A Comparative Study of Neuro-Cognitive Correlates in Patients Diagnosed with Schizophrenia and Normal Controls

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ABSTRACT

In the present study, a neuro-cognitive comparison was carried out among -Visual-Motor Functioning, Memory Functioning, Visuo-Constructional Ability, Response Inhibition and Perceptual Acuity between individuals with Schizophrenia and their approximately matched control. 30 individuals participated in the study. 20 belonged to Normal Population and 10 matched the criteria for Clinical Population.GHQ-28 was used to screen Normal Population and PANSS was used to screen the population diagnosed with Schizophrenia. Tools used for the present study included Bender Visual Motor Gestalt Test -I, PGI-Memory Scale, Clock Drawing Test, Stroop Test and Nahor-Benson Test. Product Moment Correlation was calculated for both Normal and Clinical groups. For both the groups, Memory and Response Inhibition was correlated with Visual-Motor Functioning, Visuo-Constructional Ability and Perceptual Acuity. Within the Normal Group, Delayed Recall significantly correlated with Visual-Motor Functioning and Visuo-Constructional Ability. Within Clinical Group, Perceptual Acuity significantly correlated with Visuo-Constructional Ability.

Key Words: *Schizophrenia, Florid symptoms, Partial Remission, Visual-Motor Functioning, Memory Functioning, Visuo-Constructional Ability*

INTRODUCTION

Schizophrenia is a disorder characterized by extreme distortions in perception, thinking, speech, sense of self, and social contact with a significant loss of contact and orientation with reality, referred to as psychosis. Schizophrenia spectrum and other psychotic disorders are characterized by positive and negative symptoms. Positive symptoms refer to pathological excess or addition to behavior. Delusions, hallucinations, disorganized thinking and speech, grossly disorganized or abnormal motor behavior (catatonia) are the positive symptoms that characterize schizophrenia. On the other hand, negative symptoms, which refer to pathological deficits in behavior, consist of flat, blunted affect, social withdrawal, alogia and anhedonia.

Neuroimaging, neuropsychological, and neurophysiological assessments have significantly shown differences between groups of individuals with Schizophrenia and appropriately matched control subjects. Structural neuroimaging literature implicates enlargement of the lateral ventricles. There is decrease in volume of brain tissue by widening of cortical sulci and decreased volumes of gray and white matter. Significant decrease in volume of temporal lobe has been found. Focal abnormalities have been found in medial temporal structures namely hippocampus, amygdale and entorhinal cortex. The superior temporal gyrus is found to be smaller in volume. Decreased thalamic volume has also been observed in not only individuals with Schizophrenia, but also their unaffected first-degree relatives. Hence it can be understood that genetic loading is significant over here. Another interesting finding is

that of an increase in the size of basal ganglia. An increased incidence of large cavum septum pellucidi has also been demonstrated in individuals with Schizophrenia. This may carry important implications, because it is suggestive of an early i.e., prenatal developmental brain abnormality.

Functional brain imaging studies implicate hypofrontality (i.e., a relative decrease in cerebral blood flow metabolism) to be the most consistently replicated finding. These functional abnormalities are unlikely to be limited to any one brain region as there are more widespread abnormalities involving the cortical and subcortical circuit of the brain.

Cognition is the sum total of mental processes that helps us to acquire knowledge and keeps us aware of our surroundings. Thus it enables us to arrive at appropriate judgments. Cognitive deficits in schizophrenia last throughout, thereby worsening the prognosis of the illness. They can be neuro-cognitive and relate to social cognition. Neurocognitive deficits are deficits in speed of processing, attention / vigilance, memory, perception, psycho-motor abilities, visuo-motor functioning, difficulty in changing response set along with reasoning, problem solving and social cognition. Such cognitive deficits are present at the onset of illness. Such deficits inevitably produce substantial functional impairment. Though Psychotic symptoms remit with treatment, functional impairments remain stable over time.

As we can understand neuropsychological deficits are a consistent aberration in groups of individuals with Schizophrenia. Evidence points out that that many of

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these deficits are found among individuals, during their first psychotic episode, prior to treatment with antipsychotic medication. Such deficits are also found in individuals with Schizophrenia who are in clinical remission, as well as in unaffected first-degree relatives. For these reasons, some of the neuropsychological deficits are thought to reveal how such deficits make individuals with Schizophrenia more vulnerable and functionally impaired to the course of the illness. These deficits carry clinically meaningful implications. They are related to the degree of difficulty that some individuals with Schizophrenia have with activities of daily living. They are also crucial for the ability of the affected individuals to acquire skills in psychosocial rehabilitation. Accordingly, the severity of neuropsychological deficits is a relatively strong predictor of psycho-social, vocational and cognitive outcome of the illness.

There are problems with Working Memory which can be thought of as our mental "blackboard." Patients with schizophrenia showed less prefrontal brain activity on tasks involving Working Memory in comparison to healthy controls (Cannon et.al. 2005). The medial temporal lobe in particular the hippocampus, associated with memory function (Squire, 1987), is implicated in schizophrenia (Suddath et al., 1989). There is evidence of marked deficits in procedural memory as well as implicit memory functioning in individuals diagnosed with Schizophrenia. Thus Schizophrenic patients have a global deficit in all aspects of memory (Elliott and Sahakian, 2010).

Research literature highlights the difficulties encountered by patients with schizophrenia in active, functional allocation of attentional resources, meaning that they are unable to attend well on demand. Attentional problems described in schizophrenia (Venables and Wing, 1962) can be attributed to poor frontal or executive function control (Damasio and Anderson, 1993).At the pathophysiological level, abnormal neural arousal mechanisms, associated with amygdala, hippocampus, and reticular formation have been replicated (Wing, 1962).

Tasks measuring higher order cognitive functions like conceptualization, planning, cognitive flexibility, verbal fluency, ability to solve complex problems inevitably gets compromised in Schizophrenia.

Executive Functioning encompasses set-shifting abilities, selective attention, and inhibition of inappropriate responses. In the year, 2010, Kalkstein, Hurford and Gur have shown that Schizophrenics suffer from executive impairments. Tasks sensitive to executive functioning like the Wisconsin Card Sorting Test (WCST) are poorly performed by schizophrenics (Stuss and Levine, 2002). Schizophrenic patients tend to perseverate on their responses. They encounter difficulties in shifting their response sets to new solutions when task demands change.

Visuomotor functions unlike pure motor function involve the occipital, parietal-spatial, frontal-motor cortex and other brain areas. Visual constructional ability depends on the integration of several higher order brain functions including perception, planning and motor coordination. It is compromised in schizophrenia. Schizophrenics come up with difficulties in building, assembling and drawing objects.

The right parietal lobe forms the underlying biological basis for Visuospatial functions. The role of posterior frontal lobes in visuo-constructive and praxic functions cannot be ruled out as they work in unity. Studies show moderate level of deficits in all these functions (Tracy et al. 2001; Goldberg et al., 1993) Constructional and visuospatial functions are more severely affected than other functions in schizophrenia.

A study was conducted by Bozikas et al (2004) to compare performance on Clock Drawing Test in patients with Schizophrenia with that of normal controls. Qualitative analysis of the clocks drawing performance of the patients with Schizophrenia revealed that they had difficulty placing numbers in the correct position, failure to indicate the minute targets, displacement of the minute hand from the minute number, and failure to draw a longer minute hand. Such errors were related to frontal lobe dysfunctions.

Perceptual acuity in the Visual modality is mostly compromised (Butler, Silverstein and Dakin, 2008). Schizophrenics encounter difficulties in visual processing and visual perception. Contrast, contour, form and motion processing in schizophrenia gets highly compromised. Such deficits directly implicate deficits in object recognition, grouping, perceptual closure, phase processing and reading.

In 2017, Edward et al conducted a comparative study on Visual-Motor Perceptual Dysfunction between individuals exhibiting Positive and Negative Symptoms of Schizophrenia. They came to the conclusion that Negative Schizophrenia had more deficits than Positive Schizophrenia. Rotation was seen more often in patients exhibiting Negative symptoms of Schizophrenia than patients in florid phase of Schizophrenia.

METHOD

Participants

30 adults participated in the study, out of whom20 belonged to the Normal Control Group (Screened through GHQ-28). The remaining 10 belonged to the Clinical Population. Their symptoms were screened through PANSS.

PROCEDURE

The Normal Population was provided with Information Schedule and Informed Consent Forms which they filled in themselves. The basic socio-demographic information for the Psychiatric Population was collected from the patients' family members and/or caregivers. It was a comparative study with a between-group design. It took around 1 to 1.5 hours to completely administer all the tools. Specific instructions and required stationery was provided to the participants for each specific test .30 individuals agreed to participate in the study. GHQ = 28 was administered to screen the 20 Normal Controls and the 10 Clinical Patients underwent screening through PANSS to confirm diagnosis of their symptomatology. After the data were properly scrutinized, they were scored according to the different scoring systems / keys available for the different Performance Tests used for the present study. All the scores were arranged on excel sheets. They were statistically analyzed with the help of SPSS (Version 16).Pearson Product Moment Correlation was calculated for both Normal and Clinical group. For both the groups, correlation was found out between Memory and Response Inhibition with Visual-Motor Functioning, Visuo-Constructional Ability and Perceptual Acuity. Graphical representations of Correlation were provided for the Normal and Clinical Group. Results were discussed. Necessary conclusions were drawn.

MEASURES

Detailed Information Schedule

The Detailed Information Schedule for Normal Controls consisted of basic socio-demographic details along with History of individual and family Physical and Mental Illness. For Individuals with Schizophrenia, other than the basic socio-demographic details, the detailed information schedule included Chief Complaints, Diagnosis, Medication, Duration of Illness, Family history of Psychiatric Illness etc.

Bender Visual Motor Gestalt Test

Famous Child Psychiatrist Lauretta Bender originally developed the Bender Visual Motor Gestalt Test (abbreviated as Bender Gestalt Test), in 1938 to assess visual – motor functioning, developmental disorders and neurological impairments, by extensively covering the age range from 3 years to old age in humans. The eight B – G designs scored by Pascal-Suttell and Koppitz system proved to be highly inter – correlated with a very significant positive correlation (r=0.92).

PGI – Memory Scale

The PGI Memory Scale was constructed and standardized in 1977. It is one of the sub-tests included in the PGI-Battery of Organic Dysfunction (PGI-BBD) developed by Pershad, 1977; Pershad and WIgg in 1988. It attempts to measure verbal and non – verbal memories from the neurological perspective; very short term, short term and long term memories on the basis of empirical evidences and remote, recent and immediate memories to facilitate clinical practice of evaluation of memory. PGI Memory scale was found to share a significant positive correlation with both Boston Memory Scale and Wechsler memory scale. Its test – retest Reliability over a period of 1 week and Split-Half reliability indicated significant positive correlations for both ten subtests and for the total test respectively.

Clock Drawing Test

The Clock Drawing Test (CDT) is a simple and ecological neuropsychological instrument that is used to assess visuospatial abilities and praxis. In order to correctly draw a clock, patients have to follow directions, comprehend language, visualize the proper orientation of an object, and execute normal movements along with having proper numerical knowledge. The inter-rater reliabilities of the CDT were determined in elderly people in Brazil by scoring their CDT Performance using Shulman and Sunderland methods of scoring CDT. Out of these, one scored the tests using Shulman's method, while the others compared the accuracy of Shulman and Sunderland scoring system and determined the inter-rater reliability of CDT performance. Good inter-rater reliabilities were reported from the findings. The Shulman score had the highest correlation with the MMSE scores of elderly population from Brazil. The Shulman Method also significantly correlated with and Sunderland methods of scoring the CDT performances.

Stroop Color and Word Test

The Stroop Color and Word Test (SCWT) is a neuropsychological test extensively used to assess executive dysfunctions with a special focus on response inhibition and shift in response set. It was developed by Golden and Freshwater in the year 2012. Stroop Effect is a phenomenon that was described by Stroop, after whom the test is named in the year 1935. It refers to the ability to inhibit cognitive interference arising from the processing the characteristic of a specific stimulus which impedes and competes with the simultaneous processing of that of a second stimulus. Golden (1975) reported that the Stroop Scores were found to be highly reliable and consistent when the test was administered both at the individual and group level.

Nahor Benson Test

It is a sub test included in the PGI Battery of Brain Dysfunction (PGI-BBD)(Persad and Verma, 1978) developed by Nahor and Benson in 1970. There are 8

card in this test, Five cards contain a design that each that the participant is required to copy. The remaining three cards contain instructions to be followed. In those three cards, subjects are required to draw shapes of objects .According to Pershad and Verma, (1978) participants diagnosed with having brain dysfunction reproduced and made more incorrect drawings when compared to their matched healthy counterparts. These findings implicate the clinical utility of this test in the context of neurocognitive measures.

General Health Questionnaire – 28

Developed by Goldberg and Hillier in 1979, the GHQ-28 is mainly used as a screening tool to detect people who are likely to have or to be at the risk of developing psychiatric disorders in the 4 domains namely Anxiety, Depression, Insomnia and Somatic Complaints. It consists of 28 items, scored on a 4-point rating scale. It is an easy and convenient way to measure emotional distress in medical settings. From the psychometric point of view, Test – retest reliability has been reported to be high (0.78 – 0.9) with significant Inter – rater and Intra – rater reliability (Cronbach's α = 0.9 – 0.95). High internal consistency of the items in GHQ-28 has also been reported.

Positive and Negative Syndrome Scale

The PANSS was developed by Stanley Kay, Lewis Opler and Abraham Fiszbein in the year 1987. It serves to be a valid instrument for screening and assessing the severity of schizophrenia symptoms As far as the psychometric properties of PANSS is concerned, Kay, 1990; Kay et al 1987, 1988 have reported significant Test – retest Reliability for the total score and the 3 subscales of PANSS.

RESULTS AND DISCUSSION

Result Table 1: Showing Pearson's Product Moment Coefficient of Correlation of Memory Functioning and Response Inhibition with respect to Visual – Motor Functioning, Visuo – Constructional Ability and Perceptual Acuity within Normal Control Group

Varia-bles	Remote Memory	Recent Memory	MB	AC	DR	IR	RSP	RDP	VR	R	Stroop Test
BGT	-0.235	-0.316	-0.32	-0.29	0.555*	-0.05	a	-0.18	0.166	-0.216	-0.066
CDT	-0.304	-0.195	0.222	0.315	0.456*	0.151	a	0.106	0.269	0.373	-0.309
NB	a	a	a	a	a	a	a	a	a	a	a

*Correlation is significant at the 0.05 level (2 – tailed)
a. At least one of the variables being constant, Correlation could not be computed

The correlational matrix shows that there is a significant positive correlation between Visual-Motor Functioning and Visuo-Constructional Ability with Delayed Recall (p<0.05 level) within Normal Control Group. Positive correlation was found between Visual-Motor Functioning and Visual Retention, Visuo-

Constructional Ability with Mental Balance and Attention and Concentration, Immediate Recall, Retention of Dissimilar Pair, Visual Retention and Recognition. Visual-Motor Functioning was found to negatively correlate with Remote Memory, Recent Memory, Mental Balance, Attention and Concentration, Immediate Recall, Retention of Dissimilar Pair, Recognition and Response Inhibition. Visuo-Constructional Ability was found to negatively correlate with Remote Memory, Recent Memory and Response Inhibition

There is evidence to support that visuo-motor adaptation is a cognitively demanding task (Eversheim and Bock, 2001; Taylor and Bond, 2015).One cognitive process that may play a role in visuo-motor adaptation is Spatial Working Memory. The computed values of correlation between Visuo-Constructional Ability and Delayed Recall domain of Memory Functioning was found out to be 0.456, indicating a significant positive correlation between Visuo-Constructional Ability and Delayed Recall domain of Memory Functioning at 0.05 level of significance. Three important components of visuospatial construction have been identified by cognitive psychologists, namely spatial working memory, flexibility in the use of spatial reference systems and object organization. These components are crucial for defining spatial properties and flexibility and organization of objects and configurations. All these component abilities are likely to be important for performing adequately on pattern-construction tasks**. (**Just and Carpenter, 1985; Pani et al, 1994, 1999)

Fig 1(a): Graph Showing Correlation of Variables within Normal Control Group

Graphical Representation of Pearson's Product Moment Coefficient of Correlation of Memory Functioning and Response Inhibition with respect to Visual- Motor Functioning and Visuo – Constructional Ability within Normal Control Group
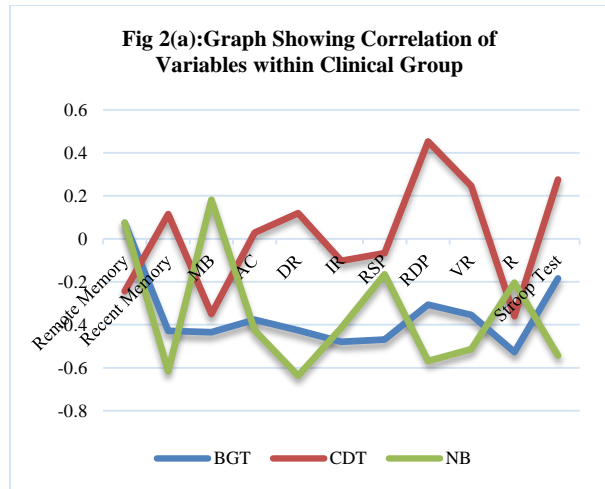
Result Table 2: Showing Pearson's Product Moment Coefficient of Correlation of Memory Functioning and Response Inhibition with respect to Visual – Motor Functioning, Visuo – Constructional Ability and Perceptual Acuity within Clinical Group

Varia-bles	Remote Memory	Recent Memory	MB	AC	DR	IR	RSP	RDP	VR	R	Stroop Test
BGT	0.074	-0.428	-0.434	-0.377	-0.425	-0.479	-0.469	-0.307	-0.254	-0.527	-0.185
CDT	-0.244	0.115	-0.35	0.028	0.119	-0.102	-0.066	0.453	0.246	-0.36	0.275
NB	0.074	-0.616	0.182	-0.425	-0.637*	0.414	-0.165	-0.569	-0.513	-0.204	-0.543

*Correlation is significant at the 0.05 level (2 - tailed)

The correlational matrix shows that there is a significant negative correlation between Perceptual Acuity and Delayed Recall (p<0.05 level) within Clinical Group. Visual-Motor Functioning was found to positively correlate with and Remote Memory. Similarly, Visuo-Constructional Ability positively correlated with Recent Memory, Attention and Concentration, Delayed Recall, Retention of Dissimilar Pair, Visual Retention and Response Inhibition. Positive correlation was also found between Perceptual Acuity and Remote Memory, Mental Balance, Immediate Recall. However there was negative correlation between Visual-Motor Functioning, Recent Memory, Mental Balance, Attention and Concentration, Delayed Recall, Immediate Recall, Retention of Similar Pair, Retention of Dissimilar Pair, Visual Retention, Recognition and Response Inhibition. Visuo-Constructional Ability was found to negatively correlate with Remote Memory, Mental Balance, Immediate Recall, Retention of Similar Pair, and Recognition. Perceptual Acuity was found to negatively correlate with Recent Memory, Attention and Concentration, Retention of Similar Pair, Retention of Dissimilar Pair, Visual Retention, Recognition and Response Inhibition.

After analyzing the results, significant negative correlation was found to exist between Perceptual Acuity and Delayed Recall (r=-0.637) at 0.05 level of significance. Performance on tasks pertaining to object and spatial visual perceptual discrimination was more impaired for the clinical population in comparison to that of the Normal Control. The posterior brain areas that mediate visual-perceptual processing and the Pre-Frontal areas involved in the active maintenance of information during delay intervals are compromised in Schizophrenia, as implicated by findings.

Fig 2(a):Graph Showing Correlation of Variables within Clinical Group

Graphical Representation of Pearson's Product Moment Coefficient of Correlation of Memory Functioning and Response Inhibition with respect to Visual-Motor Functioning, Visuo – Constructional Ability and Perceptual Acuity within Clinical Group

CONCLUSION

Significant association of neurocognitive deficits in visual-motor functioning, memory functioning, executive functioning, visual-constructional abilities and perceptual functioning were found in persons with Schizophrenia after conducting the present study. As far as the present study was concerned, the schizophrenics who were in Partial Remission Phase exhibited greater deviations in the dimensions assessed in the current study.

Certain limitations such as limited sample size, gender differences, and limited age range of participants could not be completely overruled. A formal Neuropsychological assessment in individuals with psychosis is recommended to determine the level of severity of functional impairment.

Cognitive deficits may serve as identifiers and early predictors for individuals who are at risk for the disease. They can help in monitoring the clinical course of the illness, and in determining the prognosis of the disease. The cognitive deficits worsen the functional status of the individuals more directly than their psychotic symptoms. Therefore Clinical Psychologists and Neuropsychologists should work together to improve the cognitive functioning. Better quality of life of patients, less dependence on psychiatric care and fewer hospital admissions can be achieved (Wykes et al 1999). Cognitive Remediation Therapy should be introduced in this context.

Future work should be focused on a larger sample size. Gender differences should be explored. Cognitive impairments in other types of psychotic disorders like

Mood Disorders (Major Depression, Bipolar Disorders) should be explored and compared with that in Schizophrenia. How Cognitive deficits compromise Planning, goal-directed behavior and Insight in Schizophrenia, should be researched upon. Finally the effect of cognitive dysfunction on social functioning and social skill acquisition also needs to be explored. The area of Cognitive Remediation Therapy is required to be explored more. The benefits of it should be made customizable and equitable to the specific needs of patients with cognitive dysfunctions.

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REFERENCES

www.cadabams.org:www.cadabams.org/treatment/schizophrenia

library.neura.edu.au:https://library.neura.edu.au/schizophrenia/illness-course-and-outcomes/remission-and-recovery

courses.lumenlearning.com:https://courses.lumenlearning.com/wsu-sandbox/chapter/how-memory-functions

www.advancedpsy.com:https://www.advancedpsy.com/documenation/visuoconstruction-abilities

en.wikipedia.org:https://en.m.wikipedia.org/wiki/Bender-Gestalt_Test

prezi.com:https://prezi.com/6uwtu_ejphol/pgi-memory-scale/

www.verywellhealth.com:https://www.verywellhealth.com/the-clock-drawing-test-98619

en.wikipedia.org:https://en.m.wikipedia.org/wiki/Positive_and_Negative_Syndrome_Scale

BOOK REFERENCES

(2000).*Diagonistic and Statistical Manual of Mental Disorders, Fourth Edition (IV Text Revision)* (pp. 303 - 306, 313 - 314). Washington DC: American Psychiatry Association.

(2004).M. K. S, *Current Developments in Schizophrenia* (pp. 312-320,324-329). New Delhi: Allied Publishers Pvt.Limited.

(2013).*Diagonistic and Statistical Manual of Mental Disorders, DSM 5* (pp. 87 - 88, 99 - 103, 104). Virginia: American Psychiatry Association Publishing.

(2014) J. M. Butcher James N., *Abnormal Psychology Sixteenth Edition* (pp. 416 - 417, 420, 432 - 433). Pearson India Educational Services Pvt. Ltd.

JOURNAL REFERENCES

Antonova E, Sharma T, Morris R,Kumari V. (2004 October). The Relationship between Brain Structure and Neurocognition in Schizophrrenia: A Selective Review. *Schizophrenia Research, Volume 70, Issue 2 - 3* , 117 - 145.

APA Guideline for Treating Adults with Schizophrenia. (1997). *Mental Health Medscape Psychiatry and Amp:2(3)* .

Brazo P, Marie R.M., Halbecq I, Benali K, Segard L, Delamillieure, Langlois- Thery S, Van Der Elst A, Thibaut F, Petit M, Dollfus S. (2002 May). Cognitive Patterns in Subtypes of Schizophrenia. *European Psychiatry 17(3)* , 155 - 162.

Bock O and Eversheim.U (2001). Evidence for Processing Stages in Skill Acquisition: A Dual-Task Study. *Learning and memory (Cold Spring Harbor, N.Y.), 8* (4), 183-9.

Bozikas VP, Kosmidis MH, Gamvrula K, Hatzigeorgiadou M, Kourtis A, Karavatos A. (2004 Jan 1). Clock Drawing Test in patients with Schizophrenia. *Psychiatry Res 121(3)* , 229 - 38.

Butler P D, Silverstein S M and Dakin S C (2008).Visual Perception and Its Impairment in Schizophrenia. *Biol Psychiatry, 64* (1), 40–47.

Cannon TD, Hennah W, van Erp TG, Thompson PM, Lonnqvist J, Huttunen M, Gasperoni T, Tuulio-Henriksson A, Pirkola T, Toga AW, Kaprio J, Mazziotta J, Peltonen L.(2005).Association of DISC1/TRAX haplotypes with schizophrenia, reduced prefrontal gray matterand impaired short- and long-term memory. *Arch Gen Psychiatry, 62* (11), 1205-13.

Cella M, Antonio.P, Edwards C, Dow T, Wykes T. (2017). Cognitive remediation for negative symptoms of schizophrenia:A network meta-analysis. *Clin Psychol Rev, 52*, 43-51.

Dalal, P.K.;Sivakumar,T(2010 Jan). Cognition and Schizophrenia. *Indian Journal of Psychiatry* .

Damasio, A. R. and Anderson, S.W.(1993). The Frontal lobes. *Clinical Neuropsychology* (pp. 409-460). Oxford University Press

Del Vecchio S and Gargiulo PA (1992,Dec) Visual and Motor functions in Schizophrenic patients. *Acta Psiquiatr Psicol Amlat*:*38(4),* 317-22.

DeLisi.E.L,Hoff L A, Kushner M and Degreef Gustav. (1993). Increased prevalence of cavum septum pellucidum in Schizophrenia. *Psychiatry Res, 50* (3), 193-9.

Forbes N F, Carrick L A, Mcntosh A M and Lawrie S M (2009). Working Memory in Schizophrenia: A Meta - analysis. *Psychological Medicine 39(6)* , 889 - 905.

Gargiulo P.A. (2003). Experimental Approaches to Perceptual Dysfunctionin Schizophrenia. *Rev Neurol; 37(6)* , 545 - 51.

Green M, Walker E. (1985, Nov). Neuropsychological Performance and Positive and Negative Symptoms in Schizophrenia. *Journal of Abnormal Psychology; 94(4)*, 460 - 9.

Grover S and Kulhara.P (2008 Jan - Mar). Deficit Schizophrenia: Concept and Validity. *Indian Journal of Psychiatry; 50(1)* , 61 - 66.

Goldberg E T and Green F M. (1995). Neurocognitive Functioning in Patients with Schizophrenia: An Overview. *Neuropsychopharmacology: The Fifth Generation of Progress*

Henik A,Salo R. (2004 March 1). Schizophrenia and the Stroop Effect. *Behavioral and Cognitive Neuroscience Reviews* .

Herrmann N, D. Kidron, Shulman Kl, Kaplan E, Binns M, Soni J, Leach L, Freedman M. (1999 Jan - Feb). The use of Clock Tests in Schizophrenia. *Gen Hosp Psychiatry; 21(1)* , 70 - 3.

Hoffman, S. D. (1966). The Bender Gestalt Test: A Cross - Cultural Test.

Ignatius A, Edward M (2016 June). A Study on Visuo - Motor Perceptual Dysfunction among Postive Schizophrenics and Negative Schizophrenics. *Indian Journal of Applied Research, Volume 6, Issue 6* .

Kalkstein S, Hurford I and Gur C Ruben (2010 Apr 21). Neurocognition in Schizophrenia. *Behavioral Neurobiology of Schizophrenia and its Treatment* , 373 - 390.

Krishnadas R,Moore B.P, Nayak A, Patel RR (2007 Jul 30). Relationship of Cognitive Function in patients with Schizophrenia in Remisson to disability: A Cross - Sectional Study in an Indian Sample. *Annals of Genaral Psychiatry; 6:19*.

Kulhara P, S.Ruchita and Aarya R K (2010 Jan). An Overview of Indian Research in Schizophrenia. *Indian Journal of Psychiatry ;52* , 159 - 172.

Mohamed S, Paulsen JS, O'Leary D, Arndt S, Andreasen N.(1995). Generalised Cognitive Deficits in Schizphrenia: A Study of First - Episide Patients. *Archives of General Psychiatry; 56(8)* , 749 - 754.

Pascal R.G and Suttell J Barbara (1951). The Bender Gestalt Test: Its Quantifications and Validity for Adults.

Silverstein.M. Steven and Keane P Brian (2000 May 25). Perceptual Organization, the Disorganization Syndrome and Context Processing in Chronic Schizophrenia. *Schizophrenic Research ;43(1)* , 11 - 20.

Squire, L. R. (1987). *Memory and Brain.* Oxford University Press.

Suddath RL, Christison GW, Torrey EF, Casanova MF, Weinberger DR (1990, March 22). Anatomical Abnormalities in the Brains of Monozygotic Twins Discordant for Schizophrenia. *The New England Journal of Medicine* .

Stuss DT, Levine B (2002). Adult Clinical Neuropsychology:Lessons from Studies of the Frontal Lobes. *Annual Review of Psychology,53* (1), 401-33.

Talreja.T.B, Shah.S and Kataria L (2013 Jan). Cognitive Functions in Schizophrenia and its Association with Socio - Demography Factors. *Indian Psychiatry Journal; 22(1)* , 47 - 53.

Taylor J A, and Bond K. M. (2015). Flexible explicit but rigid implicit learning in a visuomotor adaptation task. *113* (10), 3836–3849.

Tracy Joseph I., J.(1996 December 1). Clock Drawing in Schizophrenia. *Psychological Reports* .

Uhlhaas PJ, Mishara AL. (2007 Jan). Perceptual Anamolies in Schizophrenia: Integarting Phenomenology and Cognitive Neuroscience. *Schizophrenia Bulletin; 33(1)* , 142 156.

Venables P.H and Wing J.K.(1962, August 7). Level of arousal and the subclassification of schizophrenia. *Arch Gen Psychiatry* , 114-9.