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The Relationship between Cognitive Decline and Psychopathology in Patients with Schizophrenia and Bipolar Disorder

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Objective: The primary goals of the present study were to assess intellectual function in participants with schizophrenia or bipolar disorder (BD) and to investigate the relationships between cognitive decline and the severity of each type of psychopathology.
Methods: The present study included 51 patients with schizophrenia and 42 with BD who were recruited from the psychiatry outpatient clinic of Jeju University Hospital between March 2011 and March 2014. The Korean Wechsler Adult Intelligence Scale (K-WAIS) was administered to each of the 93 participants, and they were categorized into two groups based on their current intelligence quotient (IQ) and their estimated premorbid IQ: severely impaired group (SIG) and mildly impaired group (MIG). The Minnesota Multiple Personality Inventory (MMPI) and the Brief Psychiatric Rating Scale (BPRS) were used to assess psychopathology.
Results: The SIG schizophrenia participants exhibited significantly higher scores on the frequent (F) and schizophrenia (Sc) subscales of the MMPI, but significantly lower scores on the correction (K) and psychopathic deviate (Pd) subscales compared with the MIG schizophrenia participants. Furthermore, the BPRS scores were significantly higher in the SIG schizophrenia participants relative to the MIG schizophrenia participants. The SIG BD participants had significantly higher F, masculinity-femininity (Mf), paranoia (Pa), and Sc but significantly lower Pd scores compared with the MIG BD participants.
Conclusion: The present findings revealed a significant discrepancy between the estimated premorbid levels of cognitive function and current cognitive function in participants with schizophrenia or BD. Moreover, this discrepancy was correlated with severity of psychopathology in both groups.

KEY WORDS: Schizophrenia; Bipolar disorder; Cognition; Psychopathology.

INTRODUCTION

Neurocognitive impairment represents a core symptomatic feature of schizophrenia and bipolar disorder.[1)] In schizophrenia, these deficits persist throughout the course of the disease and may be predictive of various types of function.[2)] A similar but less severe pattern of cognitive impairment has also been observed in patients with bipolar disorder.[3)] In the past, cognitive impairment in bipolar disorder patients was considered infrequent and limited to affective episodes. More recently, however, it has been shown that a majority of patients with bipolar disorder demonstrate high rates of functional and cognitive impairment even during periods in which there is a sustained remission of mood symptoms.[4,5)]

Neurocognitive impairments substantially limit creativity, work performance, quality of life, self-esteem, and psychosocial functioning in patients with severe mental illnesses, especially schizophrenia.[5)] Similarly, it is highly likely that sustained neurocognitive deficits critically contribute to major occupational, social, and interpersonal dysfunctions that are commonly observed in patients with bipolar disorder.[6)]

On the other hand, cognitive deficits may also contribute to the psychopathologies underlying symptoms in schizophrenia and bipolar disorder patients. Several cross-sectional studies have indicated that these patients' performance on neurocognitive tests is correlated with

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three major schizophrenic symptom types: positive, negative, or disorganized.[7] In fact, Albus *et al*.[8] reported that psychotic symptoms were the most influential variable affecting cognitive function in patients with bipolar disorder.

Therefore, the aims of the present study were to describe intellectual function in patients with schizophrenia or bipolar disorder and to investigate the relationships between intellectual decline and the severity of each type of psychopathology.

METHODS

Participants

For the present study, 51 participants with schizophrenia and 42 with bipolar disorder were recruited from the psychiatry outpatient clinic of Jeju University Hospital (Jeju, Korea) between March 2011 and March 2014. Patients were included in this study if they were diagnosed with either bipolar I or II disorder or schizophrenia according to the criteria of the Diagnostic and Statistical Manual of Mental Disorders, 4th edition (DSM-IV). The exclusion criteria were a diagnosis of an intellectual disability or neurological disorder, or a significant physical health problem that could interfere with cognitive function. All patients included in this study were clinically stable.

All 93 participants first completed the Korean Wechsler Adult Intelligence Scale (K-WAIS), and they were then divided into two groups according to the difference between their current intelligence quotient (IQ) and their estimated premorbid IQ: the severely impaired group (SIG) and mildly impaired group (MIG). SIG participants exhibited a score difference ≥ 15 between their current IQ and estimated premorbid IQ, and the mildly impaired group had a score difference < 15. The clinical characteristics of the participants were assessed using the Minnesota Multiple Personality Inventory (MMPI) and the Brief Psychiatric Rating Scale (BPRS). The present study was approved by the institutional review board of Jeju University Hospital in Jeju, Korea, and all subjects provided informed consent.

Measures

K-WAIS

The K-WAIS was used to estimate the IQ level of each participant.[9] This measure assesses three general areas of IQ (verbal IQ [VIQ], performance IQ [PIQ], and full-scale IQ) using six verbal subtests and five performance subtests: information, digit span, vocabulary, arithmetic, comprehension, similarities, picture completion, picture arrangement, block design, object assembly, and digit symbol.

Premorbid intelligence estimates

The premorbid intelligence estimates were assessed using the three subtests of the standardized K-WAIS (VIQ, PIQ, and full-scale IQ), controlling for age and education. The premorbid IQ of each patient was inferred using the index of premorbid intelligence developed by Kim.[10]

MMPI

The MMPI is a screening instrument used to differentiate various forms of psychopathology.[11] This measure consists of 550 items across 10 clinical subscales and four validity subscales; the 10 clinical subscales detect various features of psychopathology including hypochondriasis (Hs), depression (D), hysteria (Hy), psychopathic deviate (Pd), masculinity-femininity (Mf), paranoia (Pa), psychasthenia (Pt), schizophrenia (Sc), hypomania (Ma), and social introversion (Si), and the validity subscales consist of the cannot say, lie (L), frequent (F), and correction (K) scales.

BPRS

The BPRS was developed to evaluate patients' overall psychiatric status using a 7-point Likert scale.[12] This measure consists of 18 items covering a broad range of symptoms that are commonly seen during a psychotic relapse, including hallucinations, delusions, and disorganization, as well as mood disturbances that may also accompany a relapse.

Statistical Analysis

The demographic and clinical characteristics were analyzed with independent *t*-tests, chi-square tests, or Fisher's exact tests, as appropriate. Independent *t*-tests were also conducted to compare mean scores of the two groups on the IQ, MMPI, and BPRS. All statistical analyses were conducted using IBM SPSS Statistics for Windows (version 20.0; IBM Co., Armonk, NY, USA), and a p value < 0.05 was considered to indicate statistical significance.

RESULTS

Demographic Characteristics

The mean ages in the schizophrenia and bipolar disorder groups were 32.67±11.38 years and 30.81±9.57 years, respectively. There were no significant differences

between the groups in sex, age, marital status, education, or socioeconomic status (Table 1).

Clinical Characteristics

The clinical data for the schizophrenia and bipolar disorder groups are summarized in Table 2. There were no significant differences between the two groups in terms of age of onset, duration of illness, number of admissions, or family psychiatric history.

Current IQ and Premorbid IQ

The results of the *t*-tests used to compare IQ scores are presented in Table 3. Participants with bipolar disorder had significantly higher current scores on the verbal, performance, and full-scale IQ tests compared with participants with schizophrenia. Additionally, participants with schizophrenia had significantly lower scores on the vocabulary, comprehension, block design, and digit symbol subtests compared with participants with bipolar disorder. The bipolar group displayed higher premorbid IQ scores than the schizophrenia group, but the difference was not statistically significant.

Subgroup Analyses of Schizophrenia and Bipolar Disorder

A decrease of ≥15 points in IQ from premorbid levels was observed in 52.9% of participants with schizophrenia and 31% of participants with bipolar disorder; these participants were classified as SIG. There was a significantly higher number of participants with severe intellectual decline in the schizophrenia group than in the bipolar disorder group (χ^2=4.543, p=0.038).

MMPI and BPRS Scores in the Intellectual Subgroups of the Schizophrenic Participants

The SIG schizophrenia participants exhibited significantly higher scores on the F and Sc subscales of the MMPI, but significantly lower scores on the K and Pd subscales than did the MIG schizophrenia participants (Table 4). Moreover, the BPRS scores were significantly higher in the SIG schizophrenia participants.

MMPI and BPRS Scores in the Intellectual Subgroups of the Bipolar Disorder Participants

The SIG bipolar disorder participants had significantly

Table 1. Characteristics of the participant groups

Characteristic	Group	
	Schizophrenia (n=51)	Bipolar disorder (n=42)
Sex		
Male	29 (56.9)	19 (45.2)
Female	22 (43.1)	23 (54.8)
Age (yr)	32.67±11.375	30.81±9.567
Marital status		
Married	43 (84.3)	25 (59.5)
Unmarried	5 (9.8)	17 (40.5)
Separation or divorce	3 (5.9)	0 (0.0)
Education (yr)		
7-9	1 (2.0)	1 (2.4)
10-12	25 (49.0)	10 (23.8)
13-16	24 (47.1)	30 (71.4)
≥16	1 (2.0)	1 (2.4)
Socioeconomic status		
High	2 (3.9)	1 (2.4)
Middle	46 (90.2)	41 (97.6)
Low	3 (5.9)	0 (0.0)

Values are presented as number (%) or mean±standard deviation.

Table 2. Clinical characteristics of the participant groups

Characteristic	Group	
	Schizophrenia	Bipolar disorder
Age of onset (yr)	29.25±10.88	29.45±9.92
Duration of illness (yr)	3.47±2.52	3.26±1.91
Number of admissions	2.35±2.11	2.26±1.81
Family psychiatry history		
Yes	11 (21.6)	7 (16.7)
No	40 (78.4)	35 (83.3)

Values are presented as mean±standard deviation or number (%).

Table 3. Comparisons of intelligence quotient (IQ) levels in the participant groups

Variable	Group		*p* value
	Schizophrenia	Bipolar disorder	
IQ level			
Verbal	96.06±13.50	101.40±11.79	0.047
Performance	91.33±12.10	98.64±14.72	0.010
Full scale	93.53±12.30	99.69±12.65	0.020
Subtest			
Information	9.73±2.80	9.50±2.31	0.677
Digit span	10.25±3.29	10.86±2.58	0.336
Vocabulary	8.65±2.33	10.17±2.61	0.004
Arithmetic	8.69±2.83	9.29±2.96	0.322
Comprehension	9.57±2.95	10.88±2.73	0.030
Similarities	9.69±2.61	10.02±2.37	0.520
Picture completion	7.65±2.51	8.21±2.78	0.305
Picture arrangement	8.71±2.48	9.71±2.75	0.067
Block design	8.67±2.77	10.12±3.13	0.020
Object assembly	9.29±2.71	9.88±2.51	0.285
Digit symbol	9.51±3.06	11.07±2.40	0.008
Estimated premorbid IQ			
Verbal	110.08±6.99	112.02±6.96	0.231
Performance	110.18±5.92	111.76±5.28	0.184
Full scale	108.96±6.13	110.29±4.43	0.180

Values are presented as mean±standard deviation.

Table 4. Comparisons of MMPI and BPRS scores in the intellectual subgroups of schizophrenia participants

Variable	Group		*p* value
	Severely impaired (n=25)	Mildly impaired (n=19)	
MMPI			
Validity scales			
Lie	46.64±8.86	47.79±11.97	0.716
F	56.76±11.81	51.05±8.89	0.086
K	46.08±11.79	53.58±11.25	0.039
Clinical scales			
Hypochondriasis	50.00±11.87	53.37±9.50	0.537
Depression	53.36±13.76	54.11±13.28	0.858
Hysteria	50.16±9.81	51.79±6.67	0.316
Psychopathic deviate	52.48±8.05	61.26±10.38	0.003
Masculinity-femininity	47.96±9.96	52.26±9.67	0.158
Paranoia	65.80±14.14	59.00±15.86	0.141
Psychasthenia	61.12±10.56	56.63±15.83	0.294
Schizophrenia	65.72±9.12	56.37±11.91	0.005
Hypomania	56.32±13.28	51.11±11.20	0.175
Social introversion	53.28±9.33	55.00±14.12	0.629
BPRS	58.48±13.33	45.78±9.61	0.001

Values are presented as mean±standard deviation.
MMPI, Minnesota Multiple Personality Inventory; BPRS, Brief Psychiatric Rating Scale.

Table 5. Comparisons of MMPI and BPRS scores in the intellectual subgroups of bipolar disorder participants

Variable	Group		*p* value
	Severely impaired (n=25)	Mildly impaired (n=19)	
MMPI			
Validity scales			
Lie	47.31±8.45	44.24±7.24	0.235
F	54.54±11.25	45.93±6.55	0.003
K	43.69±8.55	47.21±6.99	0.167
Clinical scales			
Hypochondriasis	50.38±8.50	54.62±11.55	0.584
Depression	54.15±17.18	59.07±20.17	0.450
Hysteria	52.54±7.67	50.97±11.55	0.139
Psychopathic deviate	51.54±8.14	60.28±7.95	0.002
Masculinity-femininity	57.08±12.04	47.52±9.85	0.006
Paranoia	63.23±8.30	54.34±9.37	0.005
Psychasthenia	64.62±9.88	57.34±14.06	0.100
Schizophrenia	63.38±7.86	54.52±9.07	0.004
Hypomania	54.85±10.68	54.24±11.25	0.871
Social introversion	51.46±11.57	53.97±15.27	0.602
BPRS	54.15±15.07	51.14±12.69	0.506

Values are presented as mean±standard deviation.
MMPI, Minnesota Multiple Personality Inventory; BPRS, Brief Psychiatric Rating Scale.

higher F, Mf, Pa, and Sc scores, but a significantly lower Pd score, compared with the MIG bipolar disorder participants (Table 5). There was no difference in the BPRS scores of the two groups.

DISCUSSION

The present study found that the participants with schizophrenia performed significantly poorer on the VIQ, PIQ, and full-scale IQ measures compared with the participants with bipolar disorder.

Only a few studies have directly compared the IQ levels of schizophrenia patients with those of bipolar disorder patients; the majority of studies have compared schizophrenic patients against the general population. A review of 28 studies encompassing more than 1,000 adults with schizophrenia concluded that individuals with schizophrenia performed slightly below the average of the general population on tests of intellectual function and that they exhibited a mean IQ deficit of approximately 10 points.[13] Pollack *et al.*[14] compared the intellectual function of 27 adults with schizophrenia with that of their nearest-age siblings and found a mean deficit of 8 IQ points in those with schizophrenic. More recently, Nelson *et al.*[15] found that the mean IQ of 63 patients with schizophrenia was significantly lower than that of the normal population.

In the present study, participants with schizophrenia showed significantly lower scores on the vocabulary, comprehension, block design, and digit symbol K-WAIS subtests compared with participants with bipolar disorder. The digit symbol subtest appears to be the most sensitive marker of cognitive impairment in patients with schizophrenia[16] and in the nonpsychotic relatives of patients with schizophrenia.[17] This study also indicated that performance levels on this task can differentiate siblings at high risk of schizophrenia who later became psychotic from those who do not. Taken together, these findings indicate that impaired performance on the digit symbol subtest is a stable trait in patients with schizophrenia and likely reflects the existence of abnormal cognitive processing that is central to the disorder.[16] This impairment is present at the onset of psychosis, even as performance remains intact on other tests of general intellectual ability.[18] The digit symbol subtest is impervious to practice effects and remains unaffected by the administration of antipsychotic medications during the first year of illness.[18] Furthermore, the comprehension and digit symbol subtests are closely associated with functional outcomes in patients with schizophrenia and in those with first-episode psychosis.[19] Consistent with these findings, previous studies have found no differences on the information and digit span subtests between the two disorders.[18,19] This finding indicates that even though patients with schizophrenia experience overall cognitive impairment, they may have crys-

tallized intelligence that is largely not affected by the illness.[19]

In the present study, 52.9% of participants with schizophrenia and 31% of participants with bipolar disorder appeared to experience a severe intellectual decline. There were significantly more SIG schizophrenia than SIG bipolar disorder participants, which is consistent with the findings of previous studies.[20,21] It appears that patients with schizophrenia and those with bipolar disorder share a similar cognitive impairment profile, with varying degrees of deficits.[20]

In the present study, the SIG schizophrenia participants had significantly higher scores on the Sc scales of the MMPI and BPRS compared with the MIG schizophrenia patients. These differences suggest that the SIG participants exhibited more severe psychopathology than do MIG participants with schizophrenia. The Sc scale measures psychosis-related symptoms, poor judgment, unconventional thoughts or behaviors, possible overvalued ideas, feelings of isolation, and alienation.[22] Similarly, the BPRS also reflects the severity of psychotic symptoms.[23] The present study identified a moderate simultaneous elevation of scores on the Sc and Pa scales in the SIG participants. The Pa subscale is associated with rigid thinking, interpersonal sensitivity, and suspiciousness.[22] Patients with high scores on the Sc and Pa scales tend to have less social interest, to be more likely to be unfriendly with others, more emotionally withdrawn, more conceptually disorganized, and more suspicious, and to have more hallucinatory behaviors and a greater degree of unusual thought content.[24] These findings suggest higher levels of these characteristics in SIG than in MIG participants.

In the present study, the SIG bipolar disorder participants had significantly higher scores on the Mf, Pa, and Sc scales than the MIG participants did, which suggests greater symptom severity in the SIG subjects. Accordingly, women with elevated Mf scores may have difficulty appropriately channeling aggressive impulses.[25]

For both schizophrenia and bipolar disorder, the Pd scores of the SIG participants were lower than those of the MIG participants. The Pd scale measures impulsivity, frustration tolerance, and risk taking.[25] A low Pd score may indicate suppressed aggressive and assertive tendencies as well as low sexual interest.[25]

SIG patients with elevated Pd and Sc scores may have marginal psychological adjustment during the course of schizophrenia or bipolar disorder.[24] These patients tend to have intense feelings of inferiority and insecurity, to be suspicious and distrustful of others, to avoid deep emotional ties, and to present with thought disorders, hallucinations, delusions, hostility, and a lack of insight.[24] Additionally, poor judgment is typical of these patients.[24] These tendencies were more likely to be prominent in the SIG participants from both groups in the present study, indicating that the participants with severe cognitive decline exhibited more psychotic symptoms, a greater degree of thought disorder, impaired reality testing, and difficulty adjusting. Thus, more severe psychopathology was associated with apparent intellectual decline.

The findings of the present study revealed a significant discrepancy between the estimated premorbid levels of cognitive function and current cognitive function. Moreover, this discrepancy was correlated with the severity of psychopathology in patients from both groups. The present results are consistent with those of a previous study of 513 inpatients with psychotic disorders, which found that a larger difference between estimated premorbid and current IQ levels predicted a greater number of psychotic indicators.[26]

There are several limitations to the present study. First, the design of this study was not longitudinal, and the premorbid IQ scores were not directly obtained. A second limitation is that the effects of psychiatric medications on the cognitive function of the participants cannot be ruled out; it is possible that the cognitive deficits observed in the present study were due to the effects of medication. Finally, no normal control group was available, and therefore, it was not possible to determine whether results for these patients deviated from the norm.

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