The International Journal of Indian Psychology
ISSN 2348-5396 (Online) | ISSN: 2349-3429 (Print)
Volume 10, Issue 3, July- September, 2022
DIP: 18.01.159.20221003, DOI: 10.25215/1003.159
https://www.ijip.in

Research Paper

Neuropsychological Assessment of Executive Dysfunction in Drug-induced Psychosis

Mr. Richard Eno Lawani[1]*, Dr. Shivani Tomar[2]

ABSTRACT

Neuropsychological assessment is a performance-based method that is used to examine the cognitive consequences of brain damage, brain disease, and other mental illness (Stuss & Benson, 1986; Aron, Robbins, & Poldrack, 2004; Ferguson et al., 2021 The present focused on the neuropsychological assessment of executive dysfunction among Nigerian patients diagnosed with drug-induced psychosis (DIP). The assessment tools employed were mini-mental status examination (MMSE), trail making test parts A and B, fluency test and Stroop colour word test (SCWT); and the executive function components assessed were working memory, inhibition, fluency and set shifting. 100 participants consisting of patients diagnosed with drug-induced psychosis (n=56, 4 females and 52 males) and a control group of 44 persons (21 females and 23 males) took part in the study. There were statistically significant differences between DIP cases and controls on all the executive function components assessed. Regression analyses show that age was a significant predictor of the trail making test (TMT) Part B and fluency scores (t=3.36, p=0.001) (t=3.00, P=0.004); while fluency was also positively predicted by duration of illness among cases (t=2.19, p=0.32).

Keywords: *Neuropsychological assessment, General cognitive functioning, executive dysfunction, Drug-induced psychosis*

Neuropsychological assessment is a performance-based method that is used to examine the cognitive consequences of brain damage, brain disease, and severe mental illness (Deuel 1971; Harvey, 2012; Bigler, 2019; Gaudest & Del Bene 2021). . Common uses of neuropsychological assessment include collection of diagnostic information, differential diagnostic information, assessment of treatment response, and prediction of functional potential, functional recovery and executive function. (Harvey, 2012; Bigler, (2019). Neuropsychological tools have been employed in the study of executive dysfunction known to occur in persons who have had severe brain injuries (Luria, 1966; Ratiu & Talos 2004; Goldstein, Naglieri, Princiotta, & Otero 2014; Srulijes & Maetzler 2015) and drug-induced psychosis (DIP) (Mauri 2016; Ham, Kim, Chung, & Im, 2017; Jatau, Sha'aban, Gulma, Shitu, Khalid, Isa, Mustapha 2021). Executive dysfunction

[1]PhD Psychology Research Scholar, Department of Psychology, School of Liberal Arts, Noida International University, Uttah Pradesh, India.
[2]Assistant Professor, Department of Psychology, School of Liberal Arts, Noida International University, Uttah Pradesh, India.
*Corresponding Author

Received: June 25, 2022; Revision Received: September 24, 2022; Accepted: September 30, 2022

renders individuals unable to cope with the performance of a series of goal-motivated behavior necessary to achieve adaptive existence in an ecologically and psychologically evolving world. Jurado & Rosselli (2007) posit that such problems include the ability to generate thought and think flexibly, to update and manipulate information mentally, to inhibit what is undesirable or irrelevant to current goals, to self-regulate, and to plan and adjust behaviour as appropriate to the current situation. Executive function entails cognitive control processes which facilitate decision making, planning and goal-driven behaviour (Wray, Kowalski, Mpondo, Ochaeta, Belleza, D., & DiGirolamo, A. et'al. 2020; Miyake, Friedman, Emerson, Witzki, Howerter, & Wager, 2000). Researchers in their study of the frontal lobe, identified anticipation, goal selection, preplanning, monitoring, and use of feedback as executive skills and have posited that the anatomical site of these skills is the prefrontal cortex (Stuss & Benson, 1986; Aron, Robbins, & Poldrack, 2004). They have also suggested that the ability to maintain or shift a mental set, to establish goals, and to plan are especially important elements of executive function noting that these components could be measured by various neuropsychological assessment tools (Stuss et al 1986; Aron, et al, 2004). Executive function is an individual's ability to initiate, sustain and complete the series of goal-motivated behaviours required for adaptive living (Lawani & Tomar, 2022).

Neuropsychological testing is usually the normatively informed application of performance-based assessments of various cognitive skills (Casaletto & Heaton 2018). Neuropsychological assessment is performed with a battery approach, which involves tests of multiple cognitive ability areas, with more than one test per ability area. These ability areas include skills such as memory, attention, processing speed, reasoning, judgment, and problem-solving, spatial, and language functions. These assessments are usually performed in conjunction with assessments designed to examine lifelong academic and cognitive achievement and potential, (Tracy, McCrory., Josiassen., Monaco 1996) and prognosis for a number of pathologies relative to mental health. The assessment battery can be standardized or targeted to the individual participant in the assessment (Casaletto & Heaton 2018). Assessment data may be collected either directly by a psychologist or by a trained examiner, who performs and scores assessments tasks. While neuropsychological assessments were originally targeted at individuals who had experienced brain injuries in wartime (Goldstein 1995); the populations for whom neuropsychological assessments are useful comprise the whole range of neuropsychiatric conditions. (Adams & Grant 2009)

Here, four distinct executive function components: working memory, inhibition, set shifting, and fluency are identified (Rabinovici, Stephens, & Possin, 2015; Lawani & Tomar 2022). These components may be differentially affected in individual patients and act together to guide higher-order cognitive constructs such as planning and organization. (Rabinovici et al, 2015; Ferguson, Brunsdon, & Bradford, 2021). They posit that specific neuropsychological tests can be applied to evaluate components of executive function. While dysexecutive syndromes were first identified in patients with frontal lesions, intact executive function relies on distributed neural networks that include not only the prefrontal cortex, but also the parietal cortex, basal ganglia, thalamus, and cerebellum (Siew, Wulff, Beckage, & Kenett, 2019). Executive dysfunction arises from injury to any of these regions, their white matter connections, or neurotransmitter systems (Ferguson et al., 2021). Hence, the present study focused on the neuropsychological assessment of the four components of executive functioning namely, working memory, inhibition or inhibitory control, set-shifting and fluency.

A Brief History of the Development of Neuropsychological assessment

Neuropsychological assessment facilitated the transition from a unitary concept of "brain damage" or "organicity" to the possibility of specificity in quantifying exact regions of structural and or functional brain damage; and consequently, the ability to precisely define independent variables. (Bigler, 1994) Alexander Luria's seminal work subsequent to the second World War in Russia represents a turning point in the development of neuropsychological assessment tools. Luria's innovative ideas revolutionalized brain-behaviour relationship. He opined that the brain underlies the ability to carry out goal-directed behaviors and that brain functionality itself is shaped by environmental and cultural contexts (e.g., language). This led to his systematic characterization of functional brain systems (Luria, 1966). Luria's primary aim was to describe and provide improved understanding of the cerebral mechanisms that support corresponding functional systems, emphasizing the overarching importance of understanding as well as explaining the multiple components that may comprise even simple neuro-behavioral functions (Luria, 1966). Luria stimulated interest and appreciation of brain specialization and moved away from the one-size-fits-all diagnosis of brain disease. However, his techniques were far from perfect as they possessed several inadequacies (Stebbins, 2007; Casaletto, & Heaton, 2017) Luria's techniques were criticized and adjudged too flexible and nonstandardized, which cast a dark shadow over its usefulness and reliability across examiners and patients (Casaletto & Heaton 2018). Luria's student, Anne-Lise Christensen, subsequently revised and published a more structured version of the Lurian approach, which was a combination of both qualitative and quantitative aspects of the former's neuropsychological battery (Draper, 1976). Next, Charles Golden followed with a more standardized neuropsychological battery which further combined the works of both Luria and Christensen in his development of the Luria-Nebraska Neuropsychological Battery (LNNB) (Golden, Purisch, & Hammeke, 1979). This creation drastically scaled down almost 2000 original measurement items to 269 items providing a coverage of 14 scales including motor, rhythm, memory, intelligence, etc. (Purisch, 2001).

In the 1950s, Arthur Benton through his pursuit of achieving reliable and systematic neuro-behavioural assessment, developed several individual measures that are still widely used in neuropsychological assessment today (e.g., Benton Visual Rention Test) and his contributions shaped the Iowa-Benton school of neuropsychology (Tranel, 2009). Notably, through his test developments, Benton sought to establish the process of raising awareness of the practical significance of the infusion of demographic factors such as age and education on test performances, which occupies a permanent place of inclusion in neuropsychological testing till date, (Casaletto & Heaton 2018).

Another milestone in the history and development of neuropsychological assessment tools was the emergence of two major leaders in the field who pioneered the fixed battery approach- Ward Halstead and Ralph Reitan, his student and assistant (Reitan & Davidson, 1974). According to Casaletto & Heaton, (2018), it was while functioning as a physiological psychologist in the mid-twentieth century, that Halstead initially propounded a philosophy of neuropsychological assessment that bore close similarity to a series of scientific experiments. Halstead believed that there wasn't sufficient scientific information to be derived from a single, isolated event, and he therefore emphasized the need to develop accurate and systematic procedures with sufficient comparison cases to interpret an individual test score (Reitan, 1994). Reitan's views were quite sympathetic with those of Halfstead as he held similar strong beliefs that empiricism should be the cornerstone of neuropsychological assessment (Grant & Heaton, 2015). Casaletto & Heaton (2018) posit

that Halstead and Reitan employed objective observation of individual patients in clinic and at home, helping to shape and modify measures that captured the observed brain–behavior relationships that could be generalized more broadly; leading ultimately to the publication of the Halstead-Reitan Battery (HRB) in 1985 (Purisch, 2001).

The goal of the HRB was to be a systematic, quantitative means to measure the presence, location, extent, and nature of neurological disease equitably across clinical syndromes (Reitan, 1985; Casaletto & Heaton 2018). With its replicable procedures and highly quantitative results, the HRB intended to shift the practice of neuropsychology from an "art to a science" (Reitan, 1985) and indeed has been one of the most researched assessment batteries in neuropsychology (Kreutzer, DeLuca, Caplan, 2011).

Another important turning point in neuropsychological practices was the development of what is now referred to as the "Boston Process Approach" led by Edith Kaplan (Kaplan,1988). Although the Boston approach can be used with either flexible or fixed batteries, it is most commonly associated with and perhaps conceptually suitable to more flexible evaluations. Of great importance to the Boston approach was on how the patient arrives at an answer (e.g., types of errors committed) rather than reliance on a single objective performance score. However, in this approach, testing the limits of a patient's cognitive abilities to elicit behaviors that may not (Chan,2019). traditionally present during standardized testing is emphasized. Through the influence of Kaplan's training, Dean Delis undertook the successful standardization of the Boston approach, in collaboration with Kaplan and Joel Kramer, into what have come to be some of the most widely accepted and implemented neuropsychological assessment tools till the present. These tools included the very popular California Verbal Learning Test [CVLT] (Delis, Kramer, Kaplan, & Ober, 1987); and CVLT-second edition, (Delis, Kramer, Kaplan, & Ober, 2000) and the globally acclaimed Wechsler Adult Intelligence Scale-Revised as a Neuropsychological Instrument (Kaplan, Fein, Morris, Delis, 1991). This was followed by another widely accepted and implemented Delis Kaplan Executive Functions System [DKEFS] (Delis, Kaplan, Kramer, 2001). In the present decade, more neuropsychological assessment tools are being developed.

According to Kessels, & Hendriks, a few of the main cognitive domains and examples of tests that could be used for their assessment are: a. Memory and learning: Rey Auditory Verbal Learning Test (RAVLT), California Verbal Learning Test (CVLT-II), Location Learning Test (LLT-R), and Wechsler Memory Scale (WMS-IV); b. Executive function: Mini Mental Status Examination (MMSE), Digit Span, Tower of London test, Trail Making Test (TMT), Wisconsin Card Sorting Test (WCST), and Stroop Color Word Test (SCWT), etc; c. Attention and speed of information processing: Test (SDMT), Paced Serial Addition Reaction-time tests, Symbol Digit Modalities Test (PASAT), and Continuous Performance Task (CPT); d. Language: Boston Diagnostic Aphasia Battery, Token Test, and Verbal Fluency tests; e. Overall cognition: Mini-Mental State Examination (MMSE), Cambridge Cognitive Examination (CAMCOG-R), Montreal Cognitive Assessment (MoCA), and Wechsler Adult Intelligence Scale (WAIS-IV); f. Perception: Ishihara Test for Color Blindness, Visual Object and Space Perception battery (VOSP), and Benton Test of Facial Matching (Kessels, & Hendriks 2016).

Drug Use and Mental Disorders

Drug-induced psychosis refers to a medical condition resulting from use and abuse of certain psychoactive substances which interfere with brain connectivity and functionality (Mauri,

2016). One of the earliest reports about the effects of cannabis on mental health originated in India from the Indian Hemp Commission of 1893 (Kulhalli, Isaac, & Murthy 2007). Nevertheless, drug-induced psychosis resulting from use/abuse of Cannabis (Indian hemp/Igboo/Moroko), alcohol, cocaine and heroin has now assumed global proportions (Mauri 2016; Jatau et al.,2021). Fiorentini et al. found that the propensity to develop psychosis is influenced by the severity of use and dependence. This position is also supported by Ham, Kim, Chung, and Im (2017) who claim that psychotic symptoms can be elicited in healthy human adults when exposed to drugs. The Global Burden of disease Study 2017 reported that globally, in 2017, about 585,000 deaths were due to drug use (UNODC, 2019). The UNODC 2018 report found that one in seven (about14.2%) persons (aged 15–64 years) had used a drug in the past year. It was also found that one in five (20%) individuals who had used drug in the past year is suffering from drug-related disorders (United Nations Office on Drugs and Crime 2018). Latest global estimates reveal that about 5.5 per cent of the population aged between 15 and 64 years have used drugs at least once in the past year, while 36.3 million people, or 13 per cent of the total number of persons who use drugs, suffer from drug use disorders. Jatau et al. (2021) noted that world drug report-2019 of the United Nations Office on Drugs and Crime (UNODC) estimated that 271 million (5.5%) of the global population (aged between 15 and 64 years), had used drugs in the previous year (UNODC, 2019). They found a prevalence of 20–40% (among students) and 20.9% (among youths) drug abuse in Nigeria. hich implies that Nigeria, with 14.4% drug use prevalence is significantly above the global average **(UNODC World Drug Report 2021).** Executive dysfunction in mental disorders especially cases of psychosis has become a global mental health concern requiring further investigation (Rabanca-Souza et al, 2016). Despite of these, there exists a paucity of research focusing on executive dysfunction in drug-induced psychosis among clinical populations in Nigeria and most countries of the Global South.

Treatment, Recovery, and Rehabilitation

Evidence of trainability of executive functioning among the children population is found in the literature and direct and Indirect approaches has been developed (Lawani & Tomar 2022). For adult patient population, clinical experience suggests that diagnosis, psychopharmacological treatment results enable the patient achieve a level of insight whereby s/he can commence cognitive re-training, rehabilitation and eventual re-integration into the larger society. (Lawani & Tomar 2022)

METHODOLOGY

The topic of investigation is 'Neuropsychological Assessment of Executive Dysfunction in Drug-induced Psychosis'. We consider in this section of the paper:

- Objectives of the study
- Research questions
- Hypotheses
- Samples
- Instruments
- Procedure
- Ethical consideration
- Statistical analysis

Objectives of the Study: The purpose of the present study is the neuropsychological assessment of executive dysfunction in Drug-induced Psychosis.

The following are the specific objectives for the study:

- To do neuropsychological examination of the level of executive dysfunction in Drug-induced Psychosis patients;
- To explain the influence of various patient clinical and demographic characteristics of Drug-induced Psychosis disorder;
- To compare mean differences in group outcomes of executive dysfunction in Drug-induced Psychosis patients and controls.

Research questions

- The broad research question is do executive dysfunction influence adaptive behavioural outcome in drug induced mental disorder patients?
- Do general intelligence scores of Drug-induced Psychosis patients fall below those of control group?
- Do Drug-induced Psychosis patients perform worse than controls on neuropsychological assessment tasks measuring executive function components?
- Are there differences in group outcomes of executive function deficits in Drug-induced Psychosis patients and controls?

Hypotheses

- General cognitive functioning scores of patients will fall below those of control group;
- Drug-induced psychosis patients will perform worse than controls on tests of inhibitory control;
- There will be differences in group outcomes of working memory, fluency and set shifting deficits in drug-induced psychosis patients and controls;

Sample

A total of 100 participants (n=25 females and n=75 males aged between 18 and 68 years were included in the study. This included a sample consisting of fifty-six Drug-induced Psychosis patients selected after consent was obtained at the In-Patient and Out-Patient departments of Federal Neuropsychiatric Hospital, Benin City; Nigeria There was a control group of forty-four volunteers. The control group was drawn largely from religious communities with a demonstrable aversion to smoking, alcohol and drug use.

Instruments

The following was adapted from Lawani & Tomar (2022).

Four instruments were used in this study

Mini-mental state examination (MMSE) 2. Trail Making Test (TMT) 3. Fluency 4. Stroop colour word test (SCWT) See Lawani & Tomar (2022) for details.

***Procedure*:**

Cases were individuals diagnosed with drug-induced psychosis resulting from the use/abuse of cannabis, alcohol, cocaine or heroin and were recruited after ethical clearance from the Federal Neuropsychiatric Hospital, Benin City, Nigeria Ethics Committee was received. All subjects who met inclusion criteria were recruited, though a few patients still opted out in the process of tests administration. Cases and controls were personally administered the mini mental status examination (MMSE), TMT, SCWT and Fluency tasks by this researcher between the months of April, 2021 and January, 2022. Time taken to complete all parts of the test and scores were recorded. Demographic and clinical details were also recorded for

all participants. See Lawani & Tomar (2022) for details of instructions to participants.

Ethical Consideration

Ethical approval was by Research Ethical Committee of Federal Neuropsychiatric Hospital Benin City, Edo State, Nigeria.

Statistical Analysis

The above neuropsychological tests were administered, scoring done according to the standard procedure as prescribed in the manuals. All data were evaluated on required statistical techniques with descriptive details. All statistical analyses were conducted using IBM SPSS Statistics version 20.0 (IBM, Armonk, NY, USA)

RESULTS

Table No.1 Mean (M) and Standard Deviation (SD) for Study Variables with N=56 (Clinical Group) and N= 44 (Control Group)

	Drug-induced psychosis (clinical group)		**Control Group**	
Variables	**M**	**SD**	**M**	**SD**
Age	32.7857	8.97818	31.90	14.46
Schooling years	13.1339	2.30512	13.43	1.96
MMSE	21.1607	4.53983	25.11	4.5
TMT Part A	100.1429	76.92084	54.59	18.82
TMT Part B	193.2321	89.32555	98.95	40.45
Fluency	24.6964	7.82518	30.38	10.94
Stroop colour word test (SCWT)	2.1964	2.03085	3.09	2.11
Duration of illness	1.6548	5.22824	Not Applicable	Not Applicable

Demographic characteristics:

The mean ages (standard deviations, SD) of the cases and controls were 32.78 (SD=8.97) and 31.90 (SD=14.46) years respectively. Mean ages of cases and controls were not different statistically (t=1.007, P= .319>0.05). Gender-wise distribution of the sample was 7.7% females, 92.38% males among cases and 47.7% females, 52.3% males among controls. There was significantly more number of males than females among drug-induced psychosis cases. The mean years of education SD) were comparable: for cases 13.13 (SD=2.30) and controls 13.43 (SD=1.96). There were no significant differences between cases and controls on schooling years.

DIP cases versus controls:

There were significant differences between cases and controls on Part A of the TMT. DIP cases (100.14; SD=76.92secs) took significantly more time than controls (54.59; (SD=18.82secs) (t= 4.43, $p<0.001$) [see Tables 1 and 3] On Part B of the TMT, cases (193.23 (SD=89.32. secs) took significantly more time than controls as well (98.95; SD=40.45secs) (t =7.89, p <0.001) [Tables 1 and 4]. In total fluency tasks (semantic fluency +polemic fluency +design fluency), cases performed significantly worse (24.69; SD=7.82) than controls 30.38 (SD=10.94) (t= 5.43, $p<0.001$) [see Tables 1 and 5]. Similarly, the Stroop colour word test performance of cases 2.19 (SD=2.03) was significantly worse than controls 3.09 (SD=2.11) (t= 3.29, $p = 0.002$) [Tables 1 and 6 refer]. And there were significant differences between cases and controls on MMSE scores. Cases 21.16 (SD=4.53) and controls 25.11(SD=4.45) (t=6.51, P<0.001) [Tables 1 and 2]

Table No.2 Comparison of means for grug[induced psychosis and Control Group MMSE scores

	Test Value = 25.11			
	t	Sig. (2-tailed)	95% Confidence Interval of the Difference	
			Lower	Upper
TOTAL MMSE SCORE of Drug induced psychosis patients	-6.510	.000	-5.1651	-2.7335

Table No.3 Comparison of means for Drug-induced psychosis and Control Group TMT Part A scores

	Test Value = 54.59			
	t	Sig. (2-tailed)	95% Confidence Interval of the Difference	
			Lower	Upper
TMT A SCORE OF Drug induced psychosis patients	4.432	.000	24.9533	66.1524

Table No.4 Comparison of means for Drug-induced psychosis and Control Group TMT Part B scores

	Test Value = 98.95			
	t	Sig. (2-tailed)	95% Confidence Interval of the Difference	
			Lower	Upper
TMTB SCORE OF Drug induced psychosis patients	7.899	.000	70.3606	118.2037

Table No.5 Comparison of means for Drug-induced psychosis and Control Group Fluency scores

	Test Value = 30.38			
	t	Sig. (2-tailed)	95% Confidence Interval of the Difference	
			Lower	Upper
TOTAL FLUENCY SCORE Drug induced psychosis patients	-5.435	.000	-7.7792	-3.5880

Table No.6 Comparison of means for Drug-induced psychosis and Control Group Stroop colour word scores

	Test Value = 3.09			
	t	Sig. (2-tailed)	95% Confidence Interval of the Difference	
			Lower	Upper
STROOP WORD COLOUR TEST SCORE of Drug induced psychosis patients	-3.293	.002	-1.4374	-.3497

Table No.7 Pearson r product moment coefficients between age and TMT B scores drug-induced psychosis patients.

		age of Drug induced psychosis patients in years	**TMTB SCORE OF Drug induced psychosis patients**
age of Drug induced psychosis patients in years	Pearson Correlation	1	.416**
	Sig. (2-tailed)		.001
	N	56	56
TMTB SCORE OF Drug induced psychosis patients	Pearson Correlation	.416**	1
	Sig. (2-tailed)	.001	
	N	56	56

***. Correlation is significant at the 0.01 level (2-tailed).*

Table No.8 Pearson r product moment coefficients between age and TMT B scores of drug-induced psychosis patients.

		age of Drug induced psychosis patients in years	**TOTAL FLUENCY SCORE Drug induced psychosis patients**
age of Drug induced psychosis patients in years	Pearson Correlation	1	-.379**
	Sig. (2-tailed)		.004
	N	56	56
TOTAL FLUENCY SCORE Drug induced psychosis patients	Pearson Correlation	-.379**	1
	Sig. (2-tailed)	.004	
	N	56	56

A Pearson product-moment correlation was run to determine the relationship between: age and TMT B score of drug-induced psychosis patients. [Table 7] age and fluency score of drug-induced psychosis patients [Table 8] The result of the Pearson r correlation coefficients showed that: age significantly correlated with TMT B scores of drug-induced psychosis patients (r= .416, n=56, p<.01) and age significantly correlated with fluency scores of drug-induced psychosis patients (r= .379, n=56, p<.01).

Table No.9: Regression analysis showing age as positive predictor of TMT B scores of drug-induced psychosis patients

Model		**t**	**Sig.**	**95.0% Confidence Interval for B**	
				Lower Bound	**Upper Bound**
1	(Constant)	1.373	.175	-26.425	141.255
	age of Drug induced psychosis patients in years	3.365	.001	1.675	6.611
a. Dependent Variable: TMT B SCORE OF Drug induced psychosis patients					

Table No.10: Regression analysis showing age as positive predictor of fluency scores of drug-induced psychosis patients

Model		**t**	**Sig.**	**95.0% Confidence Interval for B**	
				Lower Bound	**Upper Bound**
1	(Constant)	9.525	.000	28.044	42.996
	age of Drug induced psychosis patients in years	-3.008	.004	-.550	-.110
a. Dependent Variable: TOTAL FLUENCY SCORE Drug induced psychosis patients					

Table No.11: Regression analysis showing duration of illness as positive predictor of fluency scores of drug-induced psychosis patients

Model		t	Sig.	95.0% Confidence Interval for B	
				Lower Bound	Upper Bound
1	(Constant)	23.933	.000	23.277	27.533
	Duration of drug-induced pychosis patients	-2.195	.032	-.820	-.037
a. Dependent Variable: TOTAL FLUENCY SCORE Drug induced psychosis patients					

Regression analyses were performed to test for effects of different demographic variables on MMSE, TMT, SCWT, and Fluency among cases. Variables selected for analyses were age, duration of illness and school years. Analyses suggest that scores on Part B of the TMT scores were positively predicted by age, (t=3.36, *p=0.001*) [Table 9]; scores on fluency tasks were positively predicted by age and duration of illness: (t=3.00, *P=0.004*) [Table 10]; (t=2.19, *p*=0.32) [Table 11]

DISCUSSION

The major finding of this study was that drug-induced psychosis cases performed worse than controls on neuropsychological assessment of the four domains of executive function investigated. To our knowledge, this is one of the first few reports of inhibitory control, working memory, set shifting and fluency components of executive function, among drug-induced psychosis patients in Nigeria. We found that Nigerian subjects diagnosed with drug-induced psychosis performed worse than controls on Parts A and B of the TMT, assessing inhibitory control, working memory and set shifting components of executive ability; SCWT assessing working memory and inhibitory control; fluency tasks assessing fluency and working memory components of executive functions; and MMSE assessing working memory and general cognitive functioning (Rabinovici et al 2015). The deficits observed in the performances on these measures can be the direct consequence of comprehensive deficits in executive functions emanating from the disorder, or an indirect manifestation related to some underlying genetic disorders marked by executive dysfunction such as schizophrenia (Bhatia et al 2009). Age has been found to adversely affect executive function, but the effect was pronounced among drug-induced psychosis cases more than controls (Arafat & Shoquirat 2019) The cases took more time to complete Part B of TMT than normal subjects, in agreement with other studies; Arafat, & Shoqeirat, 2019). Age was an important predictor of fluncy performance in our cases. Also, scores on fluency tasks were positively predicted by duration of illness: this could be as a result of cases experiencing greater impairment as a result of repeated relapse and continual use/abuse drugs after initial treatment and rehabilitation is completed. Cognitive abilities were adversely affected by psychotic symptoms (Bhatia, et al 2009). Most subjects were male. This could be attributed to low levels of substance use among females in general. Our findings indicate that drug-induced psychosis due to abuse features prominently in clinical practice (Fiorentini 2011) (Arafat & Shoquierat 2019).

CONCLUSION

We found that a fairly large Nigerian sample of Drug-induced psychosis patients performed worse than controls on the neuropsychological assessment of working memory, inhibition, set-shifting and fluency tasks. Results confirm the stated hypotheses. The findings suggest that drug-induced psychosis patients are more vulnerable to executive dysfunction than the general population. Age was an important predictor of fluency and TMT Part B performance in our cases. This shows that the older the patients, the greater the impairments recorded in

the level of functioning with respect to organization and planning, inhibitory control as well as multitasking abilities; so that, early detection of the disorder has greater promise of recovery. Also, scores on fluency tasks were positively predicted by duration of illness: this could be as a result of cases experiencing greater impairment as a result of repeated relapse and continual use/abuse of drugs after initial treatment and rehabilitation is completed. It may be necessary to stress that strict compliance to psychopharmacological prescriptions and appropriate follow up programmes that include adherence to abstinence regime should be in place.

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Acknowledgement

The author(s) appreciates all those who participated in the study and helped to facilitate the research process.

Conflict of Interest

The author(s) declared no conflict of interest.

How to cite this article: Lawani, R. E. & Tomar, S. (2022). Neuropsychological Assessment of Executive Dysfunction in Drug-induced Psychosis. *International Journal of Indian Psychology, 10(3),* 1504-1518. DIP:18.01.159.20221003, DOI:10.25215/1003.159