

## EXECUTIVE FUNCTIONS OF PEOPLE WITH DRUG ADDICTION

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*Key words:* Executive functions, Drug dependence, Neuropsychological assessment tools

### Abstract

This study aimed to see the impairments of executive functions in people with drug dependence. Participants were selected using a purposive sampling method and the sample size was 120, among them 60 were in drug user group and 60 were healthy control. Neuropsychological assessment tools were used – Frontal Assessment Battery (FAB) and Rey-Osterreith Complex Figure Test (RCFT), for assessing the executive functioning of the participants. Data were analyzed using SPSS software, version 20. Independent-Samples t-test was carried out and the result has shown that the control group performed better in all tests. In FAB, significant difference was found in performance between the drug users and control group,  $t(90.9) = 9.89$ ,  $p = 0.00$ ,  $\alpha = 0.01$ . Both in copy and immediate recall phase of RCFT, there were significant differences of performance between the drug users and control group,  $t(70.9) = 8.11$ ,  $p = 0.00$ ,  $\alpha = 0.01$  and  $t(118) = 11.9$ ,  $p = 0.00$ ,  $\alpha = 0.01$ , respectively. Results indicate that the executive functions of drug dependent people are significantly impaired. Therefore, this issue should be taken in consideration for creating individualized treatment programs and can also assist in taking preventive measures.

### Introduction

"Drug addiction" is a crucial problem all over the world and a threat to any society because it has detrimental effects on humankind, mainly capturing the youth. Besides health, drug abuse directly influences the economic and social development of a country. According to World Health Organization (WHO), "the global burden of disease attributable to alcohol and illicit drug use is 5.4% of the total burden of disease" and about 50 crore people around the world are affected by drug addiction<sup>(1)</sup>.

There is a slight difference between these two concepts - "Drug abuse" and "Drug addiction", though they exist in a continuum. Drug abuse simply means abuse or inappropriate use of any drug e.g., alcohol, cigarettes or other prescription drugs and is a non-clinical concept. Drug abuse can create varieties of problems in one's life. But usually one is able to stop this unhealthy practice. "Drug addiction" is a more severe form of "drug abuse". People cannot simply stop this habit. Drug abuse can lead to addiction

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when a person takes a drug compulsively, unable to stop taking it despite knowing its bad consequences and it has both physiological and psychological effects on the body. The terms "drug abuse" or "drug addiction" are not used in DSM 5 (Diagnostic and statistical Manual for Mental Disorder) or other classification systems like ICD-10 (International Classification of Diseases). Instead the terms "Substance abuse" and "Substance dependence" are used. In 1963, World Health Organization Expert Committee on Drug Dependence proposed the term "Substance dependence" instead of drug addiction. Research has revealed important differences between alcohol abuse and alcohol dependence<sup>(2)</sup>. For substance abuse, there is no significant psychological or physiological dependence whereas in substance dependence there are some characteristic features like craving, tolerance or withdrawal. According to World Health Organization (WHO) – "Substance abuse refers to the harmful or hazardous use of psychoactive substances, including alcohol and illicit drugs. Psychoactive substance use can lead to dependence syndrome which is a cluster of behavioral, cognitive, and physiological phenomena developing after repeated substance use and that typically include a strong desire to take the drug, difficulties in controlling its use, persisting in its use despite harmful consequences, a higher priority given to drug use than to other activities and obligations, increased tolerance, and sometimes a physical withdrawal state."

In Bangladesh, drug abuse is a growing national concern as it is affecting the society, economy and families<sup>(3)</sup>. Almost all parts of the society are severely affected by this problem. According to the Association for the Prevention of drug abuse, the current number of people with drug addiction is 6,600,000 and the Department of Narcotic Control reports this number as 5,000,000<sup>(4)</sup>. In Bangladesh about 80 per cent of the drug addicts are adolescents and young men of 15 to 30 years of age<sup>(3)</sup>. Common drugs available in Bangladesh are Opium (e.g., Heroin, pethedine, cocaine), Cannabis (e.g., Ganga, Chorosh, bhang), Stimulants (e.g., yaba, ecstasy, Viagra), Sleeping pills (e.g., tranquilizers, diazapam) and cough syrup (e.g., phensidyl, dexpotent)<sup>(3)</sup>. The percentages from several research clearly indicate how alarming the situation is. It is already known through research that there are different psychosocial factors that may lead to drug addiction. In a study in Bangladesh, it is found that drug abuse is more prevalent in educated people and family conflicts and peer pressure are crucial risk factors<sup>(5)</sup>. More research regarding drug addiction is needed in our country for early prevention and better treatment program.

Through neuro-imaging studies, scientists have shown that several important areas of the brain are affected by drug abuse<sup>(6)</sup>. According to National Institute of Drug Addiction, three main brain areas affected by drug abuse are: (a) the brain stem; (b) the cerebral cortex and (c) the limbic system, which regulates the brain's reward circuit. Long-term drug use causes changes in other brain chemical systems and circuits besides

the reward circuit, affecting functions that include: learning, judgment, decision-making, stress, memory, behavior. One of the significant brain regions affected by drug abuse is the Prefrontal cortex<sup>(6,7)</sup>. The functions of this brain region are planning complex behaviors, personality expression, decision-making, and moderating social behavior, which are called executive functions of a human being needed to live life soundly. A formal definition of executive functions is - "The executive functions are a set of processes that all have to do with managing oneself and one's resources in order to achieve a goal. It is an umbrella term for the neurologically-based skills involving mental control and self-regulation."<sup>(8)</sup>. The mental skills that are thought to underline this umbrella term are - inhibition, mental shift, emotion control, initiation, working memory, planning, self-monitoring<sup>(9)</sup>. These are somehow related and overlapping set of skills that are crucial to living. If these functions or the brain regions which regulate these functions get somehow impaired, people then have several cognitive and behavioral problems (Fig. 1).

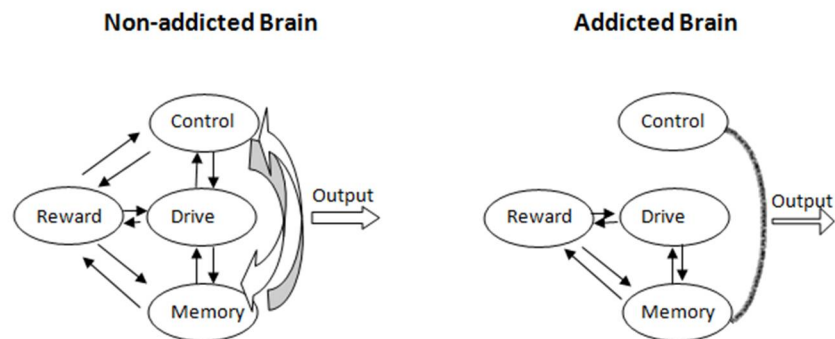


Fig. 1. The addicted brain (Collected from Nora, Joanna and Jene-Jacks study 2003).

Researchers till now investigated neuropsychological impairments due to substance dependence and emphasized that such studies are very important because they have implications on choosing the appropriate treatment approach for individual patient. These neuropsychological and cognitive impairments lead people with drug dependence to continue to seek and take drugs and also interfere with response to treatment making it difficult to persist in abstinence. Therefore, identifying such impairments and understanding the underlying mechanisms are very important. One study done by Cunha *et al.* (2010) showed that Frontal Assessment Battery (FAB), a neuropsychological tool, is useful for assessing cognitive functions of drug dependent individuals so that such assessment can direct proper interventions<sup>(10)</sup>.

This study aimed to indicate whether there are impairments in executive functions in drug abusers by assessing their executive functions with neuropsychological tools. This

can help other people besides clinicians, especially the care givers or close persons of drug abusers, understand the difficulty of abusers in controlling the addiction which in turn can facilitate the treatment and rehabilitation process and improve their condition. The specific objectives of this study are - (a) to see whether there is any relationship between the duration of drug use and the impairments in executive functions, (b) to see the impacts of different type of drugs in addicted people's executive functions.

### Methodology and Materials

A total of 120 participants were included in this study of which 60 were drug dependent people and 60 were drug non-users. A purposive sampling method was used to select participants for this study. Only Amphetamine, Cannabis, Opiates and poly users were selected because of these drugs' more availability and usage in the country (Tables 1 and 2). Both groups were selected by matching education and age range. The inclusion criteria included - (a) having overcome withdrawal period, (b) being communicable, (c) aged between 18 and 45 and minimum education is Higher Secondary level. Exclusion criteria were - (a) any previous brain injury or disease, (b) any other significant physical or mental illnesses; (c) being in withdrawal phase or treatment just started. Due to lack of access to female drug users, all participants were male.

**Table 1. Number of people in different groups.**

Groups	Number of people
Cannabis	16
Amphetamine	17
Opiates	8
Poly user	19
Control	60
Total	120

**Table 2. Demographic Information of the participants.**

Variable	Drug user group		Control group		
	N	%	N	%	
Education	Up to HSC	28	46	18	30
	Graduation	22	36	22	36
	Masters	10	16	20	33
SES	Low	1	1.6	2	3.3
	Middle	36	60	52	86
	High	23	36	6	10

SES = Socio-economic status.

### **Instruments**

The following tools were used in this study to assess participants' executive function:

1. Demographic information sheet
2. Bangla version of Frontal Assessment Battery (FAB) adapted by Shahanur Hossain and Dev Quinn 2016 <sup>(11)</sup>
3. Rey-Osterreith Complex Figure test (ROCF) <sup>(12)</sup>

### **Design**

A cross-sectional design was used for this study.

### **Procedure**

After getting the ethical clearance from the ethical review board of Department of Clinical Psychology, DU (Project Number - MS180301) several drug rehabilitation centers in Dhaka city were visited for authorization to collect data. Data were collected from the following centers - CREA, Baraca House, Brain and Life Hospital, Central Drug Addiction Treatment Centre and Beacon Point. Participants were chosen depending on which type of drug they use and considering other inclusion and exclusion criteria. The initial screening process considering the criteria was done by the centers' official record i.e. medical reports. Informed consent was taken from each participant after discussing the ethical and confidentiality issues. Data were collected from participants in individual setting. At first, the copy phase of Rey-Osterreith Complex Figure Test was administered. Then after 3 - 4 minutes, the immediate recall phase was done. After that the FAB was administered. After finishing test administrations, participants were thanked for their cooperation.

### **Result and Discussion**

For achieving the main objective of the study, an Independent-Sample t-test was carried out. Significant differences were observed between the scores of FAB of drug user and control group (Tables 3 - 4). Frontal Assessment Battery (FAB) is a valid neuropsychological tool for assessing executive functions <sup>(13)</sup> and also a valid measure for detecting deficits in executive functions in substance dependent people<sup>(10)</sup>. Among drug users, 68% of people were found to have executive function impairments which were 3% among normal population. The control group performed better than the drug user group in all six subtests of FAB. Which indicates that the executive functions of drug dependent people are significantly poor than the people who do not abuse drugs. Thus the present study confirms the previous findings that drug dependent people show cognitive deficits, especially executive functions which are crucial to managing healthy life<sup>(14-17)</sup>. Moreover, from statistical analysis, it is observed that the performance of drug user

group was poor mostly in abstract reasoning, motor programming, following instructions and inhibitory control.

**Table 3. Result of independent sample t-test between drug user and control group total score of FAB.**

Group	N	M	MD	SD	df	t value	p
Drug user	60	10.87		3.30			
			-4.8		90.7	**9.89	0.000
Control	60	15.67		1.79			

\*\*p < 0.01; the difference is statistically significant.

**Table 4. Independent samples t-test between scores on FAB of drug user and control group.**

Subtests	Drug user group N = 60	Control group N = 60	t value	
	Mean	0.97	2.05	
Similarities	Sd	0.920	0.910	**t(118) = 6.48
	Mean	1.77	2.22	
Lexical Fluency	Sd	0.981	0.825	**t(118) = 2.72
	Mean	2.07	2.92	
Motor Series	Sd	0.880	0.279	**t(70.7) = 7.13
Luria test	Mean	1.88	2.85	
Conflicting Instruction	Sd	1.18	0.36	**t(69.8) = 6.06
	Mean	1.55	2.75	
Go No-go	Sd	1.11	0.47	**t(79.6) = 7.69
	Mean	2.58	2.88	
Prehension behavior	Sd	0.59	0.32	**t(91.5) = 3.45

p < 0.01; the difference is statistically significant.

It was identified that the drug user group obtained significantly lower scores on the copy and immediate recall phases of Rey-Osterreith Complex Figure Test (RCFT) (Table 5). RCFT is also a valid measure for assessing executive functions such as visuoconstructional ability, planning, attention, working memory. The copy phase of RCFT requires several executive functions such as visuospatial ability, planning, attention etc. And the immediate recall phase can give an impression about working memory as the participant has to retain the information and has to recall immediately for

re-drawing the picture. The results indicate that drug dependent people have significant impairments in their executive functional abilities which is in harmony with the previous findings. Another interesting observation was during administering this test to the drug dependent people. Most of the participants in drug user group started drawing the figure impulsively and they were seen not taking time to plan before drawing. Consequently, they had difficulty in remembering the figure for drawing in the immediate recall phase. This observation supports the previous findings that drug dependent people have impairments in inhibitory control, planning and working memory which lies under executive functions<sup>(15,16)</sup>.

Correlations were calculated between test scores and the number of years they abused drugs. There were no significant correlations between test scores and duration of drug use (Table 6). This result seems related to a previous study which showed that there is no significant difference in performance between current and former drug users in neuropsychological tests<sup>(16,18)</sup>. Again, another study identified that the longer time people abuse drugs the lower their performances are<sup>(14)</sup>. These studies raise a conflicting issue and more rigorous research studies should be carried out to see the correlation.

**Table 5. Independent-sample t test between drug user and control group for the copy and immediate recall phase of RCFT.**

Tests/phases	Drug user group N = 60	Control group N = 60	t value	
Copy phase	Mean	26.37	34.43	<b>**t(70.9) = 8.11</b>
	Sd	7.33	2.33	
Immediate Recall Phase	Mean	12.38	26.87	<b>**t(118) = 11.9</b>
	Sd	5.74	7.45	

**\*\*p < 0.01; the differences are statistically significant**

**Table 6. Correlations between duration of drug abuse and test scores.**

		FAB total	RCFT phase 1	RCFT phase 2
	N	60	60	60
Duration	r	0.057	0.145	-0.165
	P	0.663	0.270	0.207

One-way ANOVA was carried out to see whether there is any impact of different types of drug on executive functions. No significant differences between test scores and different types of drugs were found (Table 7). Which may conclude that the severity of

executive functions impairment is not very different for different types of drugs. But previous research have found that people abusing different types of drugs show different level of impairments such as alcoholic group performed worse comparing to other drug groups<sup>(15)</sup>. This finding raises questions that whether actually different types of drugs produce different level of impairments or which type of drug creates more damaging effects and these questions can have answers through more research. Although studies revealed that different types of drugs are shown to impair different functions such as chronic cannabis abuse leads to memory impairments<sup>(19)</sup> and other problems as in decision making, inhibitory control etc. very few study have identified that the severity of impairments differ on the basis of drug types.

**Table 7. ANOVA table of mean differences of scores on tests for different types of drugs.**

Tests	Drug group	N	M	Sd	F value	p
Frontal Assessment Battery	Cannabis	16	10.81	3.9	0.83	0.48
	Amphetamine	17	9.94	3.2		
	Opiates	8	11	2.5		
	Poly	19	11.68	3		
Copy Phase of RCFT	Cannabis	16	26.31	7.5	0.19	0.89
	Amphetamine	17	27.41	4.5		
	Opiates	8	25.13	5.4		
	Poly	19	26	9.8		
Immediate Recall Phase of RCFT	Cannabis	16	12.56	6.2	0.3	0.82
	Amphetamine	17	13.29	5.1		
	Opiates	8	11.13	6.4		
	=Poly	=19	11.95	5.8		

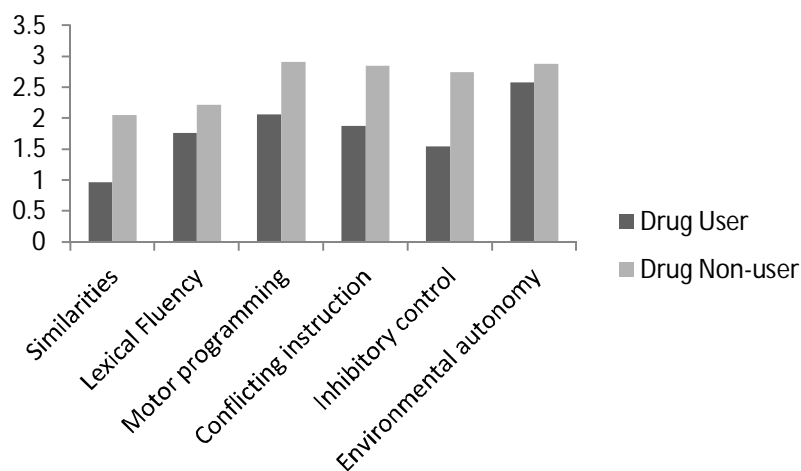


Fig. 2. Performance of two groups in each subtests of FAB.



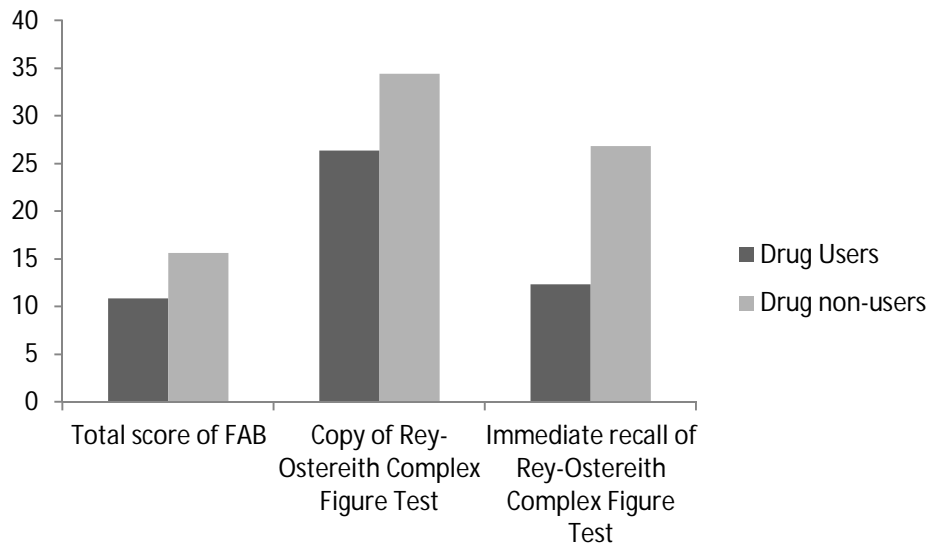


Fig. 3. Differences of performance of two groups in all tests.

Despite some limitations such as, small sample size, this study leads to an important understanding for researchers and clinicians in Bangladesh. This study may have clinical and practical implications both in substance abuse and neuropsychological field. The results that lower performance on all measures clearly indicate that people with drug dependency have impairments in executive functions of the brain which may answer why they cannot comply with treatment program or cannot sustain abstinence or relapse repeatedly. Therefore, this study can assist both clinicians and caregivers in better understanding drug dependent people and this issue should be taken in consideration for creating individualized treatment programs and can also assist in taking preventive measures.

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*(Manuscript received on 15 January, 2019; revised on 12 May, 2019)*