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Social cognitions in siblings of patients with schizophrenia: a comparison with patients with schizophrenia and healthy controls - a cross-sectional study

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ABSTRACT

Background: There are limited number of studies which have evaluated social cognitive deficits among the siblings of patients with schizophrenia.

Aim: This study aimed to evaluate the social cognitive deficits and its correlates among siblings of patients with schizophrenia.

Methodology: Patients of schizophrenia (N = 34), their siblings (N = 34) and healthy control subjects (N = 31) matched for age, gender, education and intelligence quotient were evaluated on social cognition rating tools in Indian setting (SOCRATIS). Patients were additionally evaluated on Positive and Negative Symptom Scale (PANSS). Siblings were assessed on Comprehensive Assessment for at risk mental state (CAARMS) scale and Short Wisconsin Schizotypy scale. Neurocognitive test battery was applied to all the groups.

Results: Patients with schizophrenia performed the worst and the healthy controls performed the best, with siblings falling intermediate on all the subtests of social cognition (except for externalizing bias and personalized bias) and neurocognition. There were negative correlation between some of the domains of social cognition and various domains of CAARMS. Higher level of schizotypy was associated with higher level of social cognitive deficits.

Conclusion: Social cognitive deficits can act as an important endophenotype for estimating the risk of schizophrenia in at risk siblings. Further, social cognitive deficits must be considered as important target for intervention among the at risk siblings to improve their outcome.

1. Introduction

Schizophrenia is a chronic psychiatric disorder, which is associated with negative outcome in many domains of life of the sufferer (Addington and Barbato, 2012). One of the factor which has been considered to influence the outcome of schizophrenia is duration of untreated psychosis (Chou et al., 2015; Ito et al., 2015; On et al., 2016; Tang et al., 2014). Considering this, over the last 2 decades, many early intervention programs have been conceived (Mangala et al., 2012; Rangaswamy et al., 2012), which focus on detecting the illness at the earliest. Besides this many attempts have been made to identify the at risk population. It is said that waiting for clinical features to emerge, can often delay the intervention (Tiffin and Welsh, 2013). Hence, efforts are been made to identify features, which can help identifying people at risk at the earliest, i.e., much before the onset of clinical symptoms. Identification of endophenotypes is one of the strategy for the same.

The term “endophenotype” was first as an internal phenotype, i.e., not obvious to the unaided eyes, that fills the gap between symptoms and the putative genes. Endophenotypic markers are understood as those vulnerability factors, which are present as a trait in the asymptomatic phase of the illness in those with an illness, are heritable and are also present in the unaffected relatives. These are stable factors which are present in all stages of illness in patients (premorbid, prodromal, illness, recovery) and also in high risk individuals. These may be biochemical, endocrinological, neurophysiological, neuroanatomical and neuropsychological markers(Allen et al., 2009; Braff et al., 2006).Various endophenotypes studied for schizophrenia include neurocognitive dysfunction, neurological soft signs, disordered eye movements, dermatoglyphic anomalies, minor physical anomalies, structural and functional neuroanatomic deficits as revealed by imaging studies, temperament and character, decreased social drive, stress sensitivity, mood bias towards negative emotion and social cognitions (SC). These

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deficits are found in both patients and at risk groups (Aksoy-Poyraz et al., 2011; Chan et al., 2010; Greenwood et al., 2011; Greenwood et al., 2013; Rosa et al., 2005; Smith et al., 2008).

In recent times, SC has also been evaluated as an endophenotype for patients with schizophrenia. These are defined as the mental operations underlying social interactions and these include the human ability and capacity to perceive the intentions and dispositions of others. Patients with schizophrenia have been frequently shown to have deficits in SC and neurocognitions (NC) (Fiske and Taylor, 2013; Frith and Frith, 2007) and so are the unaffected relative of the patients as they carry the genetic liability and also share environmental factors (Montag et al., 2012; Nehra et al., 2016). However, the literature on SC deficits among first degree relatives (FDR) of patients with schizophrenia is limited. Available evidence suggest that the SC deficits in patients with schizophrenia are greater than among the first degree relatives which are in turn greater than healthy controls (Albacete et al., 2016; Bora and Pantelis, 2013; Cella et al., 2015; Elsayed Eltaweel and Ibrahim, 2017; Frajo-Apor et al., 2017; Ho et al., 2015; Kohler et al., 2014; Lavoie et al., 2013; Pos et al., 2015; Rukiye et al., 2016).Studies on SC among relatives of patient with schizophrenia suggest a mean effect size to be lower than that reported for patients with schizophrenia for mentalising ($g = 0.96$), emotional processing ($g = 0.89$) and social perception ($g = 1.04$)(Lavoie et al., 2013). Even though relatives did not display important clinical SC deficits, they nonetheless showed lower performance than what is normally expected in the general population as indicated by effect sizes in moderate range (Bora and Pantelis, 2013; Lavoie et al., 2013). Although some of the studies have evaluated the FDR, but very few studies have limited themselves to siblings of patients of schizophrenia (Bora and Pantelis, 2013; Cella et al., 2015; Elsayed Eltaweel and Ibrahim, 2017; Frajo-Apor et al., 2017; Ho et al., 2015; Lavoie et al., 2013; Pos et al., 2015).Further, these studies are limited by, lack of comparison group and focus on only one or few domains of SC(Albacete et al., 2016; Bora and Pantelis, 2013; Cella et al., 2015; Elsayed Eltaweel and Ibrahim, 2017; Frajo-Apor et al., 2017; Kohler et al., 2014; Lavoie et al., 2013; Pos et al., 2015; Rukiye et al., 2016). Majority of the studies have not controlled for IQ and age (Bora and Pantelis,2013; Lavoie et al.,2013). Limited information is available on association of SC deficits and NC among siblings(Bora and Pantelis, 2013; Lavoie et al., 2013).

The evidence for SC deficits being an endophenotype for schizophrenia is not as well established as that of NC deficits. Hence, there is a need to expand this area of research. In this background, this study aimed to evaluate the SC deficits among siblings of patients with schizophrenia and compare the same with a group of patients with schizophrenia and healthy control group matched on age, gender, education and intelligence quotient. Additionally an attempt was made to evaluate the association of SC with attenuated positive symptoms and associated symptomatologyand schizotypy among the siblings of patients with schizophrenia.It was hypothesised that sibling group will perform equal to healthy controls in terms of SC and NC.

2. Methodology

This study was carried out in a tertiary care centre in north India, after due approval from the Institute Ethics Committee. All the participants were recruited after obtaining written informed consent. The study sample comprised of 3 groups: Group-I included 34 siblings of patients with schizophrenia, Group-II included 34 corresponding patients of schizophrenia and Group-III included 31 healthy controls.

Participants in all the 3 groups were required to be aged ≥16 years and be able to read Hindi and English and provide written informed consent/assent. Additionally, to be included, the sibling of patients were required to have a sibling with the diagnosis of schizophrenia but themselves not been diagnosed with schizophrenia or any other diagnosable mental disorder. Patients in the schizophrenia groups were required to be diagnosed with schizophrenia (as per MINI-PLUS) (Sheehan et al., 1998) and currently in clinical remission (Andreasen et al., 2005). Remission was defined as Scores of ≤3 on Positive and Negative Syndrome Scale items of delusions, conceptual disorganisation, hallucinatory behaviour, blunted affect, social withdrawal, lack of spontaneity, mannerisms/posturing and unsual thought content and the severity scores as above maintained over a period of minimum 6 months (Andreasen et al., 2005).Participants in the healthy control group were required to be free from any mental disorder (as ascertained by using MINI- screen)(Van Vliet and De Beurs, 2007) with no family history of any major mental disorder in the FDRs. Exclusion criteria for all the 3 groups were presence of intellectual disability, organic brain syndrome, chronic medical disorder (organic-epilepsy or any neurological illness), current/past history of any substance use disorder (other than tobacco), presence of medically diagnosable and/or self-reported visual and/or auditory impairment (not correctable with Aids), diagnosed with any psychiatric disorder in the past and presence of any diagnosable psychiatric disorder were excluded.

All the 3 study groups were matched for age, gender, education and intelligence quotient.

Siblings of patients with schizophrenia and healthy controls were evaluated on MINI-screen to rule out any psychiatric morbidity and those who screened positive were further evaluated on MINI-PLUS to rule out psychiatric morbidity. Only those healthy control subjects were included, those who screened negative on MINI-PLUS. Sibling groups included one sibling of the patients who participated in the study.

Participants in all the 3 groups were assessed on Social Cognition Rating Tools in Indian Setting (SOCRATIS)(Mehta et al., 2011) and Neurocogntive test battery. Siblings of patients were additionally assessed on Comprehensive assessment of at risk mental states (CAARMS) (Yung et al., 2005) and Short Wisconsin Schizotypy scale(Gross et al., 2012; Winterstein et al., 2011). Patients were additionally assessed on Positive and Negative symptom scale (Kay et al., 1987).

2.1. Social cognition rating tools in Indian setting – SOCRATIS (Mehta et al., 2011)

It was designed to assess SC in Indian cultural setting. It assesses three domains of SC– Theory of mind, Attributional styles and Social Perception.It has been validated in Indian setting and has been rated by panel of experts on Likert scale. All tests of the SOCRATIS had good content validity (> 4 score by > 5% of experts) and known groups validity. In addition, the social cue recognition test in Indian setting had good internal consistency (alpha value is 0.78) and concurrent validity (inter class correlation coefficient > 0.7).

2.2. Neurocognitive test battery

Five neurocognitive tests, i.e., Coloured trail making test(D'Elia et al., 1996), Hopkins Verbal Learning test (Benedict et al., 1998; Brandt and Benedict, 2001), Controlled oral word association test (Benton and Hamsher, 1989; Ross et al., 2007), Wisconsin card sorting test (Kongs et al., 2000) and Raven's Standard Progressive Matrices (Raven, 1938) were used.

2.3. Comprehensive assessment of at risk mental states CAARMS (Yung et al., 2005)

It is a semi structured interview design with seven subscales: positive, cognitive, emotional, negative, behavioural, motor/physical and general psychopathology. It is useful in identification of attenuated positive symptoms and associated symptomatology. It helps in predicting onset of psychosis (6 months; sensitivity 0.83, specificity 0.74, positive predictive value 0.12, negative predictive value 0.99) and has good inter-rater reliability (0.62–0.93 intraclass correlations).Depending on the scores on various domains,the participants can be categorised as vulnerability group (Family history of

psychotic disorder in a FDR or diagnosed Schizotypal PD along with more than 30% drop in global assessment scale), attenuated psychosis group (in addition to the criteria for vulnerability, presence of attenuated psychotic features at sub-threshold intensity or frequency along with more than 30% drop in global assessment scale) and Brief Limited Intermittent Psychotic Symptoms (BLIPS) or Trait vulnerability criteria group (in addition to the criteria for attenuated psychosis, presence of frank psychotic features that resolve spontaneously within 7 days without antipsychotics along with more than 30% drop in global assessment scale) and the Psychosis threshold/antipsychotic treatment threshold group.

2.4. Short Wisconsin schizotypy scale (Gross et al., 2012; Winterstein et al., 2011)

It consists of 15-item short forms and has four measures in the form of magical ideation, perceptual aberration, social anhedonia, and physical anhedonia which form higher-order positive symptom and negative symptom dimensions. The scales demonstrated good reliability and correlated highly with the original scales. The validity of the scales was assessed by comparing the association of the original and shortened WSS with interview measures of psychotic-like and schizophrenia-spectrum symptoms and impaired functioning, as well as with questionnaire measures of personality and social impairment. The associations of the shortened WSS with the interview and questionnaire measures were comparable in terms of statistical significance and effect size with the associations of the original scales. The associations of the shortened WSS with the interview and questionnaire measures were comparable in terms of statistical significance and effect size with the associations of the original scales.

2.5. Positive and negative scale for schizophrenia (Kay et al., 1987)

PANSS was developed and standardized for typological and dimensional assessment of patients with schizophrenia. The scale has 30 items in three subscales - positive, negative and general psychopathology. Each item is rated on a seven-point scale on the basis of a formal semi-structured clinical interview and other informational sources, pertaining to the previous 1 week. The PANSS is a standard tool for assessing the clinical outcome in treatment studies of schizophrenia. Alpha coefficient varies from 0.73 to 0.83 ($p < 0.001$) for each of the subscales, indicating high inter-rater reliability and homogeneity among items.

Data was analysed by using Statistical Package for Social Sciences

Table 2
Clinical profile of patient with schizophrenia (N = 34).

Variables	Mean(SD)(range) / frequency (%)
Age of onset (in years)	19.1(3.6)(14-28)
Subtype of schizophrenia	
Paranoid	17(50)
Undifferentiated	16(47.1)
Simple	1(2.9)
Total duration of illness (in months)	70.6(46.1)(18-180)
Total duration of treatment (in months)	60.6(43.6)(12-168)
Duration of untreated psychosis	10(7.8)(1-24)
Duration of current treatment (in months)	21.5(23.9)(2-96)
Antipsychotics	
Clozapine	11(32.2)
Olanzapine	7(20.6)
Risperidone	4(11.8)
Amisulpride	4(11.8)
Aripiprazole	4(11.8)
Others[a]	4(11.8)
Chlorpromazine equivalent dose (in mg/day)	304.8(137.7)(50-600)
Positive and Negative Symptom subscale scores	
Positive subscale	11.5(1.7)(8-15)
Negative subscale	15.1(2.6)(10-21)
General psychopathology subscale	28.9(6.3)(22-58)
PANSS Total score	55.6(8.1)(45-83)

[a] Others- Trifluperazine (N = 1), Lurasidone (N = 1), Combination of Risperidone and Amisulpride (N = 1), combination of Trifluoperazine and Olanzapine (N = 1).

Table 1
Comparison of Sociodemographic details of patients with schizophrenia, siblings of patients with schizophrenia and healthy control groups.

Variables	Patient (N = 34) mean(SD) (range)/frequency(%)	Sibling (N = 34) mean(SD) (range)/ frequency(%)	Healthy Control (N = 31) mean(SD) (range)/ frequency(%)	ANOVAtest / Chi-square test (p value)
Age (in years)	24.9(3.8)(18-32)	25.7(5.3)(18-34)	25.2(4.3)(17-33)	F = 0.279(0.757)
Education (in years)	13.4(3.1)(6-18)	14.7(3.5)(5-25)	14(2.4)(9-19)	F = 1.776(0.175)
Sex				
Male	20(58.8)	18(52.9)	20(64.5)	χ^2 = 0.897(0.639)
Female	14(41.2)	16(47.1)	11(35.5)	
Marital status				
Currently single	30(88.2)	22(64.7)	23(74.2)	χ^2 = 5.185(0.075)
Currently married	4(11.8)	12(35.3)	8(25.8)	
Education				
≤12th	10(29.4)	11(32.4)	9(29)	χ^2 = 0.104(0.949)
> 12th	24(70.6)	23(67.6)	22(71)	
Occupation status				
Unemployed	27(79.4)	14(41.2)	10(32.3)	χ^2 = 16.65(< 0.001)***
Employed	7(20.6)	20(58.8)	21(67.7)	
Socio-economic status				
Lower middle and below	14(41.2)	14(41.2)	6(19.4)	χ^2 = 4.497(0.106)
Upper middle and above	20(58.8)	20(58.8)	25(80.6)	
Religion				
Hindu	29(85.3)	29(85.3)	29(93.5)	*H* = 1.348(0.510)
Non-Hindu	5(14.7)	5(14.7)	2(6.5)	
Type of family				
Nuclear	22(64.7)	21(61.8)	22(71)	χ^2 = 0.630(0.730)
Extended/ Joint	12(35.3)	13(38.2)	9(29)	
Locality				
Urban	29(85.3)	28(82.4)	23(74.2)	χ^2 = 1.368(0.505)
Rural	5(14.7)	6(17.6)	8(25.8)	

χ2: Chi-square value; H:Kruskal-Wallis value; F: ANOVA value.
*** $p \leq 0.001$.

Table 3
Comprehensive Assessment for at risk mental state (CAARMS) scale of siblings of patients with schizophrenia.

Variables	Mean(SD)(range)/ frequency(%)
Attenuated positive symptoms and associated symptomatology	
Unusual thought content	1.2(1)(0–4)
Non bizarre ideas	1.1(0.9)(0–3)
Perceptual abnormality	1(1.2)(0–3)
Disorganized speech	1.7(0.8)(0–3)
Subjective cognitive change	1.7(1)(0–4)
Observed cognitive change	1.1(0.7)(0–2)
Abstract thinking	2.1(0.9)(0–4)
General psychopathology: mania	0.6(0.6)(0–2)
Global assessment scale score change (> 30% drop)	13(38.2)
Vulnerability group	11(32.4)
Attenuated psychosis group	2(5.9)
Brief Limited Intermittent Psychotic Symptoms (BLIPS) group	0
Psychosis threshold/antipsychotic treatment threshold group	0
Schizotypy	
Perceptual aberrations	3(1.9)(0–8)
Magical ideations	4.7(2.5)(0–10)
Physical anhedonia	5.7(2.8)(1–12)
Social anhedonia	4.9(3.3)(0–13)
Positive schizoytpy	7.6(4)(0–17)
Negative schizotypy	10.6(4.4)(4–21)
Mean positive schizotypy	0.3(0.1)(0–0.6)
Mean negative schizotypy	0.4(0.1)(0.1–0.7)
Total	18.3(6.3) (6–31)

(SPSS-14). Descriptive analysis was computed in the form of mean, standard deviation, frequency and percentages. Comparison between the three groups was done by using ANOVA for continuous variables like age, education in years, SC and NC variables. Chi-square test was used to compare the gender, locality, socioeconomic status, religion etc.Correlation between SC and other variables was evaluated by using Pearson's product moment correlation and Spearman's rank correlation. Multivariate analysis was performed by using ANCOVA in which each SC variable was taken as a dependent variable and other variables (age, gender, education and intelligence quotient, various NC domains) were used as independent variables (covariates). Standardized magnitudes of differences between the groups was estimated by using Cohen's 'd' effect sizes.

3. Results

The demographic profile of the 3 study groups is shown in Table 1. The 3 groups did not differ statistically on the demographic variables, except for the fact that compared to the healthy controls and siblings, higher proportion of the patients were unemployed.

3.1. Clinical profile of patients with schizophrenia

Clinical Profile of patients with schizophrenia is shown in Table 2.

3.2. Assessment of siblings forattenuated positive symptoms and associated symptomatology and schizotypy

CAARMS scale was used for assessment of attenuated positive symptoms and associated symptomatology. As is evident from Table 3, 11 siblings were considered to be in the vulnerable group and 2 siblings were categorised into the attenuated psychosis group. None of the siblings qualified for BLIPS or the Psychosis threshold/antipsychotic treatment threshold group. On WSS, highest score was seen in the physical anhedonia measure, followed by scores in the social

Table 4
Comparison of SC of patients with schizophrenia, siblings of patients with schizophrenia & healthy controlgroups.

Variables	Patient (N = 34) mean (SD) (range)	Sibling (N = 34) mean (SD) (range)	Healthy Control(N = 31) mean(SD) (range)	ANOVAtest (p value)	Post hoc (ANOVA)	ANCOVA test F value; p value	Effect size (η^2) (ANOVA)	Effect size (t test) between patient and sibling group	Effect size (t test) between sibling and control group
Social Cognition									
First order theory of mind index	0.76(0.27) (0.25–1)	0.91(0.2) (0–1)	0.99(0.05) (0.75–1)	11.609 (0.0001)****	I < II** I < III*** II < III	2.666 (< 0.001***)	0.195	0.631	0.549
Second order theory of mind index	0.27(0.3) (0–1)	0.48(0.24) (0–1)	0.84(0.21) (0.5–1)	41.521 (0.0001)****	I < II** I < III*** II < III***	4.654 (< 0.001***)	0.464	0.773	1.597
Faux pas composite index	0.50(0.2) (0.2–0.88)	0.64(0.15) (0.3–1)	0.91(0.11) (0.53–1)	57.494 (0.0001)****	I < II** I < III*** II < III***	7.802 (< 0.001***)	0.545	0.792	2.053
Social perception index	0.63(0.17) (0.33–0.90)	0.78(0.10) (0.46–0.96)	0.83(0.07) (0.68-0–97)	24.084 (0.0001)****	I < II*** I < III*** II < III	4.315 (< 0.001***)	0.334	1.076	0.579
Non social perception index	0.69(0.13) (0.47–0.90)	0.83(0.09) (0.63–0.96)	0.88(0.07) (0.65–0.97)	29.197 (0.0001)****	I < II*** I < III*** II < III	3.904 (< 0.001***)	0.378	1.252	0.620
Externalizing bias index	2.97(3.61) (−2–12)	3.06(3.95) (−5–11)	3.68(4.09) (−4–13)	0.315 (0.731)	I < II I < III II < III	1.491(0.088)	0.006	0.024	0.154
Personalizing bias index	0.66(0.26) (0.13–1)	0.57(0.23) (0.90–0.92)	0.52(0.21) (0.71–1)	2.911 (0.059)	I > II I > III II > III	1.303(0.183)	0.057	0.381	0.238

IQ: Intelligence quotient.
ANCOVA:after controlling for co-variates Q: age, gender, IQ (intelligence quotient), Hopkins verbal learning test(trial 1, trial 2, trial 3), controlled oral word association test (correct p,a,r; perseveration p,a,r; intrusion p,a,r; variant p,a,r) coloured trail test 1 & 2 (time in secs, error), WCST (total correct, total errors, Perseveratory responses, Perseveratory errors, non Perseveratory errors, conceptual responses).
* $p \leq 0.05$.
** $p \leq 0.01$.
*** $p \leq 0.001$.
**** $p \leq 0.001$.

Table 5
Comparison of SC and NC deficits of patients with schizophrenia, siblings of patients with schizophrenia and healthy control groups.

Variables	Patient (N = 34) mean (SD) (range)	Sibling(N = 34) mean(SD)(range)	Healthy Control(N = 31) mean (SD) (range)	ANOVAtest (p value)	Post hoc (ANOVA)	ANCOVA test (p value)	Effect size (η^2) (ANOVA)	Effect size (t test) between patient and sibling group	Effect size (t test) between sibling and control group
Neurocognition									
IQ	90.1(18.3) (67–140)	95.6(14.8) (62–122)	99.1(10.7) (72–118)	2.982 (0.055)	I < II I < III II < III	102.56 0.0001****	0.058	0.330	0.271
Hopkin's verbal learning test									
Trial 1	4.2(1.7) (1–7)	6.2(1.9) (3–10)	7(1.9) (2-10)	20.236 (0.0001)****	I < II*** I < III*** II < III	0.764 (0.384)	0.296	1.109	0.421
Trial 2	6.3(2.1) (3–11)	8.3(2) (5–12)	9.2(2.2) (2–12)	16.738 (0.0001)****	I < II** I < III*** II < III	0.206 (0.631)	0.258	0.975	0.428
Trial 3	6.7(1.9) (4–11)	8.7(1.9) (5–12)	10.1(1.8) (4–12)	27.552 (0.0001)****	I < II*** I < III*** II < III*	0.504 (0.480)	0.365	1.653	0.756
Trial delayed	5.3(2.5) (2–11)	7.6(2.2) (3–11)	9.7(1.6) (6–12)	34.602 (0.0001)****	I < II*** I < III*** II < III**	1.884 (0.173)	0.419	0.977	1.092
Controlled oral word association									
Correct p	7.3(3.7) (0–18)	10.2(4.7) (2–20)	12.8(4.6) (3–26)	13.206 (0.0001)****	I < II* I < III*** II < III	2.636 (0.108)	0.216	0.686	0.559
Perseveration p	0.4(0.8) (0–4)	0.5(0.9) (0–3)	0.3(0.7) (0–3)	0.423 (0.657)	I < II I > III II > III	0.121 (0.729)	0.009	0.117	0.248
Intrusion p	0.26(0.6) (0–3)	0.26(0.8) (0–4)	0.1(0.3) (0–1)	0.849 (0.431)	I = II I > III II > III	0.014 (0.907)	0.017	0	0.265
Variant p	0.2(0.6) (0–3)	0.3(0.6) (0–2)	0	2.841 (0.063)	I < II I > III II > III	2.415 (0.127)	0.056	0.167	–
Correct a	6.9(3.4) (1–14)	9.3(4.2) (2–20)	11(3.8) (5–22)	9.659 (0.0001)***	I < II* I < III*** II < III	0.026 (0.872)	0.167	0.628	0.424
Perseveration a	0.32(0.6) (0–2)	0.5(0.7) (0–2)	0.26(0.4) (0–1)	1.773 (0.175)	I < II I > III II > III	1.324 (0.253)	0.036	0.276	0.421
Intrusion a	0.44(1) (0–4)	0.35(0.8) (0–4)	0.1(0.3) (0–1)	1.674 (0.193)	I > II I > III II > III	1.860 (0.176)	0.034	0.099	0.414
Variant a	0	0.2(0.5) (0–2)	0.1(0.3) (0–1)	3.158 (0.047)	I < II I < III II > III	2.953 (0.089)	0.061	–	0.242
Correct r	5.2(3.3) (0–12)	7.6(4.1)(1 –19)	9.7(4.7) (1–21)	9.940 (0.000119)***	I < II I < III*** II < III	7.732 (0.007)	0.171	0.645	0.476
Perseveration r	0.24(0.6) (0–2)	0.24(0.5) (0–2)	0.29(0.5) (0–2)	0.116 (0.89)	I = II I < III II < III	0.073 (7.88)	0.024	0	0.1
Intrusion r	0.7(1.1) (0–4)	0.3(0.7) (0–3)	0.2(0.6) (0–3)	3.263 (0.043)	I > II I > III II > III	8.008 (0.006)	0.063	0.434	0.153
Variant r	0.38(1.1) (0–4)	0.06(0.3) (0–2)	0.06(0.3) (0–1)	2.519 (0.086)	I > II I > III II = III	0.720 (0.398)	0.050	0.397	0
Colour trail test									
Test 1(time in secs)	81.3(27.3) (38–155)	48.1(18.2) (20–86)	41.1(13.5) (22–70)	35.738 (0.0001)****	I > II*** I > III*** II > III	32.596 (< 0.001***	0.427	1.431	0.437
Test 2(time in secs)	172.3(44.3) (62–240)	113.8(34.2) (54–186)	94(24.9) (60–154)	43.059 (0.0001)****	I > II*** I > III*** II > III	86.405 (< 0.001***	0.473	1.478	0.662
Test 1 error	1.5(1.2) (0–5)	0.3(0.5) (0–2)	0.1(0.2) (0–1)	31.625 (0.0001)****	I > II*** I > III*** II > III	17.704 (< 0.001***	0.397	1.305	0.525
Test 2 error	6.6(4.8) (0–18)	1.6(1.2) (0–4)	0.6(1) (0–5)	38.773 (00.001)****	I > II*** I > III*** II > III	34.283 (0.029)	0.447	1.429	0.905

(*continued on next page*)

Table 5 (*continued*)

Variables	Patient (N = 34) mean (SD) (range)	Sibling(N = 34) mean(SD)(range)	Healthy Control(N = 31) mean (SD) (range)	ANOVAtest (p value)	Post hoc (ANOVA)	ANCOVA test (p value)	Effect size (η^2) (ANOVA)	Effect size (t test) between patient and sibling group	Effect size (t test) between sibling and control group
Wisconsin card sorting test									
Total correct	33.4(9.9) (15–56)	39.6(11.1) (17–57)	46.4(5.8) (32–56)	15.859 (0.0001)***	I < II* I < III*** II < III*	4.915 (< 0.001***	0.248	0.589	0.768
Total errors	30.6(9.9) (8–49)	24.4(11.1)(7–47)	17.6(5.8) (8–32)	15.859 (0.0001)****	I > II* I > III*** II > III*	45.35 (0.0001)****	0.248	0.589	0.768
Perseveratory responses	21.6(13.8) (4-55)	14.6(11.6)(4-59)	10.2(5.1) (4-24)	8.976 (0.0002)***	I > II* I > III*** II > III	12.596 (0.0001)***	0.157	0.549	0.491
Persveratory errors	18.1(10.1) (4–43)	12.6(9) (4–44)	9(3.9) (4–21)	10.249 (0.0001)****	I > II* I > III*** II > III	15.025 (0.0001)***	0.176	0.575	0.519
Non perseveratory errors	12.5(8.4) (3–38)	11.8(7.9) (2–37)	8.6(3.2) (3–16)	2.799 (0.066)	I > II I > III II > III	13.590 (0.0001)***	0.055	0.086	0.538
Conceptual responses	23.5(12.9) (3–53)	31.8(15.5)(0–56)	41.6(8) (19–56)	16.678 (0.0001)****	I < II* I < III*** II < III*	0.025 (0.868)	0.258	0.582	0.794

IQ: Intelligence quotient.
ANCOVA for Hopkins Verbal Learning Test, controlled oral word association test, colour trail test, Wisconsin card sorting test variable after controlling for co-variates Q: age, gender, IQ (intelligence quotient). For IQ, ANCOVA was used after controlling for age and gender. Hochberg's correction: 9 p values were above 0.05 for the ANOVA test, accordingly p values below 0.0055 were considered significant; for ANCOVA, 15 p values were above 0.05, accordingly p values below 0.0033 were considered significant.
* $p \leq 0.05$.
** $p \leq 0.01$.
*** $p \leq 0.001$.
**** $p \leq 0.001$.

anhedonia, magical ideation and perceptual aberrations measures. Overall negative schizotypy score was higher than the positive schizotypy score.

3.3. Comparison of social and neurocognitive deficits of siblings of patients with schizophrenia, healthy controls and patients with schizophrenia

When the siblings of patients with schizophrenia were compared with patients with schizophrenia and the healthy controls, siblings performed worse than the healthy controls on the second order ToM task and Faux pas composite index. Similarly patients with schizophrenia performed worse than the siblings and also the healthy controls on the first order ToM task, second order ToM task, Faux pas composite index, social perception index and non-social perception index (Table 4). The differences between the different groups remained significant in the ANCOVA analysis too, even after controlling for various covariates including various domains of NC (Table 4) and applying hochberg's correction for multiple comparisons. When the effect sizes were calculated for comparison between siblings and controls, siblings and patients, effect sizes were > 0.5 for all the subtests except for externalizing and personalizing bias.

Similar to the findings of SC, patients with schizophrenia performed worse than the siblings and healthy controls on the verbal learning test, word association test, colour trail test and Wisconsin card sorting test. However, significant difference between the siblings and the healthy controls were observed only in some of the subtests of verbal learning test and Wisconsin card sorting test (Table 5). Effect sizes for comparison of patients and siblings were > 0.9 for Hopkin's verbal learning test, > 0.6 for some of the subtests of COWA, > 1.0 for colour trail test and > 0.5 for most of the subtests of WCST (Table 5). When the effect sizes were calculated for comparison of siblings and controls, effect sizes were less robust than that found for sibling and patient group (Table 5).

3.4. Correlation of social and neurocognition with scores on various domains of CAARMS among siblings of patients with schizophrenia

Of the various domains of CAARMS, means of abstract thinking domain has significant negative correlation with the first order ToM, Faux pas composite index, social perception index and non-social perception index. Objective cognitive change domain score correlated negatively with second order ToM, Faux pas composite index and social perception index. Disorganized behaviour correlated negatively with social perception index. Perceptual abnormality domain score correlated negatively with second order ToM score (Table 6).

3.5. Correlation of SC with schizotypy among siblings of patients with schizophrenia

Social anhedonia, total schizotypy score and negative schizotypy score had significant negative correlation with social perception and non-social perception index (Table 7).

4. Discussion

To summarise the results, out of 34 siblings, 11 were considered to be in the vulnerable group and 2 siblings were categorised into the attenuated psychosis group. On WSS, overall negative schizotypy score was higher than the positive schizotypy score. With respect to SC, patients with schizophrenia performed the worst and the healthy controls performed the best, with siblings falling intermediate between the patients and healthy controls on all the subtests of SC except for externalizing bias and personalized bias. In NC testing, patients with schizophrenia performed worse than the siblings and healthy controls on the verbal learning test, word association test, colour trail test and Wisconsin card sorting test.Significant difference between the siblings and the healthy controls were observed only in some of the subtests of

Table 6
Correlation of Social cognition and Neurocognition with scores in the various domains of CAARMS among siblings of patients with schizophrenia.

Variables	Unusual thought content	Non bizarre ideas	Perceptual abnormality	Disorganised behaviour	Cognitive change-subjective	Cognitive change-objective	Abstract thinking	General psychopathology: mania
First order ToM index	0.016(0.931)	−0.023(0.899)	−0.147(0.405)	0.011(0.950)	0.081(0.649)	−0.177(0.317)	−0.389(0.023)*	0.112 (0.528)
Second order ToM index	−0.217(0.219)	−0.268(0.126)	−0.342(0.047)*	−0.284(0.104)	−0.151(0.395)	−0.411(0.016)*	−0.285(0.102)	−0.276(0.114)
Faux pas composite index	−0.285(0.103)	−0.210(0.233)	−0.295(0.090)	−0.222(0.206)	0.043(0.808)	−0.347(0.045)*	−0.364(0.034)*	0.139(0.432)
Social perception index	−0.166(0.349)	−0.146(0.409)	−0.260(0.138)	−0.395(0.021)*	−0.182(0.304)	−0.340(0.049)*	−0.492(0.003)**	−0.045(0.800)
Non social perception index	−0.184(0.297)	−0.277(0.112)	−0.306(0.079)	−0.207(0.239)	−0.043(0.808)	−0.259(0.140)	−0.405(0.018)*	−0.188(0.288)
Externalizing bias index	−0.121(0.496)	−0.005(0.978)	−0.019(0.915)	−0.057(0.749)	−0.186(0.292)	0.082(0.646)	0.160(0.365)	0.126(0.479)
Personalizing bias index	−0.132(0.456)	−0.137(0.439)	−0.294(0.091)	−0.240(0.171)	−0.106(0.552)	−0.169(0.340)	−0.133(0.454)	0.070 (0.695)

* $p \leq 0.05$.
** $p \leq 0.01$.

verbal learning test and Wisconsin card sorting test. There were negative correlations between some of the domains of SC and various domains of CAARMS. Higher level of schizotypy was associated with higher social cognitive deficits in some of the domains.

Research on SC deficits among patients with mental disorders has started in India in last decade, but no investigation has focused specifically on FDRs of patients with schizophrenia. Accordingly the present study, attempted to evaluate the SC in the siblings of patients with schizophrenia and compared the same with their ill relatives and a healthy control group. Further, an attempt was made to understand the relationship of SC deficits with attenuated symptoms and schizotypy among siblings of patients with schizophrenia.Earlier attempts to evaluate SC among FDRs of patients with schizophrenia/psychosis have not limited themselves to the siblings (Alfimova et al., 2009; Bora and Pantelis, 2013; De Achával et al., 2010; Huepe et al., 2012; Janssen et al., 2003; Kelemen et al., 2004; Li et al., 2010; Meijer et al., 2012; Montag et al., 2012;). Further, not all the studies have included a healthy control group(Bora and Pantelis, 2013; Kohler et al., 2014; Lavoie et al., 2013; Marjoram et al., 2006; Pentaraki et al., 2012). Studies which have included a healthy control group do not provide information about the matching of siblings and control subjects on parameters which could possibly influence the findings of social cognition (Bora and Pantelis, 2013; Lavoie et al., 2013). To overcome some of these limitations, in the present study, the “at risk” group was limited to siblings only and a healthy control group which was matched for age, gender, education and intelligence quotient. The patients with schizophrenia were also matched with siblings in terms of age, gender, education and intelligence quotient, as these variables are known to influence SC (Henry et al., 2015; Linke et al., 2015; Pérez -Arce, 1999; Sutterby et al., 2012). Siblings of patients with schizophrenia and healthy controls were also evaluated on MINI-screen and if required on MINI-PLUS to rule out any psychiatric morbidity. Only those subjects were included, those who screened negative on MINI-PLUS. The healthy controls group was limited to those without family history of psychiatric illness. Most of the previous studies which have studied SC among FDRs have not provided much information about their mental illness status and types of evaluation prior to intake into the study. None of the studies which have evaluated SC among first degree relatives of patients have used NC as a covariate while comparing the patients and their first degree relatives. In contrast, present study attempted to control for NC while carrying out the analysis. Accordingly, the present study attempted to overcome some of the limitations of the existing literature.

4.1. Assessment of siblings on comprehensive assessment for at risk mental state (CAARMS) scale and short Wisconsin schizotypy scale

Siblings of patients with schizophrenia were assessed on CAARMS for assessment of attenuated positive symptoms and associated symptomatology. Out of the 34 siblings, 11 were considered to be in the vulnerable group and 2 siblings were categorised into the attenuated psychosis group. None of the siblings qualified for BLIPS or the Psychosis threshold/antipsychotic treatment threshold group. Further, when the SC was compared between those without any abnormality on CAARMS and those belonging to vulnerable or attenuated psychosis group, no significant difference was noted, suggesting that these subtle features did not influence the trait findings of SC. In the present study overall negative schizotypy score was higher than the positive schizotypy score. These findings are similar to some of the previous studies, which have evaluated the high risk groups and/or siblings of patients with schizophrenia(Albacete et al., 2016; Alfimova et al., 2009; Irani et al., 2006).

4.2. SC deficits of study groups

Findings of SC deficits in the patient with schizophrenia in the present study are comparable with some of the previous studies from

Table 7
Correlation of SC with schizotypy among siblings of patients with schizophrenia.

Variables	Perceptual aberrations	Magical ideations	Physical anhedonia	Social anhedonia	Total score	Positive schizotypy	Negative schizotypy
Social Cognition domains							
First order ToM index	0.091 (0.607)	0.134(0.449)	−0.047(0.790)	−0.064(0.718)	0.027(0.881)	0.130(0.465)	−0.078(0.662)
Second order ToM index	−0.047(0.790)	−0.202(0.251)	−0.078(0.663)	−0.229(0.192)	−0.249(0.156)	−0.152(0.391)	−0.220(0.212)
Faux pas composite index	0.053(0.7650	−0.19390.2740	0.082(0.646)	−0.075(0.672)	−0.065(0.716)	−0.098(0.581)	−0.005(0.978)
Social perception index	−0.095(0.592)	−0.293(0.0920	−0.143(0.418)	−0.368(0.032)*	−0.401(0.019)*	−0.233(0.184)	−0.364(0.034)*
Non social perception index	−0.112(0.530)	−0.257(0.142)	−0.065(0.713)	−0.506(0.002)**	−0.430(0.011)*	−0.218(0.215)	−0.418(0.014)*
Externalizing bias index	−0.218(0.215)	−0.053(0.767)	−0.186(0.292)	0.112(0.530)	−0.110(0.536)	−0.138(0.436)	−0.033(0.851)
Personalizing bias index	0.142(0.422)	−0.125(0.481)	−0.205(0.246)	−0.219(0.214)	−0.212(0.230)	−0.012(0.948)	−0.291(0.094)
Intelligence Quotient	−0.081(0.651)	−0.226(0.199)	−0.020(0.910)	−0.268(0.126)	−0.296(0.089)	−0.183(0.300)	−0.21(0.228)

* $p \leq 0.05$.
** $p \leq 0.01$.

this centre and India (Sen et al., 2016; Vijaya Laksmi et al., 2017).

In the present study, when the 3 groups were compared, patients with schizophrenia performed the worst and the healthy controls performed the best, with siblings falling intermediate between the patients and healthy controls on all the subtests of social cognition except for externalizing bias and personalized bias. These differences persisted even when age, gender, IQ and all the domains of NC were used as covariates.ToM is understood as the ability to infer intentions, dispositions and beliefs of others (Green et al., 2008). It refers to the ability of a person to represent the mental states and/or to make inferences about another's intentions. It includes understanding false beliefs, hints, intentions, deception, metaphor, irony, and faux pas (Jones et al., 1998). Presence of higher level of SC deficits among siblings in comparison to healthy controls, suggest that these are stable traits, which are more often present in the patients and at risk individuals. This suggests that SC deficits can be considered as another important endophenotype for schizophrenia. Presence of higher level of impairment in SC among the siblings suggests that there is a need to include assessment and interventions to address the SC deficits.

4.3. Neurocognitive function of study groups

As expected, patients with schizophrenia performed worse than the siblings and healthy controls on the various tests of NC. However, significant difference between the siblings and the healthy controls were observed only in some of the subtests of verbal learning test and Wisconsin card sorting test.Available evidence suggests that patients with schizophrenia have maximum deficits in the domain of verbal learning test and executive functions (Agnew-Blais and Seidman, 2013; Bliksted et al., 2014; Calkins et al., 2010; Rund et al., 2006). Further, presence of significant verbal learning deficits and deficits in executive function among patients with schizophrenia and their sibling suggest that these may be better endophenotypes when compared to other neurocognitive functions. When one evaluates the differences in the SC and NC between the 3 groups in the present study, it can be said that possibly SC deficits are better endophenotype markers than the neurocognitive deficits.

4.4. Correlates of social cognitive deficits among the siblings of patients with schizophrenia

When the association of various domains of CAARMS and SC was evaluated in general, there were negative correlation between some of the domains of SC and various domains of CAARMS, suggesting that presence of higher level of risk for psychosis is associated with more SC deficits. When the relationship of SC with schizotypy was evaluated, it was evident that higher level of schizotypy is associated with higher SC deficits in some of the domains. As there are no previous studies, it is not possible to compare these findings with the existing literature. However, some of the previous studies which have compared patients of schizophrenia in different phases of illness suggest presence of higher level of deficits during the acute phase (Bliksted et al., 2014; Green et al., 2011; Ntouros et al., 2014; Mazza et al., 2012; Mendoza et al., 2011; Vohs et al., 2014). This possibly could indirectly explain the association of CAARMS and SC.

Present study has certain limitations. The study was limited to the patients and their siblings attending the treatment services. Hence, the findings cannot be generalized to all the patients and their siblings living in the community. Certain other domains of social cognition such as emotional processing and facial recognition were not evaluated. Future studies must attempt to overcome these limitations.

To conclude present study suggests that compared to healthy controls, siblings of patients with schizophrenia have higher level of SC deficits. However, the level of SC deficits among siblings are lower than that noted among patients with schizophrenia. Further, there is an association of SC deficits with neurocognition among siblings of patients with schizophrenia. The SC deficits among the siblings of patients with schizophrenia are not affected much by the demographic variables, except for education. Further, presence of higher level of schizotypy but not vulnerability for psychosis is associated with higher level of SC deficits. Accordingly, it can be said that SC deficits among siblings of patients with schizophrenia can act as an important endophenotype for estimating the risk of schizophrenia. Further, SC deficits must be considered as important target for intervention among the siblings to improve their outcome.

Conflict of interest

None.

Contributors

Venkatesh Raju: designing the study, collecting the resource material, writing the research proposal, collecting the data, analysis of data, writing the draft of the paper, final approval of paper.

SG: designing the study, collecting the resource material, writing the research proposal, analysis of data, writing the draft of the paper, final approval of paper.

RN: designing the study, collecting the resource material, writing the research proposal, writing the draft of the paper, final approval of paper.

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