

Executive Functions in Schizophrenia Patients

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ABSTRACT

Background: Executive function is the most essential proficiency of every human being. Executive functions are composite cognitive processes essential for planning, organizing, guiding, revising, regulating, and evaluating behavior necessary to adapt efficiently to the atmosphere and to attain their goals. **Aim:** The present study has been undertaken to determine the executive functions in schizophrenia patients. **Method:** The sample consists of 90 schizophrenia patients and 90 normal control subjects, age range from 20 to 50 years based on a purposive sampling technique. Wisconsin Card Sorting Test (WCST) was used to determine executive functions in schizophrenia patients. **Result:** Schizophrenia patients have exhibited executive dysfunctions in comparison to normal control subjects on WCST. Schizophrenia patients have taken more trials, lesser correct responses, committed more errors and percent errors, more perseverative responses and percent perseverative responses, more perseverative errors and percent perseverative errors, more non-perseverative errors and percent non-perseverative errors, impaired conceptual responses and percent conceptual responses, lesser category completed, lesser trials to complete first category and more failure to maintain set as compared to normal control subjects on WCST.

Keywords: Executive Functions, Schizophrenia, WCST

Executive function is a set of mental skills including cognitive processes such as attentional control, cognitive inhibition, inhibitory control, working memory, cognitive flexibility, ability to shift cognitive strategy, plan and organize ability to solve simple problems and make decisions, language, and self-control, etc.

Executive function is one of the most commonly observed deficits in schizophrenia. Executive dysfunctions such as impaired divided attention and sustained attention, problem in cognitive inhibition, cognitive inflexibility, inability to think properly, difficulty in focusing or paying attention and concentration, impairment in tasks measuring conceptualization, problems in planning, disturbed verbal fluency, inability to solve complex problems, problem in goal-directed behaviour and impaired working memory arise in schizophrenia ((Choudhury et al. 2009, Dalal et al., 2010; Carter et al. 2010, Hill et al. 2013). Schizophrenia patients display executive dysfunctions (Kern et al, 2008; Tyson et al, 2008; Fullam & Dolan, 2008; Bhatia et al, 2009; Lesson et al, 2010, Nayak (2009) and Jimenez et al. 2010, Allott, et al. 2020b, Bowie, et al. 2020, Paudel, et al. 2020) have explored executive dysfunctions in the

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Executive Functions in Schizophrenia Patients

case of schizophrenia. Impaired attention and concentration, problem in memory (Boeker et al, 2006; Das et al, 2007, Shen et al. 2014, Ragland et al. 2015, Bhattacharya, 2015; Aich et al, 2016, García-Laredo 2018, McCleery et al 2019) executive error monitoring (Silver & Goodman, 2007) in schizophrenic patients.

Executive dysfunctions such as impaired attentional control, problems in cognitive inhibition, impaired working memory, cognitive inflexibility, inability to think properly, difficulty in focusing or paying attention and concentration, impairment in tasks measuring conceptualization, problems in planning, cognitive inflexibility, disturbed verbal fluency, inability to solve complex problems, and impaired working memory arise in schizophrenia ((Choudhury et al. 2009, Dalal et al., 2010; Carter et al. 2010, Hill et al. 2013). Schizophrenia patients display executive dysfunctions (Kern et al, 2008; Tyson et al, 2008; Fullam & Dolan, 2008; Bhatia et al, 2009; Lesson et al, 2010). Nayak (2009) and Jimenez et al (2010) have explored executive dysfunctions in the case of schizophrenia. Impaired attention and concentration, problem in memory (Boeker et al, 2006; Das et al, 2007, Shen et al. 2014, Ragland et al. 2015, Bhattacharya, 2015; Aich et al, 2016, García-Laredo 2018, McCleery et al 2019, Saperstein, et al. 2020, Schielzeth, et al. 2020, Seccomandi, et al. 2020, Haugen, et al. 2021, Lejeune, et al. 2021, Vita, et al. 2021, Van Aken, et al. 2022) executive error monitoring (Silver & Goodman, 2007) in schizophrenic patients.

METHODOLOGY

Sample

In the present study, the sample consists of 90 schizophrenia patients and 90 normal control subjects with age ranges between 20-50 years. Only male subjects were taken as samples in this study. Schizophrenia patients were selected from different wards of Ranchi Institute of Neuro-Psychiatry and Allied Sciences (RINPAS), Kanke, Ranchi, Jharkhand diagnosed schizophrenia according to ICD-10 DCR criteria and normal controls were selected from different sections of Jharkhand state by using purposive sampling technique.

Materials

A self-prepared performa generally designed for this study was used for the purpose of socio-demographic and clinical details of the subjects. GHQ-12 developed by Goldberg and Miller (1979) was administered as a screening tool for the normal control subjects. BPRS developed by Overall et al (1962) was used to screen the severity of psychopathology in schizophrenia patients. WCST developed by Heaton et al (1981) was used to measure abstract reasoning ability and the ability to shift cognitive strategy in response to changing environmental contingencies.

Procedure

All the participants in the present study were interviewed after having informed consent and then a self-prepared semi-structured socio-demographic and clinical data sheet was used. Then GHQ-12 was administered as a screening tool for normal controls, cutoff point 2 signifies the sound mental health of an individual. Participants scoring more than 2 on GHQ were screened out. BPRS was used as a screening tool for schizophrenia patients. WCST was administered on schizophrenia patients and normal control subjects individually to evaluate executive functions. Mean, SD, and t-tests have been calculated by using SPSS 16.00.

RESULT AND DISCUSSION

It is evident from the table on WCST that patients with schizophrenia aged between 20-30 have been taken more trials as compared to normal control subjects and the difference

Executive Functions in Schizophrenia Patients

between have been found to be significant statistically (Schiz; $M=1.26\pm 2.90$, Normals; $M=1.09\pm 9.59$, $F=36.28$, $p<0.01$), similar trends have been seen in schizophrenia patients aged 31-40 years (Schiz; $M=1.26\pm 3.85$, Normals; $M=1.08\pm 12.80$, $F=36.28$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=1.26\pm 3.40$, Normals; $M=1.07\pm 12.56$, $F=36.28$, $p<0.01$). Lesser number of correct responses have been produced by schizophrenia patients aged 20-30 years as compared to normal control subjects (Schiz; $M=38.86\pm 123.47$, Normals; $M=74.47\pm 6.55$, $F=79.85$, $p<0.01$), similar trends have been seen in schizophrenia patients aged 31-40 years (Schiz; $M=40.20\pm 12.56$, Normals; $M=74.87\pm 8.80$, $F=79.85$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=44.41\pm 16.78$, Normals; $M=71.00\pm 7.80$, $F=79.85$, $p<0.01$).

Schizophrenia patients aged 20-30 years have committed more errors as compared to normal control subjects and the difference between these two groups have been found to be significant statistically (Schiz; $M=22.50\pm 5.44$, Normals; $M=38.76\pm 2.97$, $F=153.37$, $p<0.01$), similar trends have been seen in schizophrenia patients aged 31-40 years (Schiz; $M=21.91\pm 4.85$, Normals; $M=41.23\pm 3.37$, $F=153.37$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=22.94\pm 6.74$, Normals; $M=39.05\pm 3.19$, $F=153.37$, $p<0.01$). In percent errors, schizophrenia patients aged 20-30 years have committed more percent errors as compared to normal control subjects and the difference between these two groups has been found to be significant statistically (Schiz; $M=22.64\pm 4.81$, Normals; $M=38.00\pm 2.20$, $F=124.66$, $p<0.01$), schizophrenia patients aged 31-40 years (Schiz; $M=22.08\pm 5.15$, Normals; $M=40.48\pm 3.84$, $F=124.66$, $p<0.01$) and patients with schizophrenia

Table 3: Neuropsychological Functions in the group of Schizophrenia Patients and Normal Control Subjects on Wisconsin Card Sorting Test (WCST)

Variables	Subjects Age Range	Schiz Patients (N=90)		Normal Controls (N=90)		Df	F-Value
		M	SD	M	SD		
Trials Administered	20-30	1.26	2.90	1.09	9.59	BG- 5 WG-174	36.28**
	31-40	1.26	3.85	1.08	12.80		
	41-50	1.26	3.40	1.07	12.56		
Correct Response	20-30	38.86	13.47	74.47	6.55	BG- 5 WG-174	79.85**
	31-40	40.20	12.56	74.87	8.80		
	41-50	44.41	16.78	71.00	7.80		
Errors Committed	20-30	22.50	5.44	38.76	2.97	BG- 5 WG-174	153.37**
	31-40	21.91	4.85	41.23	3.37		
	41-50	22.94	6.74	39.05	3.19		
Percent Errors	20-30	22.64	4.81	38.00	2.20	BG- 5 WG-174	124.66**
	31-40	22.08	5.15	40.48	3.84		
	41-50	23.29	7.39	37.64	2.54		
Perseverative Responses	20-30	21.00	3.46	37.12	6.76	BG- 5 WG-174	93.64**
	31-40	20.98	4.04	40.46	7.01		
	41-50	22.18	5.89	38.06	5.57		
Percent Perseverative Response	20-30	20.64	2.41	37.39	7.19	BG- 5 WG-174	85.52**
	31-40	20.91	4.20	40.12	7.29		
	41-50	22.23	6.21	37.41	5.64		
Perseverative Errors	20-30	20.92	2.73	36.06	7.04	BG- 5 WG-174	78.66**
	31-40	20.74	4.02	39.82	7.78		
	41-50	21.88	5.72	37.00	6.07		
Percent	20-30	20.43	1.34	35.76	7.69	BG- 5	64.01**

Executive Functions in Schizophrenia Patients

Subjects Variables	Age Range	Schiz Patients (N=90)		Normal Controls (N=90)		Df	F-Value
		M	SD	M	SD		
Perseverative Errors	31-40	20.81	4.38	39.45	8.46	WG-174	
	41-50	32.00	6.16	35.58	6.42		
Non-perseverative Errors	20-30	32.07	7.61	41.23	2.68	BG- 5 WG-174	20.77**
	31-40	32.25	8.01	42.91	4.42		
	41-50	36.00	8.07	41.29	4.38		
Percent Non-perseverative Errors	20-30	33.42	7.77	41.24	4.60	BG- 5 WG-174	11.46**
	31-40	33.36	8.48	42.57	6.45		
	41-50	37.46	8.11	40.64	5.95		
Conceptual Level Responses	20-30	29.14	13.40	70.58	7.03	BG- 5 WG-174	114.29**
	31-40	29.67	12.20	70.46	7.91		
	41-50	33.41	18.60	67.35	7.01		
Percent Conceptual Level Responses	20-30	24.92	5.69	40.35	2.06	BG- 5 WG-174	116.06**
	31-40	24.20	4.53	41.29	4.19		
	41-50	25.47	6.04	38.88	3.75		
Categories Completed	20-30	1.35	1.08	5.00	0.00	BG- 5 WG-174	223.21**
	31-40	1.36	0.80	4.92	0.37		
	41-50	1.64	1.32	5.00	0.00		
Trials to Complete First Category	20-30	0.85	1.35	2.17	1.01	BG- 5 WG-174	28.98**
	31-40	0.62	1.14	3.25	1.25		
	41-50	1.11	1.79	2.82	1.42		
Failure to Maintain Set	20-30	3.57	1.22	4.58	0.79	BG- 5 WG-174	13.66**
	31-40	2.86	1.52	4.46	0.80		
	41-50	2.82	1.77	4.23	1.03		

**=Significant at 0.01, WG=Within Groups, BG=Between Groups

aged between 41-50 years (Schiz; $M=23.29\pm7.39$, Normals; $M=37.64\pm2.54$, $F=124.66$, $p<0.01$). Schizophrenia patients aged between 20-30 years have been committed more perseverative responses in comparison to normal control subjects (Schiz; $M=21.00\pm3.46$, Normals; $M=37.12\pm6.76$, $F=93.64$, $p<0.01$), similar trends have been seen in schizophrenia patients aged 31-40 years (Schiz; $M=20.98\pm4.04$, Normals; $M=40.46\pm7.01$, $F=93.64$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=22.18\pm5.89$, Normals; $M=38.06\pm5.57$, $F=93.64$, $p<0.01$). In the percent perseverative response, schizophrenia patients aged between 20-30 years have been committed more percent perseverative errors in comparison to normal control subjects (Schiz; $M=20.64\pm2.41$, Normals; $M=37.39\pm7.19$, $F=85.52$, $p<0.01$), similar trends have been seen in schizophrenia patients aged 31-40 years (Schiz; $M=20.91\pm4.20$, Normals; $M=40.12\pm7.29$, $F=85.52$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=22.23\pm6.21$, Normals; $M=37.41\pm5.64$, $F=85.52$, $p<0.01$).

High perseverative errors have been done by schizophrenia patients aged 20-30 years as compared to normal control subjects (Schiz; $M=20.92\pm2.73$, Normals; $M=36.06\pm7.04$, $F=78.66$, $p<0.01$), similar trends have been seen in schizophrenia patients aged 31-40 years (Schiz; $M=20.74\pm4.02$, Normals; $M=39.82\pm7.78$, $F=78.66$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=21.88\pm5.72$, Normals; $M=37.00\pm6.07$, $F=78.66$, $p<0.01$). Similar trends have been seen in percent perseverative errors done by schizophrenia patients aged 20-30 years as compared to normal control subjects (Schiz; $M=20.43\pm1.34$, Normals; $M=35.76\pm7.69$, $F=64.01$, $p<0.01$), similar trends have been noticed

Executive Functions in Schizophrenia Patients

in schizophrenia patients aged 31-40 years (Schiz; $M=20.81\pm4.38$, Normals; $M=39.45\pm8.46$, $F=64.01$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=32.00\pm6.16$, Normals; $M=35.58\pm6.42$, $F=64.01$, $p<0.01$). Findings of present study show high on non-perseverative errors in schizophrenia patients aged between 20-30 years in comparison to normal control subjects (Schiz; $M=32.07\pm7.62$, Normals; $M=41.23\pm2.68$, $F=20.77$, $p<0.01$), similar trends have been noticed in schizophrenia patients aged 31-40 years (Schiz; $M=32.25\pm8.01$, Normals; $M=42.91\pm4.42$, $F=20.77$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=36.00\pm8.07$, Normals; $M=41.29\pm4.38$, $F=20.77$, $p<0.01$). Similar trends have been observed in percent non-perseverative errors (Schiz; $M=33.42\pm7.77$, Normals; $M=41.24\pm4.60$, $F=11.46$, $p<0.01$) and also schizophrenia patients aged 31-40 years (Schiz; $M=33.36\pm8.48$, Normals; $M=42.57\pm6.45$, $F=11.46$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=37.46\pm8.11$, Normals; $M=40.64\pm5.95$, $F=11.46$, $p<0.01$).

Patients with schizophrenia aged between 20-30 years exhibited impaired conceptual level responses as compared to normal control subjects and difference between these two groups have been found to be significant statistically (Schiz; $M=29.14\pm13.40$, Normals; $M=70.58\pm7.03$, $F=114.29$, $p<0.01$), similar trends have been observed in schizophrenia patients aged 31-40 years (Schiz; $M=29.67\pm12.20$, Normals; $M=70.46\pm7.91$, $F=114.29$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=33.41\pm18.60$, Normals; $M=67.35\pm7.01$, $F=114.29$, $p<0.01$). In percent conceptual level responses, schizophrenia patients aged between 20-30 years exhibited impaired percent conceptual level responses as compared to normal control subjects and the differences between these two groups have been found to be significant statistically (Schiz; $M=24.92\pm5.69$, Normals; $M=40.35\pm2.06$, $F=116.06$, $p<0.01$), similar trends have been observed in schizophrenia patients aged 31-40 years (Schiz; $M=24.20\pm4.53$, Normals; $M=41.29\pm4.19$, $F=116.06$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=25.47\pm6.04$, Normals; $M=38.88\pm3.75$, $F=116.06$, $p<0.01$). Lesser number of categories completed by schizophrenia patients aged between 20-30 years (Schiz; $M=1.35\pm1.08$, Normals; $M=5.00\pm0.00$, $F=223.21$, $p<0.01$), similar trends have been observed in schizophrenia patients aged 31-40 years (Schiz; $M=1.36\pm0.80$, Normals; $M=4.92\pm0.37$, $F=223.21$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=1.64\pm1.32$, Normals; $M=5.00\pm0.00$, $F=223.21$, $p<0.01$).

Patients with schizophrenia took lesser trials to complete the first category as compared to normal control subjects, It may be happened due to failure to complete the first category in the whole WCST response sheet (Schiz; $M=0.85\pm1.35$, Normals; $M=2.17\pm1.01$, $F=28.98$, $p<0.01$), similar trends have been seen in schizophrenia patients aged 31-40 years (Schiz; $M=0.62\pm1.14$, Normals; $M=3.25\pm1.25$, $F=28.98$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=1.11\pm1.79$, Normals; $M=2.82\pm1.42$, $F=28.98$, $p<0.01$). Failure to maintain set was lesser in schizophrenia patients aged 20-30 years in comparison to normal control subjects (Schiz; $M=3.57\pm1.22$; Normals; $M=4.58\pm0.79$, $F=13.66$, $p<0.01$), similar trends have been seen in schizophrenia patients aged 31-40 years (Schiz; $M=2.86\pm1.52$, Normals; $M=4.46\pm0.80$, $F=13.66$, $p<0.01$) and patients with schizophrenia aged between 41-50 years (Schiz; $M=2.82\pm1.77$, Normals; $M=4.23\pm1.03$, $F=13.66$, $p<0.01$). Schizophrenia patients have impaired attention and concentration, impaired planning, set-shifting, memory, organization and executive functions (Kerns et al., 2008; Bhatia et al., 2009; Leeson et al., 2010, Dalal et al., 2010; Ram et al., 2015; Aich et al. 2016, Tripathi et al. 2018, Kaneko 2018, García-Laredo 2018, McCleery et al. 2019, Liss at al. 2019, Zeneli et al. 2019, Haugen, et al. 2021, Lejeune, et al. 2021, Vita, et al. 2021, Van Aken, et al. 2022).

CONCLUSION

Results reflect that patients with schizophrenia have executive dysfunctions in comparison to normal control subjects. Schizophrenia patients have taken more trials, lesser correct responses, committed more errors and percent errors, more perseverative responses and percent perseverative responses, more perseverative errors and percent perseverative errors, more non-perseverative errors and percent non-perseverative errors, impaired conceptual responses and percent conceptual responses, lesser category completed, lesser trials to complete first category and more failure to maintain set as compared to normal control subjects on Wisconsin Card Sorting Test.

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Executive Functions in Schizophrenia Patients

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Executive Functions in Schizophrenia Patients

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Conflict of Interest

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