Cognitive psychiatry in India

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ABSTRACT

Cognitive deficits have been shown to exist in various psychiatric disorders. Though most Indian studies pertaining to cognition have been replication studies, well designed original studies have also been conducted. This article traces the evolution of cognitive psychiatry in India. Cognitive research has huge potential in India and can help us unravel mysteries of the human mind, identify etiopathogenesis and facilitate treatment of psychiatric disorders.

Key words: Attention, bipolar disorder, brain injury, cognition, compulsive disorder, depression, executive function, memory, mini-mental status examination, obsessive compulsive disorder, Electroconvulsive therapy (ECT), psychotherapeutics, schizophrenia, substance abuse

INTRODUCTION

What is cognition?
Cognition is what enables humans to function in everyday life: Personal, social, and occupational. The ability to attend to things in a selective and focused way, to concentrate over a period of time, to learn new information and skills, to plan, determine strategies for actions and execute them, to comprehend language and use verbal skills for communication and self-expression, and to retain information and manipulate it to solve complex problems are examples of mental processes that are referred to as cognitive functions.

Cognitive deficits
Cognitive deficits may result in the inability to:

1. Pay attention
2. Process information quickly
3. Remember and recall information
4. Respond to information quickly
5. Think critically, plan, organize and solve problems
6. Initiate speech

Cognition and psychiatric disorders
Cognitive abilities have been shown to be impaired in patients with psychiatric disorders [Table 1].

Cognitive deficits contribute to poor functional outcome and therefore have been suggested as treatment targets in schizophrenia and possibly in other psychiatric disorders as well. They have also been shown to be possible endophenotypes.

METHODOLOGY

For this review, a web-based review of current and past issues of Indian journal of psychiatry was carried out with keywords cognition, cognitive, memory, attention, concentration, executive, neuropsychological, learning, amnesia etc. Publications in other journals were accessed

Table 1: Cognitive deficits seen in various psychiatric disorders

| Psychiatric disorder         | Areas in which cognitive deficits are seen                                                                 |
|------------------------------|-------------------------------------------------------------------------------------------------------------|
| Schizophrenia                | Working memory, verbal episodic memory, attention, executive function, old learning, vocabulary, visual perceptual skills |
| Mood disorders               | Attention, executive function, verbal memory, visuospatial, visuoconstructual, non verbal (encoding and retrieval), executive function |
| Obsessive compulsive disorder| Semantic memory, verbal episodic memory and visuospatial tasks                                              |
| Somatoform disorder          | Attention-vigilance, verbal learning, verbal memory, executive function                                    |
| Borderline personality disorder| Executive function, sustained attention, memory                                                             |
| ADHD                         | Attention, encoding new information, cognitive flexibility, problem solving                                |
| Substance abuse              |                                                                                                            |
Table 2: Studies on cognition in substance abuse

| Study                                      | Sample                                                                 | Tests for cognition                                                                 | Result                                                                                                                                 |
|--------------------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Agarwal et al., 1975[13]                   | 40 chronic Bhang users                                                 | Wechsler memory scale, Bhatia’s battery of intelligence test, Bender visuo-motor gestalt test | No memory disturbance in majority of cases IQ <90 in 25% of patients Cognitive disturbance in 20% patients on Bender-Gestalt test |
| VenkobaRao et al., 1975[36]                | 34 psychiatric patients with H/O ganja smoking >1 year                  | Attention span, The spiral after effect, Digit forward and digit backward, logical memory, Paired associate learning, visual reproduction, Recognition-photographs and weight discrimination | Improvement in paired associate learning and photograph recognition. The only deleterious effect observed was on the judgment of weights under the influence of ganja. |
| Mendhiratta et al., 1978[34]               | 25 Charas smokers, 25 Bhang drinkers, 25 controls                      | Bender Visual-Motor Gestalt Test, Maudsley Personality Inventory short form, and digit span tests from the WAIS | Compared with controls, cannabis users were found to react more slowly, to be poorer in concentration and time estimation, and greater perceptuo-motor disturbance. The charas smokers were the poorest performers and also showed poor memory, lowered psychomotor activity, and poor size estimation. |
| Sabhesan et al., 1990[37]                  | 11 alcohol dependent (DSM-III) head injured patients continuing to consume alcohol 11 alcohol dependent head injured patients abstaining from alcohol 11 non-alcoholic head injured patients | PGI memory scale                                                                     | Head injured persistent alcohol abusers were the poorest in performance and abstinence was followed by a welcome change |
| Narang et al., 1991[38]                    | 30 DSM III alcoholic patients                                          | P.G.I. battery of brain dysfunction                                                  | Significant relationship between cognitive impairment and duration of alcohol use                                      |
| Mendhiratta et al., 2006[39]               | Follow up study of Mendhiratta et al., 1978[28] after 9-10 years; 11 bhang users 19 charas smokers 15 controls could be followed up | Bender Visual-Motor Gestalt Test, Maudsley Personality Inventory short form, and digit span tests from the WAIS | Significant additional deterioration in case of the users on digit span, speed and accuracy tests, reaction time and Bender visuo-motor gestalt test as compared to controls |
| Saraswat et al., 2006[39]                  | 30 alcohol dependent patients 15 controls                              | Trail making test Stroop test                                                        | Patient group performed poorly in all the tests                                                                                       |
| Silva et al., 2007[41]                     | 25 high risk offspring of treatment seeking patients with alcohol dependence; 25 low risk offsprings of volunteers | Visual evoked response potential                                                     | Duration of abstinence over past one year correlated with performance on Stroop test                                                                 |
|                                            |                                                                        |                                                                                    | Strong association between lower P300 amplitudes over frontal brain areas and an excess of externalizing behavior in high risk offsprings |

through Google scholar and PUBMED search using the words India, cognition, cognitive, memory, attention, concentration, executive, neuropsychological, learning, amnesia etc in various combinations. Back references of articles were done and this yielded a few more articles. The topic of dementia has been left out as most of Indian studies have involved epidemiological aspects only. The studies have been presented in tabular form for the sake of convenience and ease in reading. “

Evolution of cognitive psychiatry in India

The first study relating to cognition in Indian Journal of Psychiatry was published in the year 1966 by Murthy et al.[2] on the effect of ECT on intelligence and memory in schizophrenic patients. This was followed up by studies on cognition in cannabis users and other populations.

Indian studies have generally been carried out in small number of subjects and tried to replicate research findings from the West; they have studied cognitive deficits in patients with common psychiatric disorders without involving less common entities. Of late, studies have included parents, siblings[3] and offsprings[4] of patients and revealed that they too suffer from cognitive deficits, which is in line with western research. There is a paucity of studies involving the pediatric population.[3] Although most Indian studies have been cross sectional studies, long term follow-up[6] studies have also been done by researchers. Recent studies have shown correlation between cognitive deficits and work functioning, rehabilitation.[7,8]

The type of cognitive tests administered has evolved from simple tests like MMSE to more sophisticated computer based tests. However, more sophisticated tests are available only in select centers in the country. Earlier studies used western tests like Wechsler memory scale, Luria Nebraska neuropsychological battery etc. Over the past few decades, Indian tests like PGI battery of brain dysfunction[6] and NIMHANS neuropsychological battery[10] to assess cognition have been developed and have been widely used in later studies. Indian norms of western tests have also been derived recently.[11,12] Recently, Trivedi et al. (personal communication) translated MATRICS-CCB in Hindi. This is likely to provide a standardized way of assessing cognition in Indian patients and pave the way for
Cases as well as their parents showed more cognitive performance than controls. Luria Nebraska neuropsychological tests for cognition executive functions assessment sample. Cognitive functioning had positive correlation with patients of mild cognitive impairment. Notable work has been done on the effect of various drugs in ECS related amnestic deficits in rats, which has helped to further our knowledge. However, there has been no significant work on the effect of commonly used psychotropic medications on cognition in psychiatric patients.
### Table 4: Studies on cognition in bipolar disorder

| Study              | Sample                                      | Tests for cognition                                                                 | Result                                                                 |
|--------------------|---------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Taj et al. 2005[49]| 30 bipolar disorder patients in remission 30 normal subjects | Digit symbol test, Trail making test part A and B, Verbal fluency test, Digit span forward and backward test, Logical memory test, Paired association learning test, Visual design reproduction test | Patients with bipolar disorder, in remission, have neuropsychological impairment in attention, memory and executive functioning |
| Trivedi et al. 2008[50]| 15 euthymic bipolar 1 patients 15 controls | Wisconsin’s Card Sorting Test, Spatial Working Memory Test, Continuous Performance Test | Euthymic bipolar patients showed significant deficits in executive functions. |
| Trivedi et al. 2008[51]| 10 first-degree apparently healthy relatives of patients with bipolar disorder 10 controls | Wisconsin’s Card Sorting Test, Spatial Working Memory Test, Continuous Performance Test | As compared to the control group, performance of the relatives on tests for executive functions and vigilance was significantly poorer. |
| Sareen et al. 2009[52]| 25 first degree non affected full biological siblings of bipolar affective disorder patients 25 controls | Wisconsin’s Card Sorting Test, Spatial Working Memory Test, Continuous Performance Test | The sibling group performed poorly on cognitive domains studied as compared to controls. Siblings from multiplex families performed poorly in some domains of executive function. |

### Table 5: Studies comparing cognition in schizophrenia and bipolar disorder

| Study              | Sample                                      | Tests for cognition                                                                 | Result                                                                 |
|--------------------|---------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Trivedi et al. 2006[53]| 15 stable maintained schizophrenia (DSM-IV) patients; 15 euthymic bipolar-1 (DSM-IV) patients; 15 controls | Wisconsin’s Card Sorting Test, Spatial Working Memory Test, Continuous Performance Test | Stable schizophrenia patients performed poorly on all the neurocognitive parameters as compared to both control and bipolar euthymic patients. When compared to controls, both bipolar disorder and schizophrenia patients were significantly impaired on different tests of executive function, memory, IQ and perceptuomotor functions. Schizophrenic patients consistently performed worse than bipolar disorder patients but the difference was not statistically significant. |
| Pradhan et al. 2008[54]| 48 euthymic bipolar (ICD-10) patients; 32 schizophrenia (ICD-10) patients in remission; 23 normal controls | Wisconsin’s Card Sorting Test (WCST), Trail making test-B, Controlled words association test, PGI memory scale, Bhatia battery of performance tests of intelligence-Short scale, Bender visual motor Gestalt test, Trail A test | |

### Table 6: Studies on cognition in depression

| Study              | Sample                                      | Tests for cognition                                                                 | Result                                                                 |
|--------------------|---------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Tandon et al. 2002[55]| 50 depressed (ICD-10) patients 30 controls | Wisconsin’s Card Sorting Test (WCST) | Depressed patients demonstrated poor performance on WCST. More severe illness was associated with greater impairment in executive functioning |

### Table 7: Studies on cognition in OCD

| Study              | Sample                                      | Tests for cognition                                                                 | Result                                                                 |
|--------------------|---------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Tarafder et al. 2006[56]| 20 OCD patients (DSM-IV-TR) 20 Controls | Wisconsin card sorting test, Embedded figure test | Impairment of executive functions in patients OCD patients perform significantly worse on cognitive measures than controls |
| Trivedi et al. 2008[57]| 30 OCD (DSM-IV) patients and 30 controls | Wisconsin’s Card Sorting Test, Spatial Working Memory Test, Continuous Performance Test | |

### Table 8: Studies on cognition in brain-injured patients

| Study              | Sample                                      | Tests for cognition                                                                 | Result                                                                 |
|--------------------|---------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Chatterjee et al. 1979[58]| 37 moderately severe head injury patients Followed up at 6 months and 1.5 years | Bender gestalt test, Wechsler memory scale, Progressive matrices | Statistically significant improvement in cognitive functions over time |
| Sabhesan et al. 1990[59]| 18 month follow up of 61 head injury patients | PGI memory scale | Patients with acceleration injuries showed a poor performance in comparison to those with contact injuries. Memory was found to be related to indices of severity of injury, particularly post traumatic amnesia (PTA). Head injured persistent alcohol abusers were the poorest in performance and abstinence was followed by a welcome change |
| Sabhesan et al. 1990[57]| 11 alcohol dependent (DSM-III) head injured patients continuing to consume alcohol, 11 alcohol dependent head injured patients abstaining from alcohol and 11 non-alcoholic head injured patients | PGI memory scale | |
Tests for cognition

**Table 9: Studies on cognition in other patients**

| Study                  | Sample                                                                 | Tests for cognition                                                                 | Result                                                                 |
|------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Hackett et al. 1998[63] | 26 children with epilepsy 4 controls                                   | Modified Osersky Test of motor incoordination, Raven’s Colored Progressive Matrices, Malayalam Vocabulary Test Malayalam, Graded Reading Test | Patients performed as well as controls on the non-verbal test, but performed worse on tests of vocabulary and reading, suggesting a specific disadvantage in the area of education |
| Edwin et al. 1999[62]  | 20 HIV seropositive symptomatic patients 20 HIV seropositive asymptomatic patients 20 HIV seronegative controls | Delayed response ability, differences and similarities test, ideational fluency, paired associate word learning test, logical memory, digit forward, digit backward, digit symbol substitution test, bender gestalt test, complex figure learning test, color cancellation test, paced auditory serial addition test, Koh’s block design test, trail making test-part A, Benton visual retention test | Broad spectrum of impairments occur n HIV seropositive patients; impairments of various functions occur at different phases of the illness |
| Mishra et al. 2002[63] | 30 epileptic patients 30 controls                                      | Luria Nebraska neuropsychological battery                                           | Performance level and pattern of epileptics were significantly different from normal controls on all the parameters. |
| Sahu et al. 2005[64]   | 30 women exposed to methylisocynate (MIC) in Bhopal gas disaster 30 control women | PGI battery of brain dysfunction                                                    | MIC exposed women had significant neurocognitive dysfunction in some specific areas as compared to control |
| Srinivasan et al. 2005[65] | 130 patients aged ≥60 years of age admitted for medical or surgical treatment | MMSE, Global rating of memory decline, Global rating of Intellectual decline       | Patients ≥70 years of age with acute medical problem are most likely to have cognitive problems |
| Pawar et al. 2006[66]  | 30 patients undergoing renal transplant                                 | Wechslser adult performance intelligence scale, Luria Nebraska neuropsychological battery | Successful renal transplant is associated with improvement in depression, IQ and life satisfaction |

**Table 10: Studies on cognition and ECT**

| Study                  | Sample                                                                 | Tests for cognition                                                                 | Result                                                                 |
|------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Murthy et al. 1966[7]  | 15 Schizophrenic patients on ECT                                       | Alexander scale of intelligence, Wechsler memory scale                              | No significant impairment of Intellectual efficacy and memory function due to ECT Improvement in the intelligence scores and a quick recovery after ECT course, of memory functions to their pre-ECT level, appear to be pre-conditions for a good prognosis on ECT in schizophrenics |
| Shah et al. 1974[17]   | 10 depressed patients on unilateral dominant and unilateral non-dominant ECT each | Wechsler memory scale                                                              | No significant difference in mean scores of memory scales in both unilateral dominant and non-dominant ECT |
| Kunigiri et al. 2007[14] | 15 right handed patients with major depressive patient with melancholic features | Orientation battery test, Trail making test-form A, Wechsler memory scale, Benton visual retention test | Disorientation more pronounced after 5th ECT Significant memory impairment following ECT |

**Table 11: Psychotherapeutic studies on cognition**

| Study                  | Sample                                                                 | Tests for cognition                                                                 | Result                                                                 |
|------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Singh et al. 1982[15]  | 30 manic depressive illness patients (Feighner criteria for primary affective disorder) on Lithium and 30 healthy controls | Bhatia’s battery of intelligence tests, Wechsler memory scale                        | No impairment in memory functioning in patients on Lithium |
| Andrade et al. 1998[18] | 22 patients of age related cognitive decline on memorin and 23 patients on placebo. Memorin is a herbal formulation derived from Mandookaparni, Jatamans, Yashtimadhu, Shankapushpi and Smruti Sagar; 3 months duration study | Complex passage test, complex figure, block design test, Digit symbol substitution test, Selective reminding test | In the Memorin group, on most tests significant improvement in performances were observed after treatment; improvement in many of the memory tasks was, however, confined to males |
| Nagaraja et al. 2001[14] | 19 patients of mild cognitive impairment on piribedil and 8 patients of mild cognitive impairment on placebo; 90 days study | MMSE                                                                                | Patients with mild cognitive impairment had improvement in global cognitive function when treated with the dopamine receptor agonist piribedil |
| Raghav et al. 2006[17] | 18 patients of age associated memory impairment on standardized Bacopa monniera extract (SBME) and 17 patients on placebo; 12 weeks study | Tests of Wechsler memory scale                                                     | SBME produced significant improvement on mental control, logical memory and paired associate learning |
| Jaykaran et al. 2009[17] | 31 patients with depression on fluoxetine; 1 month study             | PGI memory scale, six letter cancellation test                                       | Patients show significant improvement on cognitive functions |

[61] S132  
[62] Indian J Psychiatry 52, Supplement, January 2010
Research relating cognition to other biological research (like neuroimaging) to map neuroanatomical correlates has just begun.\cite{14} There has been no significant work in areas of social cognition, which has received much attention in the international forum.

The results of most Indian studies have been in accordance with western work with a few notable exceptions like negative correlation between cognition and work performance in Indian schizophrenic patients which was hypothesized to be due to social factors.\cite{8}

There has been a steady increase in the number of articles pertaining to cognition in Indian Journal of Psychiatry over the past decade. It is encouraging to note that work by Indian researchers has also been published in reputed international journals.\cite{6,19,24-26} There have been editorials on the subject in Indian Journal of Psychiatry.\cite{27} Marfatia award\cite{1,20} and DILN Murthy Rao orations\cite{1,20} have been delivered in ANCIPS for Indian research pertaining to cognition.

Indian tests to assess cognition

The validated Indian tests available in the field are

1. NIMHANS neuropsychological battery:\cite{10} Composed of tests taken from other standardized battery of tests, such as the Luria-Nebraska Neuropsychological battery.
2. PGI battery of memory dysfunction:\cite{9} Includes 10 subtests including forward and backward digit spans, one minute delayed recall of a word list, immediate recall of sentences, retention of similar word pairs, retention of dissimilar pairs, visual retention, visual recognition, recent memory, remote memory and mental balance test.
3. Hindi cognitive test battery of “The Indo-US cross national dementia epidemiology study”:\cite{28,29} Is based on the English language cognitive screening panel used by the MOVIES project. The MOVIES battery includes a brief global cognitive scale (general mental status), the mini-mental status examination (MMSE) and a set of other tests tapping several other cognitive domains.

NIMHANS neuropsychological battery has recently been validated for children.\cite{30}

Hindi MMSE\cite{28} was developed as part of the Indo-US cross-national dementia epidemiology study but has been shown to be different from MMSE.\cite{31}

Normative data for Wisconsin card sorting test (WCST) for the Indian population was reported recently.\cite{11} The study found highly significant differences between the means on almost all WCST scores among the western and Indian sample, except for the number of correct responses.

The scores of Trail making tests in Indian population have been shown to vary from published results from other cultural groups.\cite{12}

Indigenous methods\cite{32-34} have been developed by authors to assess cognition.

Cognition and substance abuse

The studies on cognition and substance abuse are reviewed in table 2.

COGNITION AND SCHIZOPHRENIA

The studies on cognition and schizophrenia are reviewed in table 3.

COGNITION AND BIPOLAR DISORDER

The studies on cognition and bipolar disorder are reviewed in tables 4 and 5. Khanna et al. (1991)\cite{48} described findings on Luria Nebraska neuropsychological battery in a 12-year-old boy with mania following encephalitis. The patient showed perseveration on rapid sequential hand movement, graphaesthesia items, extemporaneous speech and spontaneous writing. Attention problems and a tendency to answer impulsively and randomly was seen on spatial orientation items (Clock reading and Raven’s items), in counting numbers or days of week backwards and in memorizing a series of seven words. Interference procedures diminished his ability to remember. He had gross problems in arithmetic. Abstract reasoning was poor. Sequential thinking and planning skills were poor. After three months treatment with haloperidol, the patient showed some impairment in memory and intelligence though none of the clinical and summary scales were above the critical level.

COGNITION AND DEPRESSION

The studies on cognition and depression are reviewed in table 6.

COGNITION AND OCD

The studies on cognition and OCD are reviewed in table 7.

Cognition in brain injured patients

The studies on cognition in brain injured patients are reviewed in table 8. Sharma et al. (1981) first reported the clinical usefulness of Luria Neuropsychological Investigation...
Cognition in other patients

The studies on cognition in other patients, cognition and ECT, psychotherapeutic studies on cognition and cognitive experiments on animals are reviewed in tables 9, 10, 11 and 12 respectively.

In separate studies, Andrade et al. found that the herbal formulations, Mentat and Memorin effectively attenuated anterograde and retrograde amnestic effects of electroconvulsive shocks (ECS). An aqueous extract of Shankpushpi (Evolutionus alsinoide) conveyed no cognitive benefits to rats which received ECS. In similar experiments, Brahmi (Bacopa monniera) and mandookaparni (Centella asiatica) alone or in combination did not facilitate pe-ECS learning but attenuated ECS-induced anterograde and retrograde amnesia.[21]

In separate experiments, Andrade showed that Verapamil, Felodipine, sodium nitroprusside[22], phenylephrine,[19] mifepristone, indomethacin[69] and celecoxib attenuated ECS induced retrograde amnesia.[20] The theoretical explanations and possible implications have been discussed by Andrade in his DLN Murthy Rao oration.[20]

CONCLUSION

A commendable effort has been put in by Indian workers in the field of cognitive sciences despite dearth of psychiatric centers, research facilities and resources in India. Andrade cited lack of funds as the reason due to which translational research to examine safety and efficacy of herbal formulations in humans who are treated with ECT for psychiatric disorders could not be done.[20]

Given the many constraints that exist in our setup, sheer diligence and innovativeness at times has led to publication of studies with very sound methodology.

Cognitive research has huge potential in India and can help us unravel mysteries of the human mind, identify etiopathogenesis and facilitate treatment of psychiatric disorders. We require an earnest endeavor on the part of mental health professionals and greater support from Government agencies, International organizations, pharmaceutical companies and private foundations for further progress in this exciting field.

REFERENCES

1. Trivedi JK. D.L.N. MURTHY RAO ORATION. Cognitive deficits in Psychiatric disorders: current status. Indian J Psychiatry 2006;48:10-20.
2. Murthy HN. Effects of electro-convulsive treatment on memory and intelligence in schizophrenics. Indian J Psychiatry 1966;8:138-42.
3. Bhata T, Garg K, Pogue-Geile M, Nimgaonkar VL, Deshpande SN. Executive functions and cognitive deficits in schizophrenia: Comparisons between probands, parents and controls. India. J Postgrad Med 2009;55:3-7.
4. Silva MC, Benegal V, Devi M, Mukundan CR. Cognitive deficits in children of alcoholics:At risk before the first sip! Indian J Psychiatry 2007;49:182-8.
5. Malhotra S, Gupta N, Bhattacharya A, Kapoor M. Study of childhood onset Schizophrenia (COS) using SPECT and neuropsychological assessment. Indian J Psychiatry 2006;48:215-22.
6. Mendhiratta SS, Varma VK, Dang R, Malhotra AK, Das K, Nehra R. Cannabis and Cognitive Functions: A re-evaluation study. British J Addiction 1988;83:749-53.
7. Suresh Kumar PN. Impact of vocational rehabilitation on social functioning, cognitive functioning, and psychopathology in patients with chronic schizophrenia. Indian J Psychiatry 2008;50:257-61.
8. Srinivasan L, Tripathi S. Relationship Between Cognition and Work Functioning Among Patients with Schizophrenia in an Urban Area of India. Psychiatric Services. 2005;56:1423-8.
9. Pershad D, Verma SK. Handbook of PGI Battery of Brain Dysfunction (PGI-BBD). Agra: National Psychological Corporation, 1990.
10. Andrade C, Mukundan CR. NIMHANS Battery of Psychological Tests: test descriptions, instructions, clinical data and interpretation. s.l.: NIMHANS publications, Oct 1996. Proceedings of the National Workshop in Clinical Neuropsychology.
11. Kohli A, Kaur M. Wisconsin Card sorting test: Normative data and experience. Indian J Psychiatry 2006;48:181-4.
12. Bhata T, Shrirash V, Adhikara S, Bish V, Garg K, Deshpande SN. The trail making test in India. Indian J Psychiatry 2007;49:113-6.
13. Shah AV, Goswami U, Takrani LB. Memory changes and confusion in unilateral ECT. Indian J Psychiatry 1974;16:255-60.
14. Kunigiri G, Jayakumar PN, Janakiramnaiah N, Gangadhar BN, MRI T2 relaxation of brain regions and cognitive functioning following electroconvulsive therapy. Indian J Psychiatry 2007;49:195-9.
15. Singh RK, Sethi BB, Trivedi JK. Lithium and memory. Indian J Psychiatry 1982:24:15-21.
16. Andrade C, Gowda S, Chaturvedi SK. Treatment of age-related cognitive decline with a herbal formulation: a double-blind study. Indian J Psychiatry 1988;40:240-6.
17. Raghav S, Singh H, Dalal PK, Srivastava JS, Athana OP. Randomized controlled trial of standardized bacoapa monniera extract in age-associated memory impairment. Indian J Psychiatry 2006;48:238-42.
18. Nagaraja D, Jayashree S. Randomized Study of the Dopamine Receptor Agonist Piribedil in the Treatment of Mild Cognitive Impairment. Am J Psychiatry 2001;158:1517-9.
19. Anand A, Andrade C, Sudha C, Guido S, Venkataraman BV. Phenylyphrine and ECS-induced retrograde amnesia. J ECT 2001;17:166-9.
20. Andrade C, D.L.N. MURTHY RAO ORATION. Molecular mechanisms underlying electroconvulsive therapy-induced amnestic deficits: A decade of research. Indian J Psychiatry 2008;50:244-52.
21. Andrade C, Chandra JS. Anti-amenresic properties of Brahmi and mandookaparni in a rat model. Indian J Psychiatry 2008;48:232-7.
22. Sudha S, Andrade C, Anand A, Guido S, Venkataraman BV. Nitroprusside and ECS-induced retrograde amnesia. 2001, J ECT 2001;17:414-1.
23. Kamath S, Andrade C, Fanuqi S, Venkataraman BV, Naga Rani MA, Cандade VS, Evaluation of pre-ECS antihypertensive drug administration in the attenuation of ECS-induced amnesia in rats. Convulsive Ther 1997;13:185-95.
24. Mendhiratta SS, Wig NN, Verma SK. Some Psychological Correlates of Long-term Heavy cannabis users. British J Psychiatry 1978;132:482-6.
25. Andrade C, Singh NM, Thayagarajan S, Nagaraja N, Rao NS, Chandra JS. Possible glutamatergic and lipid signalling mechanisms in ECT-induced retrograde amnesia: Experimental evidence for involvement of COX-2 and review of literature. J Psychiatr Res 2008;42:837-50.
26. Nagaraja N, Andrade C, Sudha S, Singh NM, Chandra JS, Venkataranan BV. Glucocorticoid mechanisms may contribute to ECT-induced retrograde amnesia. Psychopharmacology (Berl) 2007;190:83-90.
27. Trivedi JK. EDITORIAL: Cognition and Depression. 2001, Indian J Psychiatry 2001;43:197-8.
28. Ganguli M, Ratcliffe G, Chandra V, Sharma S, Gilby JE, Pandav R, Bello S, Ryan CM, Baker CR, Seanger CR, DeCosky ST. A Hindi version of the MMSE: the development of a cognitive screening instrument for a largely illiterate rural elderly population in India. International Journal of Geriatric Psychiatry 1995;10:367-77.
29. Ganguli M, Chandra V and Gilby J.E. Cognitive test performance in
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50. Trivedi JK, Dhyani M, Sharma S, Sinha PK, Singh AP, Tandon R. Cognitive functions in euthymic state of bipolar disorder: An Indian study. Cognitive Neuropsychiatry 2008;13:135-47.
51. Trivedi JK, Goel D, Dhyani M, Sharma S, Sinha PK, Singh AP, Tandon R. Neurocognition in first-degree healthy relatives (siblings) of bipolar affective disorder patients. Psychiatry and Clinical Neurosciences 2008;62:190-6.
52. Sareen H, Trivedi JK, Dalal PK, Sinha PK, Dhyani M. Assessment of cognition in unaffected full biological siblings of patients with bipolar disorder. San Francisco: APA annual meeting, New research poster session, NR4-108, 2009.
53. Trivedi JK, Goel D, Sharma S, Singh AP, Sinha PK, Tandon R. Cognitive functions in stable schizophrenia and euthymic state of bipolar disorder. Indian J Med Res 2007;126:433-9.
54. Pradhan BK, Chakraborti S, Nehra R, Mankota A. Cognitive functions in bipolar affective disorder and schizophrenia: comparison. Psychiatry and Clinical Neurosciences 2008;62:515-25.
55. Tandon R, Singh AP, Sinha PK, Trivedi JK. Executive functions in depression: A clinical report. Indian J Psychiatry 2002;44:343-7.
56. Tandon R, Singh AP, Sinha PK, Trivedi JK. Executive functions in patients with obsessive-compulsive disorder. Indian J Psychiatry 2006;48:102-6.
57. Trivedi JK, Dhyani M, Goel D, Sharma S, Singh AP, Sinha PK, Tandon R. Neurocognitive dysfunction in patients with obsessive compulsive disorder: Aft J Psychiatry 2008;11:204-9.
58. Chatterjee SB, Kishore R. Psychiatric disability in brain trauma. Indian J Psychiatry 1979;21:127-32.
59. Sabhusesan S, Anumugham R, Natarajan M. Clinical indices of head injury and memory impairment. Indian J Psychiatry 1990;32:313-7.
60. Samuel R. Cognitive rehabilitation for reversible and progressive brain injury. Indian J Psychiatry 2008;50:282-4.
61. Hackett R, Hackett L, Bhakta P. Psychiatric disorder and cognitive function in children with epilepsy in Kerala, South India. Seizure 1998;7:321-4.
62. Edwin T, Nammalvar N, Sabhusesan S, Ganesh R, Devarajan H. Neurocognitive impairments in HIV infection. Indian J Psychiatry 1999;41:30-6.
63. Mishra BP, Mahajan R, Dhanuka A, Narang RL. Neuropsychological profile of epilepsy on Luria Nebraska neuropsychological battery. Indian J Psychiatry 2002;44:53-6.
64. Sahi RN, Naik GP, Dusad A. Agraval VK. Neuropsychological profile of epilepsy in women affected by the Bhopal gas disaster. Indian J Psychiatry 2005;47:51-3.
65. Srinivasan TN, Punitha RN. Cognitive decline in elderly medical and surgical inpatients. Indian J Psychiatry 2005;47:99-101.
66. Pawar AA, Rathod J, Chaudhury S, Saxena SK, Saldana D, Rlyai VSSR, Srivastava K. Cognitive and emotional effects of renal transplantation. Indian J Psychiatry 2006;48:21-6.
67. Jaykaran, Bhardwaj P, Kantharia ND, Yadav P, Panwar A. Effect of fluoxetine on some cognitive functions of patients of depression. Indian J Psychol Med 2009;31:24-9.
68. Sethi N, Dubes Singh HK. Effect of chronic administration of Lithium on memory functions in rats. Indian J Psychiatry 1983;25:102-6.
69. Rao NS, Andrade C, Reddy KPS, Madappa KN, Thyagarajan S, Chandra JS. Memory protective effect of indomethacin against electroconvulsive shock-induced retrograde amnesia in rats. Biol Psychiatry 2002;51:770-3.

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