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RELATIONSHIP BETWEEN COGNITIVE FUNCTIONING AND SYMPTOM DOMAINS AMONG PERSONS WITH SCHIZOPHRENIA

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The present study aimed to examine the relationship between cognitive functioning and symptom domains in persons with schizophrenia. A cross-sectional design was used to enroll sixty people diagnosed with schizophrenia. The degree of symptoms was assessed using the Positive and Negative Syndrome Scale (PANSS) and detailed neuropsychological assessment was done using appropriate tests. The most prevalent cognitive dysfunction was inadequate verbal fluency (98.4%), followed by category fluency (96.7%), mental flexibility on all domains of WCST (90%), mental speed (76.6%), abstraction ability (70%), performance intelligence (65%), selective attention (48.3%), working memory (45%), and attention span (36.6%). Stepwise regression analysis revealed that Color Trail 1, which is a test of selective attention significantly, predicted the score on positive symptoms scale. Color Trail 2, a test of working memory, performance intelligence on BSS, and failure to maintain set of WCST test significantly predicted the score on general symptoms scale. Both working memory and performance intelligence significantly predicted the score on negative symptoms in the present study. Extremely high percentages of schizophrenia patients display deficits in various cognitive areas. Deficits in selective attention, working memory, performance intelligence, and executive functioning can significantly predict the score on various symptom domains. This is specifically important for negative symptoms, which do not respond to antipsychotics. Hence targeting the cognitive deficits may improve the function outcome in schizophrenia.

Keywords: Schizophrenia; Cognitive; Functional impairment; Memory; Intelligence.

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Schizophrenia is a psychiatric condition characterized by the presence of positive, negative, and general symptoms, which tend to manifest in clusters and affect cognitive domain. The symptoms exhibit variability in terms of their origin, development, and responsiveness to therapeutic interventions. The positive symptoms include manifestations such as thought disorders, delusions, hallucinogenic behavior, heightened excitement, grandiosity, suspiciousness, and aggression (Berrios, 1985). On the other hand, the negative symptoms are the deficits and functional impairments that occur when a disease progresses. These symptoms include emotional alogia, flattening, anhedonia, asociality, avolition, difficulties in abstract thinking, stereotyped thinking, and lack of spontaneity. Finally, the general symptoms include a variety of manifestations, such as physical concerns, anxiety, feelings of guilt, tension, peculiar behavior and posing, depression, slowed movement, uncooperative behavior, abnormal thoughts, confusion, difficulty focusing, impaired judgment and self-awareness, loss of motivation, poor impulse control, excessive preoccupation, and avoidance of social interactions (Pogue-Geile & Harrow, 1984).

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Cognitive impairments are widely acknowledged as chronic and persistent characteristics in individuals diagnosed with schizophrenia, and they are closely associated with illness severity. Schizophrenia is associated with impairments in various cognitive areas, including attention/vigilance, speed of processing, working memory, visual memory, verbal memory, reasoning, social cognition, and problem solving. Cognitive deficiencies encompass challenges related to attention, language, various facets of memory, cognitive flexibility, executive functioning, and the processing of social cues (Buchanan et al., 2005; Conklin et al., 2005; Couture et al., 2006; Hardy-Baylé et al., 2003; Hill et al., 2004; Karilampi et al., 2007). Numerous studies that demonstrate significant variability in the extent of cognitive dysfunction among patients have been conducted (Goldstein, 1994). Previous research has indicated that individuals with disorganized type schizophrenia and those exhibiting a higher prevalence of negative symptoms tend to experience more pronounced cognitive deficits, particularly in the areas of memory and executive function (Brazo et al., 2002). Conversely, individuals with a higher prevalence of positive symptoms tend to exhibit better preservation of these cognitive skills. Individuals exhibiting negative symptoms demonstrate a notable impairment in their capacity to engage in effective planning and organization. The observed pattern has been determined to have no correlation with the degree of disease severity. Multiple studies have demonstrated that patients with schizophrenia display impairments in set shifting abilities as measured by conventional cognitive assessments (Goldberg & Weinberger, 1988). Moreover, the executive control component of attention has been observed to exhibit impairment, resulting in subsequent cognitive dysfunctions (Rothbart & Posner, 2006). Individuals diagnosed with schizophrenia commonly experience attention problems that are not limited to specific stimuli, but rather affect their ability to focus on various types of information, including both spatial and verbal cues. In the context of schizophrenia, it has been observed that attentional functioning remains stable across time, with deficiencies persisting even after the amelioration of the illness (Chen & Faraone, 2000). Therefore, the presence of these underlying abnormalities contributes to the persistence of functional impairments during the stable phase.

Schizophrenia is regularly associated with impairments in declarative memory. In their comprehensive analysis, Cirillo and Seidman (2023) conducted a thorough examination of 110 papers, revealing substantial evidence indicating impairment in declarative memory in individuals diagnosed with schizophrenia. The presence of attention and working memory deficits in individuals with schizophrenia is more pronounced, perhaps leading to indirect effects on learning and memory (Kenny & Meltzer, 1991). Memory impairment in individuals with schizophrenia is widely recognized as being extensive and nonspecific in nature. Deficits encompass many impairments in memory, such as deficiencies in recall abilities, including both crude recollection and immediate recall. Additionally, deficits may manifest in the ability to process different types of stimuli, including both verbal and nonverbal stimuli. Furthermore, deficits may also be observed in the retention interval, encompassing both immediate and delayed memory recall. The magnitude of a deficit is contingent upon the overall magnitude of impairment (Aleman et al., 1999).

Numerous scholarly investigations have endeavored to examine the cognitive abilities, specifically intelligence quotient (IQ), in individuals diagnosed with schizophrenia. Research has confirmed that individuals diagnosed with schizophrenia exhibit cognitive impairments throughout their entire lifespan. Substantial cognitive impairments have been observed subsequent to the initiation of the illness (Aylward et al., 1984).

Deficits in working memory have consistently been observed in individuals diagnosed with schizophrenia, as evidenced by a wide range of methodologies and approaches. Individuals diagnosed with schizophrenia exhibit challenges in the process of developing plans, commencing actions, and adapting strategies when they become ineffective. Additionally, they encounter difficulties in effectively utilizing feedback (Lewis, 1934). Schizophrenia is characterized by a loss in working memory, which is observed

regardless of the specific modality of the activity. To successfully perform a working memory task, one must engage in the processes of encoding the target, internally representing the target, maintaining the mental representation of the target while disregarding irrelevant information, and retrieving the mental representation at the appropriate moment. Impaired performance may arise as a consequence of dysfunction within any of these sub-processes. In recent years, a number of studies have provided evidence suggesting that deficient encoding processes may play a role in the working memory impairments observed in individuals diagnosed with schizophrenia (David, 1990). Moreover, a correlation exists between deficiencies in working memory and the manifestation of symptoms associated with schizophrenia. Studies have shown that there is a negative relationship between visuo-spatial, working memory, and negative symptoms. Patients have been observed to demonstrate below-optimal performance on spatial span tests (Pantelis et al., 1997).

Executive functioning encompasses various cognitive processes, including volition, planning, purposeful action, and self-monitoring of behavior. This statement elucidates a diverse range of cognitive processes at an advanced level, which enable the adaptable alteration of thoughts and behaviors in accordance with shifting cognitive or environmental circumstances. The aforementioned phenomenon is a multifaceted cognitive process that encompasses the utilization of various subprocesses in order to attain a specific objective (Manglam et al., 2010). There is data indicating that deficiencies in executive function are linked to the extent of negative symptoms, such as alogia and emotional flatness, as well as the severity of the illness and lack of awareness (Donohoe et al., 2006).

Individuals diagnosed with schizophrenia exhibit cognitive abnormalities in areas such as processing speed, verbal fluency, and categorical fluency. The findings of a recent meta-analysis on cognitive domains and measures in schizophrenia have underscored the significance of a processing speed deficit as a key factor contributing to cognitive impairment in individuals with schizophrenia (Dickinson et al., 2007; Kay et al., 1987). The study found that individuals diagnosed with schizophrenia had a notable decline in their ability to generate words based on semantic categories compared to their performance in generating words based on phonemic categories (Dickinson et al., 2007). Over time, a more comprehensive knowledge of the severity of cognitive abnormalities associated with schizophrenia has emerged. Antipsychotics are still the preferred medication for improving cognitive performance and quality of life, but they can also make cognitive function worse. Antipsychotics may worsen side effects and neuropsychiatric impairments directly or indirectly through anticholinergic or antihistaminic actions. According to review research, nonpharmacological neuroplastic stimulation can enhance neuropsychological functioning, which has a positive impact on cognitive domains and functional outcomes (Harvey et al., 2022).

Factor analysis revealed several key factors influencing cognitive performance (Tyburski et al., 2020), including Factor 1, which reflects a slower speed of perceptual tracking. This slower processing speed may significantly impact various cognitive functions, particularly in relation to symptoms observed in schizophrenia.

The existing body of literature reveals a dearth of studies from north India examining the complete association including both symptom domains and cognitive functioning in individuals diagnosed with schizophrenia. There is a scarcity of studies that have examined this matter, utilizing a notably restricted range of cognitive function assessments in separate subsets. The main aim of this study was to investigate the cooperative relationships between cognitive impairment and the positive, negative, and general symptoms of schizophrenia. Additionally, the study aimed to explore cognitive dysfunction as a potential predictor of symptom syndromes in individuals diagnosed with schizophrenia.

METHODS

The study was carried out at the Department of Psychiatry in a tertiary care hospital located in the northern region of India. The study included patients who were diagnosed with schizophrenia by two experienced psychiatrists using the ICD-10 diagnostic criteria. The participants were between the ages of 18 and 60 and had at least a primary level of education. The study was conducted between March 2017 and June 2018. Individuals who had both a psychiatric disorder and substance dependence (excluding nicotine and caffeine), a history of head injury, intellectual disability, recent neuropsychological assessment, previous cognitive retraining or social skill training, recent electro-convulsive treatment (ECT), or a movement disorder were not included in the study. A total of 60 participants were enrolled in the study following the acquisition of signed informed permission. The study received approval from the Institutional Ethics Committee of Panjab University Chandigarh (India), which is analogous to an Internal Review Board in other locations.

Scales were applied to test the cognitive functions. To assess neurocognition Positive and Negative Syndrome Scale (PANSS) was used to assess the symptoms in the subjects. The participants underwent administration of the PANSS, where a higher score signifies the presence of more severe symptoms. Cognitive functions were assessed through the administration of various tests. Neurocognitive functions were evaluated by using Bhatia Short Scale for performance intelligence (BSS). Passalong Test and Kohs Block Test were used to measure the intelligence. Color Trails 1 and 2 were employed to assess attention, perceptual tracking, basic sequencing, and mental flexibility. The Digit Symbol Substitution Test (DSST) was conducted to evaluate visuo-motor coordination, motor persistence, sustained attention, and response speed. The assessment of phonemic fluency was conducted using the Controlled Oral Word Association Test (COWAT), while memory was evaluated by the Digit Span Test (DST). The researchers employed the Animal Naming Test (ANT) and the Wisconsin Card Sorting Test (WCST) to evaluate the patients' fluency and mental flexibility (set shifting), respectively. Scoring was done as per the Indian National Institute of Mental Health and Neurosciences (NIMHANS) manual of psychiatry.

The collected scores on the aforementioned tools were analyzed using descriptive and inferential statistical methods with the assistance of Statistical Package for Social Sciences (SPSS) Version 16, after the evaluations. For continuous variables, we estimated the mean and standard deviation. For discontinuous variables, we computed the percentages. The Pearson correlation coefficient was employed to examine the association between the severity of symptoms and cognitive functioning. Sequentially, the study utilized regression analysis to determine the predictive relationship between cognitive dysfunctions and symptom domains.

RESULTS

Table 1 depicts the sociodemographic and clinical characteristics of the participants. The majority of the participants were males (65%), educated up to middle or above (88.3%) with mean age of 34.5 years. The majority of the participants were single (76.6%) and half of the patients belonged to low socioeconomic status. The mean total duration of illness was 102.1 months and out of them majority (63.33 %) were having more than 10 years of duration. Mean scores on positive, negative, and general syndromes on PANSS were 8.3, 7.7, and 15.2, respectively.

The status of cognitive functioning of participants is presented in Table 2. As shown, inadequate cognitive functioning was observed in a lot of participants. The most commonly prevalent cognitive dysfunction was inadequate verbal fluency (98.4%), followed by category fluency (96.7%), mental flexibility

on all domains of WCST (90%), mental speed (76.6%), abstraction ability (70%), performance intelligence (65%), selective attention (48.3%), working memory (45%), and attention span (36.6%). Increase in percentage depicts deficits in selective attention, working memory, performance intelligence, and executive functioning on various cognitive domains.

TABLE 1
Sociodemographic and clinical characteristics of the participants

Variable	Description	*N* = 60 Frequency (%)
Gender	Male Female	39 (65.0) 21 (35.0)
Education	Primary to middle Middle to senior secondary Graduate and above Mean ± *SD*	7 (11.7) 29 (48.3) 24 (40.0) 34.5 ± 10.3
Marital status	Single Married	46 (76.7) 14 (23.3)
Socioeconomic status (SES)	Low SES Middle SES	30 (50.0) 30 (50.0)
Current episode	Acute Subacute Chronic	6 (10.0) 2 (3.3) 52 (86.7)
Medical history	Yes No	1 (1.7) 59 (98.3)
Past history	Yes No	1 (1.7) 59 (98.3)
Total duration of illness (months)	Mean ± *SD* 0-59 months 60-119 months 120 and above	102.1 ± 92.1 14 (23.34) 8 (13.33) 38 (63.33)
Symptom severity	PANSS (positive scale) PANSS (negative scale) PANSS (general scale)	8.3 ± 7.2 7.7 ± 6.4 15.2 ± 11.6

Note. PANSS = Positive and Negative Syndrome Scale.

TABLE 2
Cognitive profile of participants

Cognitive functions	Tests	Adequate/inadequate	*N* = 60			
			F	%	Mean	*SD*
Selective attention	CT 1 (total time taken)	Adequate Inadequate	31 29	51.7 48.3	105.1	79.2
Working memory	CT 2 (total time taken)	Adequate Inadequate	33 27	55.0 45.0	200.6	131.2
Attention span	DST (digit forward and backward)	Adequate Inadequate	38 22	63.3 36.6	8.4	2.3

(table 2 continues)

Table 2 (continued)

Cognitive functions	Tests	Adequate/inadequate	*N* = 60			
			F	%	Mean	*SD*
Mental speed	DSST (total time taken)	Adequate	14	23.3	427.8	298.8
		Inadequate	46	76.6		
Verbal fluency/ Phonemic fluency	COWAT (average number of new words)	Adequate	1	1.7	5.9	3.2
		Inadequate	59	98.4		
Category fluency	ANT (number of new words)	Adequate	2	3.3	8.4	2.9
		Inadequate	58	96.7		
Intelligence	BSS (performance IQ)	Average (IQ = 90 and above)	21	35	87.2	26.0
		Below average (IQ = 80-89)	11	18.3		
		Borderline (IQ = 70-79)	10	16.6		
		IQ below 70	18	30		
Mental flexibility (WCST)	Number of category completed	Adequate	4	6.6	2.9	2.1
		Inadequate	58	93.3		
	Failure to maintain set	Adequate	2	3.3	0.8	1.3
		Inadequate	58	96.6		
	Perseverative response	Adequate	9	15	37.7	29.8
		Inadequate	51	85		
	Perseverative errors	Adequate	6	10	30.5	24.7
		Inadequate	54	90		
	Nonperseverative errors	Adequate	8	13.3	24.6	18.2
		Inadequate	52	86.6		
Abstraction ability	Similarities and differences	Adequate	18	30	11.1	7.0
		Inadequate	42	70		

Note. CT 1 = Color Trail 1; CT 2 = Color Trail 2; DST = Digit Span Test; DSST = Digit Symbol Substitution Test; COWAT = Controlled Oral Word Association Test; ANT = Animal Naming Test; BSS = Bhatia Short Scale for performance intelligence; WCST = Wisconsin Card Sorting Test.

Table 3 depicts that there was significant correlation between PANSS (positive, negative, and general) symptoms syndromes and selective attention, mental speed, working memory, number of category completed, failure to maintain set on Wisconsin Card Sorting Test, and performance intelligence. This corelation represents the association of symptoms (positive, negative, general) with cognitive dysfunction on various domains. It is significantly important for negative symptoms that shows minimal or no response to antipsychotics in improving cognitive functions.

TABLE 3
Correlation between symptom severity and cognitive functions

Cognitive functions	Tests	PANNS P	PANNS N	PANNS G
Selective attention	CT 1	.264*	–.398**	.386**
Working memory	CT 2	.252	.426**	.441**
Attention span	DST	–.144	–.216	–.144

(table 3 continues)

Table 3 (continued)

Cognitive functions	Tests	PANNS P	PANNS N	PANNS G
Mental speed	DSST	.254	.321*	.369**
Verbal fluency/ Phonemic fluency	COWAT	.035	–.172	–.084
Category fluency	ANT total new words	–.038	–.217	–.144
Intelligence	BSS	–.257*	–.379**	–.342**
Mental flexibility (WCST)	WCST_number of category completed	–.176	–.325*	–.277*
	WCSTFTMS	.144	.151	.321*
	WCST_perseveration	–.002	.121	.057
	WCST_perseverativeerrors	–.04	.139	.009
	WCST_nonperseverativeerrors	–.036	.125	.004
Abstraction ability	Similarities and differences	–.157	–.113	–.006

Note. PANNS = Positive and Negative Syndrome Scale (P = positive; N = negative; G = general). CT 1 = Color Trail 1; CT 2 = Color Trail 2; DST = Digit Span Test; DSST = Digit Symbol Substitution Test; COWAT = Controlled Oral Word Association Test; ANT = Animal Naming Test; BSS = Bhatia Short Scale for performance intelligence; WCST = Wisconsin Card Sorting Test; WCSTFTMS = Wisconsin Card Sorting Test failure to maintain set.
*$p < .05$. **$p < .01$.

Findings in Table 4 reveals that Color Trail 1, which is a test of selective attention, predicted the score on positive symptoms scale ($p < .001$). Further, Color Trail 2, a test of working memory, performance intelligence on BSS, and failure to maintain set of WCST test predicted the general symptoms at $p < .01$, $p < .02$, and $p < .04$, respectively. Working memory and performance intelligence predicted the negative symptoms at $p < .007$ and $p < .02$, respectively, in the present study.

Significant predictors in the form of cognitive dysfuction have been ellicited. To this, scores on various domains were considered as dependent variables. This shows decreased performance in tests which reasons neurocognitive deficits.

Discussion

The current study was undertaken to investigate the correlation between cognitive functions and positive, negative, and general symptoms of schizophrenia. Cognitive functions were found to be impaired in large number of the participants with inadequate verbal fluency reported to be the most widely prevalent cognitive dysfunction, present in 98.4% of the participants. Similarly, other cognitive functions like category fluency, mental flexibility on all domains of WCST, mental speed, abstraction ability, performance intelligence, selective attention, working memory, and attention span were found to be impaired in significant number of participants. Previous studies on schizophrenia have also reported dysfunction in attention/vigilance, speed of processing, working memory, visual memory, verbal memory, verbal fluency, set shifting, reasoning, and problem solving along with social cognition (Aylward et al., 1984; Cirillo & Seidman, 2003; Conklin et al., 2005; Couture et al., 2006; Goldstein, 1994; Hill et al., 2004; Karilampi et al., 2007; Manglam et al., 2010; Rothbart & Posner, 2006). The high prevalence of cognitive dysfunction among participants in our study may be attributed to the chronic course and extended duration of their illness. Existing literature supports this notion, indicating that patients with chronic schizophrenia are more likely to experience cognitive deficits, which can significantly impact their functional outcom (Bhattacharya, 2015).

TABLE 4
Regression coefficients and predictors of score on positive, negative, and general symptoms domains on PANSS

Coefficients[a]								
Model		Unstandardized coefficients		Standardized coefficients	T	Sig.	95% confidence interval for B	
		B	*SE*	Beta			Lower bound	Upper bound
1	(Constant)	5.711	1.519		3.761	.000	2.671	8.751
	CT 1	.024	.012	.264	2.087	.041	.001	.047
a. Dependent variable = positive scale								
1	(Constant)	7.413	2.488		2.979	.004	2.432	12.394
	CT 2	.039	.010	.441	3.746	.000	.018	.060
2	(Constant)	6.275	2.470		2.541	.014	1.330	11.221
	CT 2	.035	.010	.397	3.424	.001	.015	.056
	WCSTFTMS	2.301	1.064	.251	2.163	.035	.171	4.431
3	(Constant)	17.065	5.714		2.987	.004	5.619	28.511
	CT 2	.028	.011	.317	2.661	.010	.007	.049
	WCSTFTMS	2.450	1.037	.267	2.363	.022	.373	4.526
	BSS	–.109	.052	–.244	–2.081	.042	–.214	–.004
b. Dependent variable = general scale								
1	(Constant)	3.467	1.394		2.487	.016	.676	6.258
	CT 2	.021	.006	.426	3.590	.001	.009	.033
2	(Constant)	10.170	3.284		3.097	.003	3.594	16.746
	CT 2	.017	.006	.341	2.813	.007	.005	.029
	BSS	–.067	.030	–.271	–2.239	.029	–.127	–.007
c. Dependent variable = negative scale								

Note. CT 1 = Color Trail 1; CT 2 = Color Trail 2; WCSTFTMS = Wisconsin Card Sorting Test failure to maintain set; BSS = Bhatia Short Scale for performance intelligence.

With respect to severity of symptoms, which was assessed on Positive and Negative Syndrome Scale (PANSS), general symptoms were found to be more persistent as compared to positive and negative symptoms. Previous researches have also shown that as the course of the condition becomes chronic, the positive feelings decrease while the overall symptoms tend to continue (Bhattacharya, 2015).

Findings of our study are also suggestive of a significant correlation between scores on various domains of PANSS (positive, negative, and general) and selective attention, mental speed, working memory, number of categories completed, failure to maintain set on Wisconsin Card Sorting Test, and performance intelligence. A significant positive correlation was observed between selective attentions tested on Color Trail 1 and scores of positive and general symptoms syndromes whereas negative correlation was observed between the same and negative symptoms score. Findings suggestive of inverse relationship of attention with negative symptoms are consistent with previous research findings (Chen & Faraone, 2000; Rothbart & Posner, 2006).

The results of the Color Trail 2 test indicated a strong positive relationship between working memory and the negative and general symptom syndromes of the PANSS. This finding aligns with previous research that suggests patients with positive symptoms of schizophrenia have greater deficits in attention and working memory (Kenny & Meltzer, 1991).

The Digit Symbol Substitution Test (DSST) revealed a strong and positive correlation between mental speed and scores of negative and general symptoms on the PANSS. Recent meta-analyses examining various cognitive domains and measurements in schizophrenia have emphasized that a deficiency in processing speed is a key factor contributing to cognitive impairment in individuals with schizophrenia (Bhattacharya, 2015; Dickinson et al., 2007; Henry & Crawford, 2005).

The assessment of performance intelligence showed that one third of the patients had below average intellectual functioning and one third had IQ scores below 70. Historically, there had been no intellectual disability before the onset of illness. Furthermore, a significant and negative correlation was found between performance intelligence scores and positive, negative, and general symptom's scores of the PANSS. This is suggestive of declining IQ scores among patients with schizophrenia irrespective of type of symptoms syndrome. Prior studies have confirmed that individuals diagnosed with schizophrenia experience cognitive impairments throughout their lives, and substantial decreases in IQ have been observed following the onset of the condition (Aylward et al., 1984).

Set shifting was assessed through WCST test and we found that the number of categories completed was negatively and significantly correlated with negative and general symptom scores on the PANSS. Additionally, the failure to maintain set was positively correlated with general symptom scores. It implies that number of category completion was poor in those patients who exhibited negative and general symptoms whereas failure to maintain set was associated with general symptoms. There have been no previous research findings that studied prefrontal cognitive dysfunction with WCST and PANSS in schizophrenic patients. In addition to the above attention span, verbal fluency (phonemic fluency), category fluency, and abstraction ability was not found to be significantly correlated with any of the symptoms syndrome on PANSS, which is again a significant finding in patients with schizophrenia as there has been limited literature on this cognitive domain. In addition to correlations, regression analysis was done to find out the significant predictors in the form of cognitive dysfunctions. For this, scores on various domains were considered as dependent variables.

Table 4 reveals that Color Trail 1 (CT1; selective attention test) and Color Trail 2 (CT2; working memory test) predicted scores on the Positive Symptoms Scale ($p < .001$) and the General Symptom Scale ($p < .02$), respectively. These findings corroborate previous research, indicating that patients exhibited decreased performance on both CT1 and CT2 tasks, along with higher regression factor scores for Factor 1, which reflects a slower speed of perceptual tracking. Additionally, notable associations were found between certain CT metrics and symptoms related to negativity and disorganization (Tyburski et al., 2020).

Further, performance intelligence on BSS and failure to maintain set of WCST predicted the scores on general symptoms scale at $p < .01$ and $p < .04$, respectively. Working memory and performance intelligence predicted the scores on negative symptoms at $p < .007$ and $p < .02$, respectively in the present study. There have been no studies which have looked at cognitive dysfunctions as predictors of clusters of symptoms grouped into positive, negative, and general symptoms syndromes in schizophrenia. Though cognitive deficits are considered to a separate domain of schizophrenia, our study suggests that the presence of certain cognitive deficits increases the likelihood of positive, negative, and general symptoms of schizophrenia. Hence, cognitive assessment should be carried out in routine for all patients of schizophrenia and suitable management should be carried out to improve the cognitive functioning. This may in turn lead to improvement in other symptoms of schizophrenia, as previous research has also documented that cognitive remediation not only improves cognitive functioning, but also leads to mild improvement in overall symptoms and especially negative symptoms (Aleman et al., 2017; McGurk et al., 2007; Sevy et al., 2020). This is especially important as it is a widely known fact that symptoms of schizophrenia do not respond completely to antipsychotics, especially the negative symptoms which tend to persist for years after the resolution of positive symptoms (Ventura

et al., 1993). However, further research is required in Indian contexts to strongly establish the relationship between cognitive functioning and the symptomatology of schizophrenia, as well as to explore potential improvements in cognitive functioning and symptom management.

Even though lot of research on neurocognitive deficits in schizophrenia has been carried out, our study has tried to elicit the findings while assessing correlations among different domains along with pharmacological treatment and symptomatology adding novelity in this research. With the advancement of treatment (pharmacological and nonpharmacological) for improving symptoms and cognitive functions in schizophrenia, further research is needed on larger population for enhance our knowledge. In particular, research (longitudinal and cross-sectional) to assess the outcome of new drugs and other nonpharmacological methods is required for improving life quality among patients and caregivers.

Conclusion

Schizophrenia patients have significant dysfunctions in almost all domains of the cognitive functions. The presence of some of the cognitive dysfunctions like deficits in attention, working memory, set shifting, and decline in performance intelligence can have effect on the symptom domains in schizophrenia. Hence, the authors believe that targeting the cognitive deficits may have beneficial effects on outcome on various symptom domains of schizophrenia.

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