRATS				
Total				
Baseline	29.2 (1.3)	28.8 (1.3)	0.820	–
4 weeks	26.1 (1.3)	29.2 (1.3)	0.102	–
8 weeks	25.8 (1.3)	29.4 (1.3)	0.053	0.1
Auditory hallucinations				
Baseline	18.3 (1.4)	19.4 (1.4)	0.558	–
4 weeks	17.0 (1.3)	19.8 (1.3)	0.138	–
8 weeks	16.7 (1.3)	20.0 (1.3)	0.091	–
Delusions				
Baseline	10.9 (0.8)	9.3 (0.8)	0.178	–
4 weeks	9.2 (0.8)	9.5 (0.8)	0.771	–
8 weeks	9.1 (0.8)	9.5 (0.7)	0.729	–
ASI				
Baseline	18.4 (2.4)	15.3 (2.4)	0.383	–
4 weeks	15.2 (2.3)	16.0 (2.3)	0.847	–
8 weeks	13.0 (2.1)	16.1 (2.0)	0.293	–
BDI				
Baseline	16.4 (2.2)	12.2 (2.1)	0.181	–
4 weeks	10.9 (1.6)	13.3 (1.6)	0.297	–
8 weeks	9.0 (1.6)	13.4 (1.6)	0.059	–

All data are expressed as means (SDs), which were adjusted for sex. Abbreviations: CBT-I, cognitive behavioral therapy for insomnia; ISI, Insomnia Severity Index; PSQI, Pittsburgh Sleep Quality Index; PSYRATS, Psychotic Symptom Rating Scales; ASI, Anxiety Sensitivity Index; BDI, Beck Depression Inventory. $p < 0.017$ considered significant after Bonferroni correction.

4. Discussion

The present study is the first to assess the effects of group CBT-I on insomnia as well as psychotic, depressive, and anxiety symptoms in schizophrenia patients utilizing rehabilitative/residential facilities. We observed significant improvements in the main measures related to sleep in the CBT-I group compared to the control group, and these effects remained evident one month after treatment. There were no significant improvements, however, in psychotic symptoms, anxiety, and depressive symptoms in the CBT-I group compared to the control group.

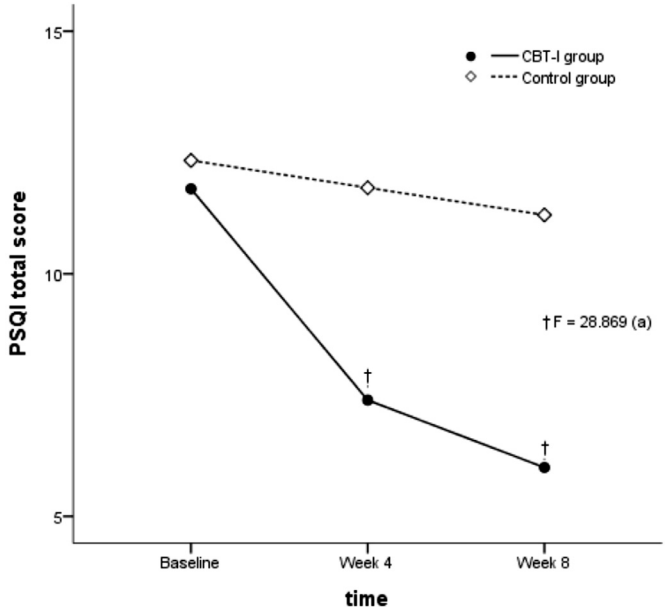

Fig. 3. Significant changes in PSQI total score according to time and group. Between groups comparisons by ANCOVA at weeks 4 and 8 and time–group interaction by repeated-measures ANOVA (a). *Abbreviations*: CBT-I, cognitive behavioral therapy for insomnia; PSQI, Pittsburgh Sleep Quality Index; ANCOVA, analysis of covariance; ANOVA, analysis of variance. † $p < 0.001$.

The high recurrence rate of psychotic episodes of schizophrenia debilitates not only patients but also their family members and communities, and a substantial portion of the healthcare system is devoted to the treatment of recurrent patients (Kim et al., 2011). The demand for an integrated system of schizophrenia therapy not limited to acute psychotic treatment has ignited the development of community-based mental rehabilitation programs (Anthony et al., 1990). In Seoul, Korea, government managed community-based mental rehabilitation program is led by 26 community mental health centers and networked with 487 residential facilities, 153 community-based psychiatric inpatient units, and 43 daytime rehabilitation facilities (Seoul, 2016).

The present study recruited patients diagnosed with schizophrenia from social facilities, including residential facilities, which enabled sociodemographic comparability between groups. Most participants were long-term users of these facilities prior to the study. Furthermore, the group CBT-I intervention and outcome measures were administered in the facilities the participants normally used for daytime activities and programs by the CBT-I therapist and evaluator. These factors helped to minimize the dropout rate and ensure the objective verification of self-reported medication use and sleeping habits.

The BEST study is the only randomized controlled trial to test the effects of CBT-I on psychotic patients with insomnia; it included 50 patients with non-affective psychosis (Freeman et al., 2015). Their results showed that ISI scores were significantly reduced by 3.4 in the control group and by 9.3 in the experimental group at the 12th week when compared to initial evaluations. However, the changes in the psychotic symptoms were nonsignificant. Similarly, a large-scale meta-analytic study evaluating the effects of CBT-I on primary insomnia patients with comorbid physical and mental conditions, but not limited to psychotic patients, reported an average reduction in ISI score of 6.36 following CBT-I—a treatment effect that was maintained for 18 months (Geiger-Brown et al., 2015).

In the present study, the ISI score was significantly reduced by 6.3 at week 8 in the CBT-I group, which showed a medium effect size, similar to that seen in previous studies (Freeman et al., 2015; Myers et al., 2011). The smaller decrease in ISI scores in our study compared to the BEST study may be due to our shorter CBT-I intervention (which consisted of only four sessions) or the delivery method in group format. This allows for the possibility of a stronger effect if CBT-I were to be conducted in more sessions or delivered individually. Along with ISI, the total score and several sleep quality, duration, efficiency and daytime dysfunction component scores of the PSQI also significantly decreased in the CBT-I group. These therapeutic effects of CBT-I lasted for 4 weeks after the intervention, thus supporting the long-standing effects of CBT-I found in the general population (Mitchell et al., 2012) in patients with schizophrenia. Furthermore, our study was the first to assess the effects of group CBT-I in the schizophrenia population, and shows that the relatively short CBT-I intervention, which has been demonstrated to be effective in insomnia patients (Edinger et al., 2007) and those comorbid with PTSD (Margolies et al., 2013), is also effective for patients with schizophrenia. Overall, our findings support increased feasibility and widens the available delivery methods for CBT-I in schizophrenia patients.

The present study showed significant time–group interaction for psychotic, anxiety, and depressive symptoms, but post-hoc analysis failed to demonstrate significant differences between the groups at either week 4 or week 8. The findings are in line with the BEST study in which psychotic symptoms showed no significant differences among the CBT-I and control groups (Freeman et al., 2015). However, our study might have been underpowered to detect changes in psychotic symptoms. Myers et al. reported moderate to large reductions in psychotic symptoms and unusual perceptual anomalies, anxiety, and depression symptoms from more than half of the patients (Myers et al., 2011). Furthermore, a recent randomized study conducting a digital CBT-I intervention in a large nonclinical sample of students ($N = 3755$) showed a significant decrease in paranoia and hallucinations, with insomnia being the mediator of these changes (Freeman et al., 2017).

Depression and insomnia are highly related. One study of CBT-I conducted in depressive patients demonstrated bidirectional improvements between insomnia and depressive symptoms, with improvements in insomnia more strongly affecting reductions in depressive symptoms than the reverse (Ashworth et al., 2015). Although our study in schizophrenia patients failed to show significant improvements of depressive or anxiety symptoms despite improvements in insomnia symptoms, the significant time-group interaction implies that future studies with larger samples and longer follow-ups might demonstrate more promising results for CBT-I in reducing psychotic and neurotic symptoms.

The limitations of the present study are as follows. First, patients were not randomly allocated to the groups. The CBT-I group had higher percentage of women and higher education level, which may have influenced positive effect for CBT-I. However, different factors were not significantly different between the groups. Second, a four-week CBT-I intervention and a four-week follow-up may have been insufficient to produce significant results. Third, schizophrenia patients were voluntarily admitted to their rehabilitative and residential facilities, and their psychotic symptoms had been active but stable for some time by the time they participated in the study; as such, their drive for recovery might not be generalized to the entire schizophrenia population. Additionally, the exclusion criteria including those with obstructive sleep apnea, substance abuse, use of sleeping pills may reduce the generalizability of our results considering their high prevalence in the schizophrenia population (Myles et al., 2016; Stummer et al., 2018; Winklbaur et al., 2006). Finally, the sleep measures were all subjective and were not complemented by more objective measures such as polysomnography or actigraphy; the subjective improvements we observed may not correspond to objective improvements.

In conclusion, the present study demonstrated that CBT-I has considerable advantage in promoting sleep in patients with schizophrenia. As researchers shed further light on the complex interactive pathologies of insomnia and psychiatric symptoms, we expect that CBT-I will eventually be shown to be an effective way of reducing active psychotic symptoms and thus preventing relapse in patients with schizophrenia.

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