Research Paper

Executive Functions in Bipolar Affective Disorder During Remission Phase of Mania

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ABSTRACT

Background: Executive function is one of the important part of cognitive abilities that regulate our decision making and problem solving process. Generally it waxes and wanes in concert with the clinical symptoms of bipolar disorder. Though, it is still unclear that improvement in executive functions simply legs behind normalization of mood. *Purpose:* Present study was conducted to expend the limited knowledge base regarding executive function in bipolar affective disorder (mania) to reveal the controversial issue in bipolar affective disorder so that a new dimension could be added while making a prognosis of the illness and a management plan. *Methods:* Executive function was assessed to 80 adult bipolar affective disorder patients with current episode of mania during remission phase equally included by gender. Only those patients were included fulfilling less than five years of illness and had two to three episodes. All they were assessed on Wisconsin Card Sorting Test and compared to normal control. *Result:* Findings suggested impairment in domains of executive function. 41.3% patients performed poorer to normal control. They significantly performed poorer in all dimension of WCST except in non-perseverative errors, percent non-perseverative errors and failure to maintain set variable. But when compared on different dysfunction categories patients group did not significantly differ to each other on variables non-perseverative errors, percent non-perseverative errors, conceptual level responses, percent conceptual level responses, and failure to maintain set. Further, age, sex and education were to be found significantly influencing the performance on some variables of WCST. *Conclusion:* Undoubtedly, ample number of patients of bipolar affective disorder with manic episode does not reach to optimum level of their executive abilities during normal or remission phase of the illness and need consideration while managing them.

Keywords: Decision Making, Cognition, Prognosis, Manic-Depressive Illness.

Cognition is a higher mental process by which we understand the world process information, make judgment and decisions, and communicate knowledge to others. Executive ability or function is one of the parts of our cognitive ability which is related to planning, choosing, strategies, set shifting and the enactment of these strategies.

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The term executive function describes a set of cognitive abilities that control and regulate other abilities and behaviours. Executive functions are necessary for goal directed behaviour. They include the ability to initiate and stop actions, to monitor and change behaviour as needed, and to plan future behaviour when faced with novel tasks and situations. Executive functions allow us to anticipate outcomes and adopt to changing situations. The ability to form concepts and think abstractly is often considered components of executive functions. (www.minddisorders.com/Del-Fi/Executive function.html)

Executive function deficits are associated with a number of psychiatric and developmental disorders, including obsessive-compulsive disorder, Tourette's syndrome, depression schizophrenia, attention-deficit/hyperactivity disorder, and autism.

A number of studies have reported the outcome for patients with bipolar disorder to be generally good, however, a subpopulation of between 5% - 34% have constantly been described as having poor social outcome or poor response to treatment (Carlson et al., 1974; Johnston et al., 1985; Harrow et al., 1990). It has been observed for many years that some individuals with manic-depressive illness (bipolar disorder) cannot think clearly. Though, it waxes and wanes in concert with the clinical symptoms of bipolar disorder. When present, it may account in part for the poor judgment and decision making that afflicts some patients with bipolar disorder.

The time course of impairment in executive function in bipolar disorder is not well studied. Certainly, some functions appear to tightly co-vary with clinical improvement, including measures of executive function and verbal fluency (McGrath et al., 1997). Some deficits have been shown to be more persistent though it is unclear if cognitive improvement simply legs behind normalization of mood.

Undoubtedly, to the wealth of empirical data pertaining to neuropsychological impairment in individual suffering from major depression, few researchers have investigated executive functioning in manic-depressive illness; converging evidence suggests that people with bipolar disorder exhibit persisting impairment in executive function during remission (Torrent et al., 2006; Kolur et al., 2006; Martinez-Aran et al., 2004). However, small sample size may be major limitation of such studies. Moreover it still remains unclear whether impairment in executive functions is stable and exists independently of clinical state.

Studies suggest that among the various neuropsychological tests measuring the executive function of bipolar patients more sensitive tests are Control Oral Word Association Test (FAS), Stroop Colour and Word Test, Wisconsin Card Sorting Test, Trial Making Test, Cambridge Neuropsychological Test Automated Battery, Hayling Sentence Completion Test, Tower of London, Intradimensional – Extradimensional Shift (ID-ED Shift), Rapid Visual Information Procession, and Iowa Gambling Task. Findings based on these tests suggested that patients perform significantly poorer than normal controls. However, the result found on the basis of few above mentioned neuropsychological test, differed and patients' performance during remission or euthymic phase of illness, was similar to normal controls' performance mainly on Controlled Oral Word Association Test, FAS – Verbal Fluency, (Cavanagh et al., 2002), Stroop Colour and Word Test, (Cavanagh et al., 2002), Tower of London (Clark et al., 2002), Iowa Gambling Task (Clark et al., 2002), Wisconsin Card Sorting Test (except correct responses, total errors and perseverative responses) (Mishra et al., 2002) and Trial Making Test – Part B (Thompson et al., 2005).

Moreover, there are some clinical factors that may influence executive function in bipolar patients such as the number of episodes especially of the manic type (Van Grop et al., 1998; Cavanagh et al., 2002), as well as chronicity, defined as the duration of the illness and the severity of the illness (Murphy et al., 2001).

The present study aims studying executive function in bipolar affective disorder (mania) because it is the most controversial issue now a days in bipolar affective disorder that might affect not only prognosis of the illness but patients' overall occupational or social functioning including its socio-demographic and clinical correlate with the illness.

MATERIALS AND METHODS

Sample

Using the purposive sampling technique 40 male and 40 female diagnosed on DCR of ICD – 10 patients of bipolar affective disorder with current episode of mania were selected from different wards and OPD of Ranchi Institute of Neuro-Psychiatry & Allied Sciences (RINPAS), Ranchi, Jharkhand. The clinical sample were restricted to less than five years of duration including two to three episodes of mania or mania & depression with after 18 years of age of onset of their illness. Such patients were excluded from the study having co-morbid psychiatric disorder, history of alcohol and substance abuse, family history of mental illness, significant head injury or other neurological problems, mental retardation or poor eye sight. Further, 80 normal controls including 40 male and 40 female were randomly selected matched on age, sex, education, handedness, marital and socioeconomic status. The age of all sample were in between 20 to 45 years.

Tools

In the present study to gather basic demographic and clinical information a self designed socio-demographic and clinic data sheet were used. Apart from this following screening tools and assessment for executive function tool were used.

> ***Sidedness Bias Schedule (Mandal et al., 1992)*** – To determine the handedness of the subjects, Hindi version of sidedness bias schedule was used.
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> ***Young Mania Rating Scale (Young et al., 1978)*** – This is well reliable and probably the most frequently worldwide utilized rating scale to assess core manic symptoms containing 11 items – elevated mood, increased motor activity-energy, sexual interest, sleep, irritability, speech (rate and account), language-thought disorder, content, disruptive-aggressive behaviour, appearance, and insight.
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> ***PGI-General Well Being Measure (Verma & Verma, 1989)*** – Based on USA developed general well being schedule the Hindi version of this scale contains 20 items to measure general well being. It is a well reliable on KR-20 formula and found to be 0.98 and valid as well. It was used to screen the well being of the normal controls.
>
> ***Wisconsin Card Sorting Test (WCST) (Heaton et al., 1993)*** – It is a clinical neuropsychological instrument originally developed by Grant and Berg (1948) to assess abstract reasoning ability, and ability to shift cognitive strategy in response to changing environmental contingencies. Similar to other measures of executive functioning WCST requires strategic, planning, organized searching, utilized environmental feedback to shift cognitive sets, directing behaviour towards achieving a goal and modulating impulsive responding. This test contains 4 stimulus cards and two identical decks of 64 response cards with figure of varying form, color, and number. First deck of response card is handed to the client with the instruction to match each consecutive card from the deck with one of the 4 stimulus cards. Once,

the client has made a specified number of consecutive correct matches, the sorting principles changed and WCST proceeds in this manner through a number of shifts in set. WCST not only provides objective score of overall success but also for specific sources of difficulty on the task, e.g. in efficient initial conceptualization, failure to maintain cognitive set, perseveration and inefficient learning across stages of the test. To make findings more comparable across studies Heaton and colleagues (1993) provided a standard method of administering and scoring WCST. Performance on neuropsychological tests is influenced by socio-demographic variables such as age, education and the test taking attitude of the population. For example, the Indian population has wide variations with reference to education and thence normative data collected elsewhere will be invalid in an Indian context. Moreover, although the field of neuropsychology, in the international context, has seen the development of many tests in the recent past, these tests cannot be used in our country without being modified. For the above two reason in the present study, Indian normative data (Rao et al., 2004) has been used, that has been established factorial and criterion validity.

Procedure
Out of 125 consecutive in-patients with BAD currently mania finally 80 were selected fulfilling the inclusion and exclusion criteria in the clinical group. They were interviewed and screened by screening tools along with semi-structured socio-demographic and clinical data sheet. Only right handed patients scoring <22 in YMRS were included in the study. For normal subjects, total 90 people were consulted. Those who otherwise fulfilled inclusion and exclusion criteria and scored below cut-off point on PGI-General well being scale were taken in the study. Finally Wisconsin Card Sorting Test (WCST) was administered to all subjects according to instruction given in the test manual. All data were analyzed by SPSS for windows (Ver. 10.0). Descriptive statistics has been used to describe the data. Discriminant analysis has been used to assess the classification rate. For group comparison t-test was used for interval scale and Chi-square was used for category scale data. To find out the correlation Pearson's r and contingency coefficient were used for continuous variable and category variable respectively.

RESULT

In the present study the socio-demographic characteristics of both groups show no significant difference in age (χ^2 = 3.998, df = 2), education (χ^2 = 5.77, df = 2), socio-economic status (χ^2 = 0.259, df = 2) and occupation level (χ^2 = 7.545, df = 3). Age range for most of the subjects in mania group was 18 – 25 years (52.5%) and 26 – 35 years (41.3%), and normal group was 53.8% and 31.3% respectively. Education level for most of the subjects was up to tenth standard e.g. 73.8% in mania and 57.5% in normal. Similarly, manic group (86.3%) and normal group (86.3%) were belongs to middle socio-economic status. However, both groups were significantly differ on marital status (χ^2 = 9.554, df = 3, p<0.05) and religion (χ^2 = 17.174, df = 3, p<0.05) variables. As far the characteristics of clinical variable was concerned of mania the age of onset of illness was ranged from 18 to 37 years (M = 23.72, SD = 5.24), total duration from 1st episode was 12 to 60 months (M = 37.35, SD = 16.14), duration of the present episode was 1 to 11 months (M = 2.66, SD = 1.68), number of episodes was 2 to 3 and total score on Young Mania Rating Scale was 3 to 21 (M = 11.08, SD = 4.53).

Stepwise Discriminant analysis shows a classification rate of 68.1% for Wisconsin Card Sorting Test (WCST) (Table 1). It also shows that 41.3% of mania patients performed within impaired range. Though, total variables entered for analysis most discriminating variables were present perseverative responses and number of trial administered.

Table – 1: Showing Discriminant analysis of WCST

		Predicted group membership		Classification rate
		Mania (%)	Normal (%)	
Original group membership	Mania	33 (41.3)	47 (58.8)	68.1%
	Normal	4 (5)	76 (95)	

The different variables of WCST shows (Table 2) that mania group took significantly more trials in comparison to normal group (p<0.01). Total number of correct response, conceptual level responses and percent conceptual level responses were found significantly higher in normal group comparison to mania group (p<0.001). Mania group have made significantly more total errors, percent errors, perseverative responses, percent perseverative responses, perseverative errors and percent perseverative errors comparison to normal group in the variable of WCST (p<0.001). Mania group completed significantly less categories than normal (p<0.001). Further, mania group took significantly more trials to complete first category comparison to normal (p<0.01). There were no significant difference found between both groups in non-perseverative errors, percent non-perseverative errors and failure to maintain set variable of WCST.

Table 2: Showing difference of different variables of mania and normal group on WCST

Variable	Group				t-value (df)
	Mania (N = 80)		Normal (N – 80)		
	Mean	SD	Mean	SD	
Number of Trial Administered	127.67	2.25	123.25	12.09	3.217**
Total Number Correct	67.66	12.27	76.77	10.74	4.998***
Total Number of Errors	59.88	12.89	46.45	15.35	5.994***
Percent Errors	46.90	9.89	36.98	10.89	6.024***
Perseverative Responses	44.55	18.11	27.13	11.73	7.216***
Percent Perseverative Responses	35.08	14.10	21.57	8.88	7.251***
Perseverative Errors	36.93	13.43	23.98	9.37	7.070***
Percent Perseverative Errors	28.83	10.44	18.88	6.73	7.164***
Non-Perseverative Errors	22.95	8.95	22.35	9.09	.420
Percent Non-Perseverative Errors	17.88	6.92	17.75	6.84	.126
Conceptual Level Responses	47.60	15.44	60.17	14.92	5.237***
Percent Conceptual Level Responses	37.30	12.45	49.68	15.09	5.662***
Number of Categories Completed	2.55	1.47	3.91	1.55	5.692***
Trials to Complete First Category	33.13	32.15	21.06	21.23	2.803**
Failure to Maintain Set	1.63	1.39	1.71	1.36	.344

* = P < .05   ** = P < .01   *** = P < .001

Further, comparison of dysfunction categories on different variables of WCST reveals (Table 3) that both groups significantly differ on many variables. For example number of trial administered, total number of errors, percent errors, and trials to complete first category significantly differ at p<.05 level; total number of correct response (p<.01); and perseverative response, perseverative errors, percent perseverative errors, number of categories completed significantly differ at p<.001 level. Table 3 also shows that both groups are not significantly differ to each other on variables non-perseverative errors, percent non-perseverative errors, conceptual level responses, percent conceptual level responses, and failure to maintain set. Percentage on different categorical variables also has been shown in table 3.

Table 3: Showing difference of different dysfunction categories and χ² (Chi-square) of mania and normal group on WCST

Variable	Group						Chi-square (df = 158)
	Mania (N=80)			Normal (N=80)			
	Aver. N (%)	Bord. N (%)	Imp. N (%)	Aver. N (%)	Bord. N (%)	Imp. N (%)	
Number of Trials Administered	69 (86.3)	11 (13.8)	0 (0)	58 (72.5)	22 (27.5)	0 (0)	4.619*
Total Number Correct	61 (76.3)	10 (12.5)	9 (11.3)	75 (93.8)	3 (3.8)	2 (2.5)	9.665**
Total Number of Errors	52 (65.0)	23 (28.8)	5 (6.3)	67 (83.8)	10 (12.5)	3 (3.8)	7.512*
Percent Errors	53 (66.3)	21 (26.3)	6 (7.5)	68 (85.0)	9 (11.3)	3 (3.8)	7.660*
Perseverative Responses	45 (56.3)	16 (20.0)	19 (23.8)	64 (80.0)	14 (17.5)	2 (2.5)	17.207***
Percent Perseverative Responses	45 (56.3)	17 (21.3)	18 (22.5)	69 (86.3)	9 (11.3)	2 (2.5)	20.314***
Perseverative Errors	47 (58.8)	17 (21.3)	16 (20.0)	65 (81.3)	15 (18.8)	0 (0)	19.018***
Percent Perseverative Errors	44 (55.0)	13 (16.3)	23 (28.8)	67 (83.8)	8 (10.0)	5 (6.3)	17.528***
Non-Perseverative Errors	70 (87.5)	6 (7.5)	4 (5.0)	66 (82.5)	10 (12.5)	4 (5.0)	1.118
Percent Non-Perseverative Errors	70 (87.5)	6 (7.5)	4 (5.0)	67 (83.8)	9 (11.3)	4 (5.0)	.666
Conceptual Level Responses	59 (73.8)	13 (16.3)	8 (10.0)	70 (87.5)	8 (10.0)	2 (2.5)	5.728
Percent Conceptual Level Responses	57 (71.3)	15 (18.8)	8 (10.0)	66 (82.5)	11 (13.8)	3 (3.8)	3.547
Number of Categories Completed	50 (62.5)	20 (25.0)	10 (12.5)	69 (86.3)	4 (5.0)	7 (8.8)	14.230***
Trials to Complete First Category	51 (63.8)	6 (7.5)	23 (28.8)	63 (78.8)	8 (10.0)	9 (11.3)	7.674*
Failure to Maintain Set	57 (71.3)	18 (22.5)	5 (6.3)	58 (72.5)	13 (16.3)	9 (11.3)	1.958

* = P < .05; ** = P < .01; *** = P < .001; Aver. = Average; Bord. = Borderline; Imp.=Impaired

We also try to find out the relation between different variables of WCST and age (table 4), sex (table 5) and education (table 6). In which age was to be found significantly correlated with number of trials administered, total number of correct and conceptual level of responses at p < 0.05 level. Hence, total number of correct, total number of errors, percent errors, perseverative responses, percent perseverative responses, perseverative errors, percent perseverative errors, conceptual level responses, percent conceptual level responses, number of categories completed and failure to maintain set were positively correlated with sex. Similarly, number of trials administered, total number of errors, percent errors, perseverative errors, percent perseverative errors, non-perseverative errors, percent non-perseverative errors and percent conceptual level responses were positively correlated with education. These findings suggest that age, sex and education significantly influences the performance on these variables.

Table 4: Showing relationship between age and different variable of WCST

Variable	N = 160									Contingency Coefficient
	Age									
	18-25			26-35			36-44			
	Av. N (%)	Bord. N (%)	Imp. N (%)	Av. N (%)	Bord. N (%)	Imp. N (%)	Av. N (%)	Bord. N (%)	Imp. N (%)	
Number of Trials Administered	62 (72.9)	23 (27.1)	0 (0.0)	48 (82.8)	10 (17.2)	0 (0.0)	17 (100)	0 (0.0)	0 (0.0)	.204*
Total Number Correct	70 (82.4)	11 (12.9)	4 (4.7)	49 (64.5)	2 (3.4)	7 (12.1)	17 (100)	0 (0.0)	0 (0.0)	.242*
Total Number of Errors	59 (69.4)	22 (25.9)	4 (4.7)	44 (75.9)	10 (17.2)	4 (6.9)	16 (94.1)	1 (5.9)	0 (0.0)	.186
Percent Errors	61 (71.8)	20 (23.5)	4 (4.7)	44 (75.9)	9 (15.5)	5 (8.6)	16 (94.1)	1 (5.9)	0 (0.0)	.187
Perseverative Responses	51 (60.0)	20 (23.5)	14 (16.5)	43 (74.1)	9 (15.5)	6 (10.3)	15 (88.2)	1 (5.9)	1 (5.9)	.201
Percent Perseverative Responses	55 (64.7)	17 (20.0)	13 (15.3)	44 (75.9)	8 (13.8)	6 (10.3)	15 (88.2)	1 (5.9)	1 (5.9)	.170
Perseverative Errors	54 (63.5)	20 (23.5)	11 (12.9)	43 (74.1)	10 (17.2)	5 (8.6)	15 (88.2)	2 (11.8)	0 (0.0)	.180
Percent Perseverative Errors	55 (64.7)	10 (11.8)	20 (23.5)	41 (70.7)	9 (15.5)	8 (13.8)	15 (88.2)	2 (11.8)	0 (0.0)	.201
Non-Perseverative Errors	71 (83.5)	11 (12.9)	3 (3.5)	49 (84.5)	5 (8.8)	4 (6.9)	16 (94.1)	0 (0.0)	1 (5.9)	.147
Percent Non-Perseverative Errors	72 (84.7)	10 (11.8)	3 (3.5)	49 (84.5)	5 (8.8)	4 (6.9)	16 (94.1)	0 (0.0)	1 (5.9)	.138
Conceptual Level Responses	64 (75.3)	17 (20.0)	4 (4.7)	48 (82.8)	4 (8.3)	6 (10.3)	17 (100)	0 (0.0)	0 (0.0)	.254*
Percent Conceptual Level Responses	61 (71.8)	19 (22.4)	5 (5.8)	43 (74.1)	7 (12.1)	8 (13.8)	17 (100)	0 (0.0)	0 (0.0)	.232
Number of Categories Completed	61 (71.8)	15 (17.6)	9 (10.6)	42 (72.4)	8 (13.8)	8 (13.8)	16 (94.1)	1 (5.9)	0 (0.0)	.170
Trials to Complete First Category	61 (71.8)	9 (10.6)	15 (17.6)	44 (75.9)	3 (5.2)	11 (18.9)	9 (52.9)	2 (11.8)	6 (35.3)	.167
Failure to Maintain Set	60 (70.6)	16 (18.8)	9 (10.6)	43 (74.1)	11 (18.0)	4 (6.9)	12 (70.6)	4 (23.5)	1 95.9)	.077

* = p<0.05; Av. = Average; Bord. = Borderline; Imp. = Impaired

Table 5: Showing relationship between sex and different variable of WCST

Variable	N = 160						Contingency Coefficient
	Sex						
	Male			Female			
	Av. N (%)	Bord. N (%)	Imp. N (%)	Av. N (%)	Bord. N (%)	Imp. N (%)	
Number of Trials Administered	60 (75.0)	20 (25.0)	0 (0.0)	67 (83.8)	13 (16.3)	0 (0.0)	.108
Total Number Correct	58 (72.5)	12 (15.0)	10 (12.5)	78 (97.5)	1 (1.3)	1 (1.3)	.330***

Variable	N = 160						Contingency Coefficient
	Sex						
	Male			Female			
	Av. N (%)	Bord. N (%)	Imp. N (%)	Av. N (%)	Bord. N (%)	Imp. N (%)	
Total Number of Errors	49 (61.3)	25 (31.3)	6 (7.5)	70 (87.5)	8 (10.0)	2 (2.5)	.288***
Percent Errors	50 (62.5)	23 (28.8)	7 (8.8)	71 (88.8)	7 (8.8)	2 (2.5)	.292***
Perseverative Responses	43 (53.8)	19 (23.8)	18 (22.5)	66 (82.5)	11 (13.8)	3 (3.8)	.316***
Percent Perseverative Responses	48 (60.0)	15 (18.8)	17 (21.3)	66 (82.5)	11 (13.8)	3 (3.8)	.277***
Perseverative Errors	44 (55.0)	22 (27.5)	14 (17.5)	68 (85.0)	10 (12.5)	2 (2.5)	.323***
Percent Perseverative Errors	41 (51.3)	12 (15.0)	27 (33.8)	70 (87.5)	9 (11.3)	1 (1.3)	.408***
Non-Perseverative Errors	67 (83.8)	10 (12.5)	3 (3.7)	69 (86.3)	6 (7.5)	5 (6.2)	.097
Percent Non-Perseverative Errors	68 (85.0)	9 (11.3)	3 (3.7)	69 (86.3)	6 (7.5)	5 (6.2)	.083
Conceptual Level Responses	55 (68.8)	17 (21.3)	8 (10.0)	74 (92.5)	4 (5.0)	2 (2.5)	.288***
Percent Conceptual Level Responses	53 (66.2)	19 (23.8)	8 (10.0)	70 (87.5)	7 (8.8)	3 (3.8)	.244**
Number of Categories Completed	47 (58.8)	20 (25.0)	13 (16.2)	72 (90.0)	4 (5.0)	4 (5.0)	.338***
Trials to Complete First Category	55 (68.8)	7 (8.8)	18 (22.5)	59 (73.6)	7 (8.8)	14 (17.5)	.063
Failure to Maintain Set	59 (73.6)	10 (12.5)	11 (13.8)	56 (70.0)	21 (26.3)	3 (3.8)	.225**

*** = p<0.001; ** = p<0.01; * = p<0.05; Av. = Average; Bord. = Borderline; Imp. = Impaired

Table 6: Showing relationship between education and different variable of WCST

Variable	N = 160									Contingency Coefficient
	Education									
	Upto 10th			High. Scec.			Above			
	Av. N (%)	Bord. N (%)	Imp. N (%)	Av. N (%)	Bord. N (%)	Imp. N (%)	Av. N (%)	Bord. N (%)	Imp. N (%)	
Number of Trials Administered	105 (100)	0 (0.0)	0 (0.0)	4 (26.7)	11 (73.3)	0 (0.0)	18 (45.0)	22 (55.0)	0 (0.0)	.581***
Total Number Correct	88 (83.8)	8 (7.6)	9 (8.6)	13 (86.7)	2 (13.3)	0 (0.0)	35 (87.5)	3 (7.5)	2 (5.0)	.119
Total Number of Errors	87 (82.9)	13 (12.4)	5 (4.8)	4 (26.7)	10 (66.7)	1 (6.7)	28 (70.0)	10 (25.0)	2 (5.0)	.368***
Percent Errors	87 (82.9)	12 (11.4)	6 (5.7)	6 (40.0)	8 (53.3)	1 (6.7)	28 (70.0)	10 (25.0)	2 (5.0)	.309**
Perseverative Responses	74 (70.5)	17 (16.2)	14 (13.3)	7 (46.7)	6 (40.0)	2 (13.3)	28 (70.0)	7 (17.5)	5 (12.5)	.177
Percent Perseverative Responses	77 (73.3)	14 (13.3)	14 (13.3)	7 (46.7)	6 (40.0)	2 (13.3)	30 (75.0)	6 (15.0)	4 (10.0)	.211

Variable	N = 160									Contingency Coefficient
	Education									
	Upto 10th			High. Scec.			Above			
	Av. N (%)	Bord. N (%)	Imp. N (%)	Av. N (%)	Bord. N (%)	Imp. N (%)	Av. N (%)	Bord. N (%)	Imp. N (%)	
Perseverative Errors	77 (73.3)	14 (13.3)	14 (13.3)	6 (40.0)	9 (60.0)	0 (0.0)	29 (72.5)	9 (22.5)	2 (5.0)	.335***
Percent Perseverative Errors	73 (69.5)	7 (6.7)	25 (23.8)	7 (46.7)	8 (53.3)	0 (0.0)	31 (77.5)	6 (15.0)	3 (7.5)	.401***
Non-Perseverative Errors	97 (92.4)	5 (4.8)	3 (2.9)	6 (40.0)	7 (46.7)	2 (13.3)	33 (82.5)	4 (10.00)	3 (7.5)	.402***
Percent Non-Perseverative Errors	97 (92.4)	5 (4.8)	3 (2.9)	7 (46.7)	6 (40.0)	2 (13.3)	33 (82.5)	4 (10.0)	3 (7.5)	.363***
Conceptual Level Responses	86 (81.9)	12 (11.4)	7 (6.7)	10 (66.7)	4 (26.7)	1 (6.7)	33 (82.5)	5 (12.5)	2 (5.0)	.1333
Percent Conceptual Level Responses	86 (81.9)	12 (11.4)	7 (6.7)	7 (46.7)	6 (40.0)	2 (13.3)	30 (75.0)	8 (20.0)	2 (5.0)	.248*
Number of Categories Completed	81 (77.1)	13 (12.4)	11 (10.5)	7 (46.7)	5 (33.3)	3 (20.0)	31 (77.5)	6 (15.0)	3 (7.5)	.207
Trials to Complete First Category	70 (66.7)	10 (9.5)	25 (23.8)	11 (73.3)	0 (0.0)	4 (26.7)	33 (82.5)	4 (10.0)	3 (7.5)	.201
Failure to Maintain Set	79 (75.2)	18 (17.1)	8 (7.6)	8 (53.3)	5 (33.3)	2 (13.3)	28 (70.0)	8 (20.0)	4 (10.0)	.142

*** = p<0.001; ** = p<0.01; * = p<0.05; Av. = Average; Bord. = Borderline; Imp. = Impaired

However, there were no significant correlation to be found between clinical variables of bipolar affective disorder- mania patients and different variables of WCST except significant negative correlation between age of onset and number of trials administered (table 7)

Table 7: Showing relationship between clinical variables and variables of WCST of BAD-mania

Variables	N = 80			
	Episode	Age of onset (in year)	Total duration after 1st episode (in month)	Duration of the present episode (in month)
No. of Trials Administered	.042	-.265*	-.007	-.029
Total Number correct	.094	.089	.197	.081
Total Errors	-.074	-.120	-.181	-.078
Percent Errors	-.069	-.119	-.174	-.069
Perseverative Responses	-.130	-.178	-.121	-.089
Percent Perseverative Responses	-.108	-.176	-.092	-.081
Perseverative Errors	-.106	-.167	-.118	-.120
Percent Perseverative Errors	-.109	-.162	-.128	-.118
Non-Perseverative Errors	.053	.077	-.083	.067
Percent Non-Perseverative Errors	.054	.096	-.086	.068
Conceptual Level Responses	.086	.115	.198	.089

Variables	N = 80			
	Episode	Age of onset (in year)	Total duration after 1stepisode (in month)	Duration of the present episode (in month)
Percent Conceptual Level Responses	.099	.146	.199	.106
Number of Categories Completed	.153	.028	.150	.086
Trials to Complete First Category	-.128	.132	-.124	.111
Failure to Maintain Set	-.110	.059	.143	-.063

** = Correlation is significant at the 0.01 level (2-tailed); * = Correlation is significant at the 0.05 level (2-tailed)

DISCUSSION

Since, executive function is one of the most important parts of cognitive function so in the present study executive function was measured using WCST. WCST is one of the most acceptable neuropsychological tests, measuring executive function all over the world. Earlier studies frequently used this test to measure the executive function (Arduini et al, 2003; Alessandro et al., 2000; Martinez-Aran et al., 2002, 2004; Van Gorp et al., 1998 etc). In previous studies only few variables of WCST have been used, for example categories achieved (Van Gorp et al., 1998, Arduini et al., 2003; Martinez-Aran et al., 2004; Robinson et al., 2006), perseverative errors (Van Gorp et al., 1998; Arduini et al., 2003; Martinez-Aran et al., 2004; Robinson et al., 2006), unique errors (Arduini et al., 2003), total errors (Arduini et al., 2003) etc. In the present study all variables of WCST has been included. Indian norm has been followed to calculate WCST. Though, in the manual cut-off score has been given for different groups but, it includes only few variables of WCST i.e. number of correct responses, percentage of errors, percentage of perseverative responses, percentage of perseverative errors percentage of non-perseverative errors, percentage of conceptual level responses, number of categories completed, trials to complete category-1 and failure to maintain set. Since, all variables of WCST (number of trials administered, total number correct, total number of errors, percent errors, perseverative responses, percent perseverative responses, perseverative errors, percent perseverative errors, non-perseverative errors, percent non-perseverative errors, conceptual level responses, percent conceptual level responses, number of categories completed, trials to complete first category and failure to maintain set) has been included in this study so result were calculated from mean and SD of the given norm in the manual.

In the present study, result showed significant difference between patient group and normal control on most of the variables of WCST i.e. Number of Trials Administered, Total Number Correct, Total Number of Errors, Percent Errors, Perseverative Responses, Percent Perseverative Responses, Perseverative Errors, Percent Perseverative Errors, Conceptual Level Responses, Percent conceptual Level Responses, Number of categories Completed and Trials to Completed First Category but no significant differences were found in Non-perseverative Errors, Percent Non-Perseverative Errors, and Failure to Maintain Set which shows that bipolar patients performed similar to normal control on these variables, when both groups (BAD-M, and normal) were categorized into average, borderline, and impaired categories, statistically significant differences were not found in conceptual level response and percent conceptual level response. On other variables difference was statistically significant. These results suggest that executive function seems to be impaired in patient with bipolar affective disorder, even in mania. The impairment of executive function measured by WCST has bee also found in other studies of bipolar disorder (Alessandro et al., 2000; Arduini et al., 2003). However, in contrast, no significant impairment was reported in

performance on WCST by Mishra et al., (2002) except for total number of correct response, total number of error and perseverative response. Though, previous studies included few variables of WCST, however, deficits similar to the present findings were reported. For example, total number correct (Mishra et al., 2002), total number of errors (Mishra et al., 2002), perseverative responses (Mishra et al., 2002), perseverative errors (Van Gorp et al., 1998; Arduini et al., 2003; Martinez-Aran et al., 2004), and number of categories completed (Van Gorp et al., 1998; Martinez-Aran et al., 2002; Arduini et al., 2003) were previously reported. Previous studies also reported that patients with bipolar affective disorder, even during remission of euthymic phase, show significantly poor performance in domains of executive function (Van Gorp et al., 1998; Martinez-Aran et al., 2002, 2004; Quraishi et al., 2002; Clark et al., 2002; Thompson et al., 2005; Torrent et al., 2006; Kolur et al., 2006; Nehra et al., 2006; Robinson et al., 2006). In contrast, some studies indicated no significant deficits in excutive function in BAD patients during their remission or euthymic phase (McKay et al., 1995; Rubinsztein et al., 2000; Cavanagh et al., 2002). There variations in result might be due to small sample sizes, age variation and norm variation in previous studies. As in the present study, Indian norm has been used to determine executive function. However, impaired executive functions were reported during remission of affective syndrome in patients with chronic or severe affective disorder (McKay et al., 1995). Few previous studies showed that BAD patients had deficits in problem-solving (Sweeney et al., 2000; Malhi et al., 2004). Present study, is in favour of previous findings which show that patients with BAD have significant impairment in executive function.

CONCLUSION

It will not be exaggerated to say that the illness bipolar affective disorder definitely affects executive abilities during disturbances in mood and does not recover completely in normalization phase in many patients. So, it must to take into consideration while managing and treating them.

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