Neurocognitive and clinical correlates of insight in schizophrenia

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ABSTRACT

Background: Schizophrenia is a heterogeneous disorder characterized by various symptom dimensions and neurocognitive deficits. Impairment of insight is a core clinical symptom of the disorder. There has been an increasing focus on neurocognition and insight in schizophrenia; although, many studies fail to control for premorbid cognitive status.

Materials and Methods: Schizophrenia patients (n = 60) selected for adequate background education were recruited from outpatient services of a tertiary care hospital and community care homes in Southern India. These patients were comprehensively assessed using a neurocognitive battery. Clinical assessments were done using the Positive and Negative Syndrome Scale (PANSS) and Schedule for the Assessment of Insight-expanded version (SAI-E). Partial correlation was performed to examine the relationship of insight with clinical and neurocognitive measures. Statistical significance was set at \( P = 0.004 \) (Bonferroni correction for 12 tests of association). Linear regression analysis was performed to examine the predictors of insight.

Results: The mean PANSS positive, negative, general psychopathology, and total scores were 14.2 ± 4.9, 17.4 ± 5.0, 34.3 ± 6.8, and 65.8 ± 13.9, respectively. Mean insight score (SAI-E) was 8.5 ± 2.9. In partial correlation done after controlling for IQ, significant negative correlations were observed between insight score and the Wisconsin Card Sorting Test (WCST) total errors (\( P = 0.001 \)), WCST perseverative errors (\( P < 0.001 \)). Insight scores had negative correlations with PANSS negative (\( P < 0.002 \)) and total scores (\( P < 0.002 \)). WCST perseverative errors were the primary predictor of insight in the regression analysis.

Conclusion: Insight has a strong relationship with executive functioning in schizophrenia. This could indicate shared neurobiological substrates for insight and executive functioning.

Key words: Insight, neurocognition, schizophrenia

INTRODUCTION

Schizophrenia is a psychiatric disorder characterized by multiple symptom domains, and it has a heterogeneous outcome.[1] A cardinal clinical feature of schizophrenia has been the absence of insight in patients. The International Pilot Study of Schizophrenia in different cultures conducted by the World Health Organization proved this by demonstrating that 50%–80% of patients with acute and chronic schizophrenia had “lack of insight” either partially or totally.[2] The current consensus regarding understanding insight is of a multidimensional phenomenon encompassing...
awareness of a particular disorder, including specific signs and symptoms, attributing these to the particular disorder, awareness regarding the need for treatment, and understanding its social consequences. Impaired insight has been investigated through various approaches as a symptom of the disorder specifically illness severity, due to cognitive deficit or to the neuroanatomical deficit. Another approach to understanding insight has been using the concept of cognitive insight which refers to the cognitive processes involved in self-reflection of one’s abnormal experiences and the ability to modify dysfunctional beliefs and misinterpretations. Poor insight has been found to be associated with medication nonadherence, higher risk of relapse, and rehospitalization.

The research on the relationship of insight with clinical symptoms has been conflicting. There has been evidence indicating an inverse relationship between insight and clinical symptoms. In a meta-analysis, a small inverse relationship between insight and global, positive and negative symptoms was reported and this was greater during the acute phase of the illness.

Cognitive deficits have now come to be considered as an independent symptom domain of schizophrenia observed in >80% of the patients. This has been found to be persistent throughout the illness, present irrespective of other symptoms and medication status and has an effect on the overall outcome. The most commonly replicated findings on cognitive deficits include impairments in executive functions, verbal and visual memory, visuospatial ability, working memory, and verbal fluency. Specific cognitive domains such as attention, executive functions, learning, and problem-solving abilities have been found to have an effect on functional outcomes.

Insight impairment has found to be associated with multiple cognitive deficits measured through neuropsychological methods. The most widely reported finding in research related to insight and cognitive functions has been impaired Wisconsin Card Sorting Test (WCST) performance. A recent meta-analysis found insight to have a small but clinically significant relationship with total cognition, intelligence quotient (IQ), memory, and executive functions. Studies done in India have found a positive association between insight and executive functioning but have used varying measures of insight; clinical and cognitive, divergent cognitive test battery and have not controlled for IQ. However, results have been inconsistent in insight-related research.

The inconsistencies in research in this area can be explained by multiple factors. Many studies have included a heterogeneous sample containing both schizophrenia and schizoaffective disorder. The findings could also be influenced by the stage of illness in the study population whether it is first-episode schizophrenia or chronic schizophrenia. A heterogeneous sample and the stage of illness of the study sample are bound to affect the outcome of the results. Some studies have used the single domain for the assessment of cognitive dysfunction which may not be sufficient in disorder like schizophrenia where the nature of cognitive deficits is in multiple domains. Therefore, studies involving a homogeneous sample of stable schizophrenia patients using a comprehensive battery of neuropsychological tests assessing executive function, attention, working, visual and verbal memory, and general cognitive ability using IQ tests is necessary to further understand this complex relationship of insight with both clinical and neurocognitive deficits.

This study seeks to systematically and thoroughly evaluate the clinical and neurocognitive correlates of insight in schizophrenia.

MATERIALS AND METHODS

Participants and setting
The participants for this study were recruited from a tertiary care teaching hospital and from the community sources within the city of Bangalore in Southern India over a period of 2 years. The diagnosis was made based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision criteria and the diagnosis was concurred by two experienced psychiatrists. The patients needed to have the illness for a period of at least 1 year and were on stable antipsychotic dosage for the past 3 months. They were required to have completed at least 12 years of formal schooling and be proficient in English. This was chosen to ensure adequate premorbid cognitive functioning. Patients with comorbid neurological and psychiatric disorders (except nicotine dependence), those who were disturbed and underactive inpatient treatment and those having uncontrolled medical illness within the previous 2 months were excluded from the study. The Institutional Ethical Review Board approved the study. The study was conducted in accordance with the ethical guidelines laid down by the Declaration of Helsinki.

A total of sixty patients diagnosed with schizophrenia were recruited for the study after taking written informed consent. Patients were evaluated using a semi-structured interview to assess demographic and clinical features. Data were obtained from a combination of patient interviews, medical records, and structured assessments. The clinical and cognitive assessments were made in English.

Clinical assessments
The current level of psychopathology was assessed using the Positive and Negative Syndrome Scale (PANSS), a 30-item rater administered scale for measuring positive symptoms (PANSS P), negative symptoms (PANSS N),
and general psychopathology (PANSS G).[25] We used the Schedule to Assess Insight-Expanded version (SAI-E), a 7 item semi-structured scale for the assessment of insight.[26] The SAI-E has three factors-awareness of a disorder, treatment compliance, and ability to re-label unusual events as pathological.[27]

**Cognitive assessments**

The following tests were employed for cognitive assessment:

- Bhatia’s battery of performance tests of intelligence– Short Scale was used for the assessment of IQ.[28] Digit vigilance test was used to assess sustained attention and psychomotor speed.[29]
- WCST was employed to assess executive functions specifically cognitive flexibility and attentional set-shifting.[26]

The category fluency test assesses verbal fluency,[29] Rey-Osterrieth complex figure test was used to measure nonverbal memory.[31]

The Rey Auditory Verbal Learning Test was used to measure verbal memory.[32]

Verbal N-Backtest (with 1-back and 2-back versions) was employed to examine working memory performance.[23]

**Statistical analysis**

Initially, descriptive statistics were calculated for basic demographic and clinical variables such as age illness duration, IQ scores, PANSS scores, and SAI-E scores for insight and also for neuropsychological parameters. Partial correlation was calculated to assess the relationship of clinical variables such as PANSS scores, SAI-E scores, age, and illness duration with neuropsychological parameters after controlling for IQ. Bonferroni correction was performed to control for multiple comparison testing and to avoid type 1 errors. Subsequently, P value of 0.004 was considered (dividing alpha value of 0.05 with 12 comparisons). Finally, linear regression was used to evaluate the predictors of insight with significant clinical variables such as PANSS positive and negative scores, IQ, age, years of education, and neuropsychological test of significance in correlation analyses.

**RESULTS**

In this study, sample of sixty participants, there were 37 males and 23 females. The mean total SAI-E score is 8.5. The mean clinical and demographic values of the study sample are given in Table 1. The performance scores of various neuropsychological parameters are given in Table 2.

As shown in Table 3, insight and WCST performance scores (total and perseverative errors) were found to be significantly negatively correlated after controlling for IQ, indicating that better performance on this task indicated better insight. There was no correlation between insight and the other neuropsychological test scores.

| Variable | Mean±SD (range) |
|----------|-----------------|
| Age (years) | 37.7±9.68 (18-55) |
| Duration of education (years) | 14.52±1.85 (12-17) |
| IQ | 99.36±18.44 (56.5-138) |
| Duration of illness (years) | 12.28±8.96 (1-34) |
| PANSS total score | 65.80±13.85 (35-102) |
| PANSS positive | 14.17±4.89 (7-25) |
| PANSS negative | 17.38±5.00 (8-32) |
| PANSS GP | 34.25±6.79 (20-53) |
| SAI-E total score | 8.50±2.86 (1-13) |

| Neuropsychological parameters | Mean±SD (range) |
|-----------------------------|-----------------|
| WCST (total errors) | 50.30±26.48 (6-97) |
| WCST (perseverative errors) | 34.17±26.13 (4-95) |
| Attention errors (DVT) | 18.77±28.67 (0-146) |
| Category fluency | 11.05±3.18 (4-18) |
| Verbal 1 back errors | 1.28±1.64 (0-7) |
| Verbal 2 back errors | 4.17±2.48 (0-9) |
| RAVLT immediate recall | 8.27±3.06 (1-14) |
| RAVLT delayed recall | 7.93±3.42 (2-15) |
| RAVLT recognition trial | 13.38±2.06 (6-16) |
| RCFT copy | 31.07±5.73 (15.5-36) |
| RCFT delayed recall | 13.38±4.42 (1-130) |
| RCFT recognition trial | 19.52±4.93 (14-70) |

| Neuropsychological parameters | SAI-E total (r, P) |
|-----------------------------|-------------------|
| WCST (total errors) | −0.43, 0.001 |
| WCST (perseverative errors) | −0.47, <0.001 |
| Attention errors | −0.30, 0.02 |
| Category fluency | −0.01, 0.92 |
| Verbal 1 back errors | −0.17, 0.92 |
| Verbal 2 back errors | −0.06, 0.65 |
| RAVLT immediate recall | 0.25, 0.06 |
| RAVLT delayed recall | 0.12, 0.37 |
| RAVLT recognition trial | 0.29, 0.03 |
| RCFT copy | 0.16, 0.22 |
| RCFT immediate recall | −0.03, 0.83 |
| RCFT delayed recall | 0.006, 0.97 |
| RCFT recognition trial | −0.006, 0.96 |

Partial correlation analysis was performed controlling for the effects of IQ score. *P<0.004 is considered as statistically significant. DVT – Digit Vigilance Test; WCST – Wisconsin Card Sorting Test; RCFT – Rey's complex figure test; RAVLT – Rey auditory verbal learning test; IQ – Intelligence quotient; SAI-E – Schedule for Assessment of Insight – expanded version.

indicating that better performance on this task indicated better insight. There was no correlation between insight and the other neuropsychological test scores.

Both PANSS total ($r = −0.400 P = 0.002$) and negative scores ($r = −0.391 P = 0.002$) were also found to be...
negatively related to insight scores after controlling for IQ. However, PANSS positive was not significantly related \( r = -0.349 \, P = 0.007 \).

In the linear regression model, PANSS positive and negative scores, IQ score, age, years of education, and WCST perseverative errors were entered as covariates with SAI-E score as the dependent variable. This model revealed that WCST perseverative errors \( (B = -0.04; \, P = 0.004; \) confidence interval = \(-0.07\) to \(-0.02\) predicted insight.

**DISCUSSION**

The present study examines the clinical and neurocognitive correlates of insight in patients with schizophrenia.

Both the total and negative symptom scores were found to be inversely related to insight scores. Hence, implying as expected that more severe clinical symptoms were associated with lower the insight. Similar to our results, previous studies have reported that insight was inversely related to negative symptoms.\(^3\)\(^4\) However, in contrast to the study results, there are reports of positive symptom scores being related to insight.\(^1\)\(^2\)\(^4\)\(^5\)\(^6\)\(^7\) A modest inverse relationship between insight and global, positive and negative symptoms was reported in a meta-analysis and this was greater during the acute phase of the illness.\(^8\)

In comparison to the positive symptoms, the negative symptom scores in PANSS were higher in our study population. Patients with persistent negative symptoms have been reported to have a higher degree of impairment in cognitive performance.\(^9\) In a study assessing insight in schizophrenia patients, insight correlated with positive symptom scores in both treated and untreated patients.\(^1\)\(^1\) However, negative symptom scores were noted to be related to poor insight only in patients who had received treatment.\(^1\)\(^1\) The authors hypothesized that there could be a subgroup of patients with treatment-resistant traits of negative symptoms and impaired insight. Hence, treatment response/nonresponse would enable in identifying this subgroup, hinting toward a shared neurobiological underpinning for both insight and negative symptoms which can be explained by hypofrontality.

Cognitive deficits have increasingly come to be considered as an independent symptom domain of schizophrenia observed in >80% of the patients and can lead to overall poor functional outcome.\(^1\)\(^3\)\(^4\)\(^5\) It predates the onset of schizophrenia symptoms and has also been demonstrated in unaffected first-degree relatives.\(^6\)\(^7\)\(^8\)\(^9\) It has been proposed that though cognitive deficits in schizophrenia may be generalized, more significant deficits occur in certain cognitive domains such as executive functioning, working memory, attention, episodic memory, and verbal fluency.\(^1\)\(^7\)\(^8\)\(^9\)\(^1\)\(^0\)\(^1\)\(^1\) Executive function impairment has been found to be one of the most consistently replicated cognitive deficits in schizophrenia.\(^1\)\(^2\)

The main finding of this study is that after controlling for the effects of IQ, among the various cognitive functions in schizophrenia, only WCST perseverative errors in the cognitive flexibility task were found to be inversely correlated with insight. Executive function impairment has been found to be one of the most consistently replicated cognitive deficits in schizophrenia, thus representing frontal lobe dysfunction as demonstrated by imaging studies.\(^1\)\(^3\)\(^4\)\(^5\)\(^6\)\(^7\)\(^8\)\(^9\) However, it was also demonstrated that among all the clinical and cognitive parameters, WCST perseverative errors is the only parameter which predicted insight.

We found that among the cognitive deficits, only WCST perseverative errors negatively correlated with insight scores and could also be a predictor of insight. This is in line with existing research in this field.\(^1\)\(^2\)\(^3\)\(^4\)\(^5\)\(^6\) As per a review, WCST performance impairment with poor insight has been a mostly consistently replicated findings in research related to insight in comparison to other cognitive measures such as verbal fluency, memory, and IQ.\(^1\)\(^5\) However, a recent meta-analysis, reported a smaller effect size for WCST perseverative errors in comparison to previous work.\(^1\)\(^6\) Our sample was selected for premorbid adequate education. On separating those individuals who currently scored IQ <70, the WCST-Insight relationship continued to be significant.

This is a major strength of our study.

WCST assesses cognitive flexibility by testing the ability to generate and shift sets in along with correcting errors. An earlier study had reported that patients who have a lesser degree of awareness regarding their illness had higher WCST perseverative errors.\(^1\)\(^7\) Hence, impairment of insight could be reflective of underlying deficiencies in cognitive flexibility and concept formation as evidenced by WCST perseverative errors. This study did not find a correlation between insight and other neuropsychological tests. This is similar to various other studies and reflects the lack of consistency in the findings pertaining to various cognitive deficits associated with insight.\(^1\)\(^7\)\(^8\)

The fact that executive function has a relationship with insight might indicate a shared neurobiological basis for these dimensions of the illness. Insight and executive functioning have a strong association; whether there is a causal relationship is not very clear from our study. Understanding these relationships could help testing whether remediation strategies could also improve insight and cognitive deficits.

The strengths of our study include having educated (at least 12 years of formal schooling) subjects as a proxy for adequate baseline general cognitive ability, a homogenous sample of stable schizophrenia and also the use of an extensive battery of neuropsychological tests that can measure
multiple cognitive domains. The limitations of our study include nonassessment of cognitive insight, absence of a control group, cross-sectional nature, and examining the participants on medications. However, confirmation that insight and WCST perseverative errors are related indicates that treatment options such as cognition-enhancing medications and cognitive remediation might be beneficial in improving insight. These aspects warrant further prospective systematic studies.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Lang FU, Kötsters M, Lang S, Becker T, Jäger M. Psychopathological long-term outcome of schizophrenia – A review. Acta Psychiatr Scand 2013;127:173-82.
2. Carpenter WT Jr, Strauss JS, Bartko JJ. Flexible system for the diagnosis of schizophrenia: Report from the WHO International Pilot Study of Schizophrenia. Science 1973;182:1275-8.
3. Amador XF, David AS. Insight and psychosis. 2nd ed. New York: Oxford University Press; 2004.
4. Mintz AR, Dobson KS, Romney DM. Insight in schizophrenia: A meta-analysis. Schizophr Res 2003;61:75-88.
5. Nair A, Palmer EC, Aleman A, David AS. Relationship between cognition, clinical and cognitive insight in psychotic disorders: A review and meta-analysis. Schizophr Res 2014;152:191-200.
6. Beck AT, Baruch E, Bailer JM, Steer RA, Warman DM. A new instrument for measuring insight: The Beck cognitive insight scale. Schizophr Res 2004;68:319-29.
7. Drake RJ, Nordentoft M, Haddock G, Arango C, Fleischhacker WW, Glenthoj B, et al. Modeling determinants of medication attitudes and poor adherence in early nonaffective psychosis: Implications for intervention. Schizophr Bull 2015;41:584-96.
8. Sendt KV, Tracy DK, Bhattacharyya S. A systematic review of factors influencing adherence to antipsychotic medication in schizophrenia-spectrum disorders. Psychiatry Res 2015;225:14-30.
9. Drake RJ, Dunn G, Tarrier N, Bentall RP, Haddock G, Lewis SW. Insight as a predictor of the outcome of first-episode nonaffective psychosis in a prospective cohort study in England. J Clin Psychiatry 2007;68:81-6.
10. Nieto L, Cobo J, Pousa E, Blaz-Marinj A, Warman DM. Insight, symptomatic dimensions, and cognition in patients with acute-phase psychosis. Compr Psychiatry 2012;53:502-8.
11. Tirupati S, Padmavalli R, Thara R, McCreadie RG. Insight and psychopathology in never-treated schizophrenia. Compr Psychiatry 2007;48:264-8.
12. Minigone C, Rocca P, Castagna F, Montemagni C, Sigaudo M, Scalese M, et al. Insight in stable schizophrenia: Relations with psychopathology and cognition. Compr Psychiatry 2013;54:484-92.
13. Keefe RS, Fenton WS. How should DSM-V criteria for schizophrenia include cognitive impairment? Schizophr Bull 2007;33:912-20.
14. Bilder RM, Goldman RS, Robinson D, Reiter G, Bell L, Bates JA, et al. Neuropsychology of first-episode schizophrenia: Initial characterization and clinical correlates. Am J Psychiatry 2000;157:549-59.
15. Gold JM, Weinerberger DR. Cognitive deficits and the neurobiology of schizophrenia.Curr Opin Neurobiol 1995;5:225-30.
16. Kraus MS, Keefe RS. Cognition as an outcome measure in schizophrenia. Br J Psychiatry Suppl 2007;50:s46-51.
17. Fioravanti M, Bianchi V, Cindi ME. Cognitive deficits in schizophrenia: An updated metaanalysis of the scientific evidence. BMC Psychiatry 2012;12:64.
18. Bozakas VP, Kosmidis MH, Kiosseoglou G, Karavatos A. Neuropsychological profile of cognitively impaired patients with schizophrenia. Compr Psychiatry 2006;47:136-43.
19. Green MF, Kern RS, Braff DL, Mintz J. Neuropsychological deficits and functional outcome in schizophrenia: Are we measuring the “right stuff”? Schizophr Bull 2000;26:119-36.
20. Shad MU, Tamminga CA, Cullum M, Haas GL, Keshavan MS. Insight and frontal cortical function in schizophrenia: A review. Schizophr Res 2006;86:54-70.
21. Grover S, Sahoo S, Nehra R, Chakrabarti S, Avasthi A. Association of neurocognitive deficits and insight in schizophrenia. Asian J Psychiatr 2018;36:112-7.
22. Choudhury S, Khess CR, Bhattacharyya R, Sanyal D. Insight in schizophrenia and its association with executive functions. Indian J Psychiatr Med 2009;31:71-6.
23. Kumar A, Sharma P, Das S, Nath K, Talukdar U, Bhagabati D. Insight in psychotic disorder: Relation with psychopathology and frontal lobe function. Psychopathology 2014;47:32-8.
24. APA. Diagnostic and Statistical Manual of Mental Disorders, 4th ed. Washington, DC: American Psychiatric Press; 1994.
25. Kay SR, Fiszbein A, Opler LA. The positive and negative syndrome scale (PANSS) for schizophrenia. Schizophr Bull 1987;13:261-76.
26. Kemp R, David A. Insight and compliance. In: Blackwell B, editor. Compliance and the Treatment Alliance in Serious Mental Illness. Amsterdam: Harwood Academic Publishers; 1997.
27. David AS, Morgan KD, Mallet R, Leff J, Murray RM. Insight: Unitary or multidimensional phenomenon? Schizophr Res 2003;60:14.
28. Murthy HH. A short scale of the Bhatia’s performance tests. Indian Psychol Rev 1966;2:133-4.
29. Lezak MD. Neuropsychological Assessment. 3rd ed. New York: Oxford University Press; 1995.
30. Heaton R, Chelune G, Talley J, Kay GG, Curtis G. Wisconsin Card Sorting Test Manual: Revised and Expanded. Odessa, Florida: Psychological Assessment Resources, Inc.; 1993.
31. Oestereith PA. The test of copying and a complex figure: A contribution to the study of perception and memory. Arch Psychiatr Neurol 1944;30:286-350.
32. Schmidt M. Rey Auditory Verbal Learning Test; A Handbook. Los Angeles: Western Psychological Services; 1996.
33. Smith EE, Jonides J. Storage and executive processes in the frontal lobes. Science 1999;283:1657-61.
34. Chan SK, Chan KK, Lam MM, Chiu CP, Hui CL, Wong GH, et al. Clinical and cognitive correlates of insight in first-episode schizophrenia. Schizophr Res 2012;135:40-7.
35. Mintz AR, Addington J, Addington D. Insight in early psychosis: A 1-year follow-up. Schizophr Res 2004;67:213-7.
36. Sevy S, Nathanson K, Visweswariah H, Amador X. The relationship between insight and symptoms in schizophrenia. Compr Psychiatry 2004;45:6-9.
37. Bora E, Binnur Akdede B, Alptekin K. Neuropsychological impairment in deficit and non-deficit schizophrenia: A meta-analysis. Psychol Med 2017;47:2401-13.
38. Henry JD, Crawford JR. A meta-analytic review of verbal fluency deficits in schizophrenia relative to other neuropsychological deficits. Cogn Neuropsychiatry 2005;10:1-33.
39. Bora E, Murray RM. Meta-analysis of cognitive deficits in ultra-high risk to psychosis and first-episode psychosis: Do the cognitive deficits progress over, or after, the onset of psychosis? Schizophr Bull 2014;40:744-55.
40. Szőke A, Schürhoff F, Mathieu F, Meary A, Ionescu S, Leboyer M. Tests of executive functions in first-degree relatives of schizophrenic patients: A meta-analysis. Psychiatry Res 2008;160:77-82.
41. Trandafir A, Méary A, Schürhoff F, Leboyer M, Szőke A. Memory tests in first-degree adult relatives of schizophrenic patients: A meta-analysis. Schizophr Res 2006;81:217-26.
42. Dickinson D, Ragland JD, Gold JM, Gur RC. General and specific cognitive deficits in schizophrenia: Goliath defeats David? Biol Psychiatry 2008;64:823-7.
43. Reichenberg A, Harvey PD. Neuropsychological impairments in schizophrenia: Integration of performance-based and brain imaging findings. Psychol Bull 2007;133:833-58.
44. Nieuwenstein MR, Aleman A, de Haan EH. Relationship between symptom dimensions and neurocognitive functioning in schizophrenia: A meta-analysis of WCST and CPT studies. Wisconsin card sorting test. Continuous performance test. J Psychiatr Res 2001;35:119-25.
45. Lee J, Park S. Working memory impairments in schizophrenia: A meta-analysis. J Abnorm Psychol 2005;114:599-611.
46. Aleman A, Kahn RS, Selten JP. Sex differences in the risk of schizophrenia: Evidence from meta-analysis. Arch Gen Psychiatr 2003;60:565-71.
47. Kragh-Ananth C, Minzenberg MJ, Ragland JD. The cognitive neuroscience of memory function and dysfunction in schizophrenia. Biol Psychiatry 2008;64:18-25.
48. Pantelis C, Perlstein W, Ganguli R, Brar J, Mintun M, Cohen JD. Functional hypofrontality and working memory dysfunction in schizophrenia. Am J Psychiatry 1998;155:1285-7.
49. Andreasen NC, O’Leary DS, Flaus M, Nopoulos P, Watkins GL, Boles

Raveendranathan, et al.: Insight and cognition in schizophrenia
Ponto LL, et al. Hypofrontality in schizophrenia: Distributed dysfunctional circuits in neuroleptic-naïve patients. Lancet 1997;349:1730-4.

51. Simon V, De Hert M, Wampers M, Peuskens J, van Winkel R. The relation between neurocognitive dysfunction and impaired insight in patients with schizophrenia. Eur Psychiatry 2009;24:239-43.

52. Aleman A, Agrawal N, Morgan KD, David AS. Insight in psychosis and neuropsychological function: Meta-analysis. Br J Psychiatry 2006;189:204-12.

53. Mysore A, Parks RW, Lee KH, Bhaker RS, Birkett P, Woodruff PW. Neurocognitive basis of insight in schizophrenia. Br J Psychiatry 2007;190:529-30.

54. Zhou Y, Rosenheck R, Mohamed S, Zhang J, Chang Q, Ou Y, et al. Insight in inpatients with schizophrenia: Relationship to symptoms and neuropsychological functioning. Schizophr Res 2015;161:376-81.

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