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ORIGINAL ARTICLE

Impairment of Executive Function in Alcohol Dependent Persons

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ABSTRACT

Aims: To compare the executive dysfunction of alcoholic dependent cases with age-matched controls.

Methods: Fifty alcohol dependent cases along with fifty healthy relatives of the patients selected randomly were included in this single interview cross-sectional hospital-based study. The executive function of all the cases and control were tested by applying the frontal assessment battery (FAB).

Results: On making a comparison of the scores of the FAB between the cases and the controls, it was found that the mean score of the cases was 10.02 with a standard deviation of 2.64 indicating more executive dysfunction whereas that of the controls was 16.96 with a standard deviation of 1.56 showing better executive functioning.

Conclusion: Regular and long-term alcohol intake significantly impairs the executive functions.

Keywords: Alcohol dependence, Cognitive functions, Executive function, Frontal lobe functions, Neocortex.

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INTRODUCTION

The impact of alcohol on the present day society is overwhelming. The number of people who consume alcohol has shown an alarming rise in the past decade. There are 208 million people with alcoholism worldwide according to the World Health Organization (WHO) as of 2010 (4.1% of the population over 15 years of age).[1] Studies show that impairments in chronic alcoholics including a decline in one's ability to process new information, acquire new skills and plan strategiesand, theoretically, these impairments should undermine behavioral changes targeted by treatment; however, little evidence supports a direct influence of impairment on treatment response. To address this paradox, the authors used structural equation modeling and project matching alcoholism treatment to client heterogeneity (MATCH) data (N = 1,726).[2] There have been many attempts at gauging the neurocognitive deterioration that occurs in chronic alcoholics. Episodic memory deficits associated with long-term drinking has also been associated with the loss of executive dysfunction. Thus it was found that assessing the executive dysfunction in chronic alcoholics can help us in realizing the extent of cognitive decline.

Executive functions is not a singular concept. It involves a set of processes which refer to the individual's ability to solve complex problems. Executive functions are described as having four components: The abilities of goal formation, planning how to achieve that goal, carrying out the plans, and effective performance. A person with intact executive functions can continue with his or her independent life irrespective of having any kind of cognitive loss.[3] They are also seen to predict the prognosis of chronic alcoholics. If there is any executive dysfunction, a task-oriented behavior of the individual is hampered. This causes disruptions in behavior which need control of natural responses and goal activation which is important for adjusting to environmental changes and act accordingly.[4] Subsequently, problems of impulsivity, hyperactivity, disorganized behavior and aggressiveness arise in clinical patients with executive dysfunction. There may be some emotional dysregulation also in such patients, which can ultimately manifest into mood disorders.[5] Various studies have reported that most of the patients with alcohol dependence are prone to suffer from progressive cognitive deterioration mainly the executive functions.[6-8] Cognitive impairments in alcohol-dependent patients without any other neurological complications are increasingly becoming the focus of attention of addiction medicine specialists, as, according to various studies, between 50 and 80% of these patients present with impaired cognitive function.[9,10] Detailed neuropsychological assessment or screening of these cognitive impairments appears to be fundamental to adapt patient management strategies optimally.[11-13]

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Adhikari et al., evaluated the executive function with FAB in alcohol-dependent inpatients (N = 62) after the stage of detoxification is over and reported that one-third of study subjects had cognitive dysfunction.[14]

These cognitive impairments have a significant impact on the efficacy of management. It, therefore, appears important to identify alcohol-related cognitive impairments so that alcohol treatment can be adapted to meet their needs.

With this overview, our study aims at evaluating cognitive dysfunctions mainly the executive functions, and memory in patients with alcohol dependence, which is rampant in this part of the country and such studies have not been done in this region of Northeast India.

AIMS AND OBJECTIVES

- To find out the important socio-demographic variables of the cases.
- To evaluate the different domains of executive cognition in the cases.
- To compare the scores of the alcohol-dependent subject group with the nonalcoholic control group.

METHODS

This is a descriptive study of cognitive dysfunction in patients with alcohol dependence syndrome carried out in the Department of Psychiatry, Silchar Medical College and Hospital, Assam, India which is a tertiary care teaching hospital throughout six months after taking proper approval of the institutional ethics committee. This hospital provides medical facilities to the whole Barak Valley of Southern Assam, which includes the districts of Cachar, Karimganj, and Hailakandi along with the neighboring states like Manipur, Mizoram and Tripura, India.

Participants

All patients who were admitted for detoxification of alcohol were enrolled in the study immediately after completion of detoxification with benzodiazepines and gabapentin. The average period of detoxification was about two weeks. Alcohol dependence cases were diagnosed according to the International Classification of Disease and Related Health Problems (ICD-10) criteria (clinical descriptions for diagnostic guidelines.[12]

Case

Admitted patients above 18 years of age and who gave written informed consent to participate in the study were included. Fifty subjects were included in the study. The sample was taken on the basis of purposive sampling. All the fifty subjects had a first degree relative above 18 years of age and fulfilled all the inclusion and exclusion criteria. Informed consent was obtained. There were no harms to the participants in the study. The average abstinent period before cognitive evaluation was two weeks. Cognitive assessments were conducted using the FAB and the montreal cognitive assessment test (MoCA) after 72 hours of the last dose of benzodiazepine/gabapentin used for detoxification of alcohol. Inclusion criteria for a subject group were the diagnosis of alcohol dependence obtained according to diagnostic criteria ICD-10, abstinent since at least last 3 weeks, and had not taken any psychotropic drugs since last 72 hours. Subjects having a history of any other drug abuse including tobacco, significant head injury, clinically apparent neurological problem or seizure other than alcohol withdrawal seizure, history of previous psychiatric illness, mental retardation were excluded from the study. Patients in the intoxicated state or acute withdrawal state or delirium were excluded. Details of alcohol use in the cases showed that the average duration of alcohol dependence was 3.97 ± 3.20 years and their mean amount of alcohol consumption was 26 drinks per week. Majority of the participants used to drink alone and consumed Indian made foreign liquor.

Controls

The age-matched first-degree relatives of the alcohol dependence cases were considered as controls. General Health Questionnaire scores more than two was considered as cut off point for the control group. The exclusion criteria were, having any past diagnosis of the psychiatric disorder, abusing alcohol or any other substances, clinically apparent neurological problem and significant head injury. At first, informed consent from all patients was taken after explaining them the purpose and procedure of the study. Interview pattern was flexible to elicit maximum data. For all cases, the privacy of interview and confidentiality was strictly maintained.

Tools

A standard proforma describing socio-demographic variables was used which was designed and standardized and tested in the Department of Psychiatry, Silchar Medical College Hospital. The sociodemographic proforma gave information about age, gender, religion, marital status, family type and domicile, education, occupation and socioeconomic status of alcoholic cases and their relatives.

For the assessment of the executive functions in individuals, FAB was used. FAB is a tool which differentiates between the frontal executive type of dementia and Alzheimer's type of dementia. This test has also been used for individuals with frontotemporal dementia, Parkinson's disease dementia, corticobasal degeneration,

progressive supranuclear palsy, and multiple system atrophy and also for evaluating the extent of brain injury[11] convergent correlations, receiver operating characteristic (ROC) curve and logistic regression were used to assess its psychometric properties.

We found good internal consistency, significant correlations with other tests and moderate accuracy (64% FAB is a reliable and quick bedside test which has six subtests: *Similarities, Lexical fluency, Motor Series, Conflicting Instructions, Go/No-Go, PrehensionBehaviour. FAB has good interrater reliability (k = 5 0.87, p = 0.001),* internal consistency (Cronbach's coefficient alpha = 0.78), and discriminant validity (89.1% of cases correctly identified in a discriminant analysis of patients and controls).

The FAB is easy to administer at the bedside and is sensitive to frontal lobe dysfunction. The maximum score for each subtest is 3 points, and the total score of the test is calculated by adding the scores of the six subtests (maximum score = 18). The executive function of all the cases and control were tested by applying the FAB.[11] Higher scores mean better executive functions of the individual. The original English version of the FAB was translated into Bengali by the two authors carrying out the present study, blinded to each other. The two translations were subsequently compared: minor inconsistencies were found and solved; consistency was also reached on wording for all verbal instructions.

The MoCA Test was used as a screening test for the detection of cognitive impairments in these patients,[15] as this tool is more sensitive than the mini-mental state examination (MMSE) for mild-to-moderate cognitive impairments.[16] The test is a one-page, 30-point. It assesses short-term memory recall (5 points), visuospatial abilities through clock-drawing (3 points) and cube copy (1 point), and orientation (6 points). Executive function is assessed through modified trail making part B (1 point), phonemic fluency (1 point), and verbal abstraction (2 points). A sustained-attention task (1 point), digit span (2 points), and serial calculation (3 points) test attention, concentration, and working memory. Lastly, language is assessed through naming low-familiarity animals (3 points), sentence repetition (2 points), and the fluency task. The rater adds 1 point to the score of patients with ≤ 12 years of education.

Analysis of data

Appropriate data were collected, tabulated and statistical analysis was done by GraphPad prism for windows version 6.01. Descriptive statistics were used to summarize the data. Unpaired t-test was applied to find out p-value and statistical significance wherever necessary. Significance was determined at $p < 0.05$.

RESULTS

This hospital-based study was done on 100 individuals, 50 of which were cases and 50 of which were controls. Table 1 shows the sociodemographic variables of the cases and controls.

The age of the cases is between 25 to 65 years of age with the mean age of 57.5 years. Majority of the cases

Table 1: Sociodemographic variables

Age (in years)	*Cases (n = 50)*	*Controls (n = 50)*
<25	1 (2%)	0 (0%)
25–34	6 (12%)	2 (4%)
35–44	21 (42%)	12 (24%)
45–54	18 (36%)	33 (66%)
55–65	4 (8%)	13 (26%)
Religion	*Cases (n = 50)*	*Controls (n = 50)*
Christian	2 (4%)	1 (2%)
Hindu	46 (92%)	47 (94%)
Muslim	2 (4%)	2 (4%)
Residence	*Cases (n = 50)*	*Controls (n = 50)*
Rural	35 (70%)	41 (72%)
Urban	15 (30%)	09 (38%)
Family	*Cases (n = 50)*	*Controls (n = 50)*
Joint	31 (62%)	35 (70%)
Nuclear	19 (38%)	15 (30%)
Marital status	*Cases (n = 50)*	*Controls (n = 50)*
Married	46 (92%)	46 (92%)
Separated	1 (2%)	1 (2%)
Single	3 (6%)	3 (6%)
Education	*Cases (n = 50)*	*Controls (n = 50)*
Graduate	3 (6%)	2 (4%)
Illiterate	6 (12%)	7 (14%)
Primary	34 (68%)	32 (64%)
Secondary	7 (14%)	9 (18%)
Occupation		
Business	13 (26%)	18 (36%)
Daily laborer	5 (10%)	9 (18%)
Serviceman	23 (46%)	9 (18%)
Student	1 (2%)	0 (0%)
Unemployed	1 (2%)	4 (8%)
Unskilled	7 (14%)	10 (20%)
SE Status		
High	2 (4%)	3 (6%)
Low	6 (12%)	16 (32%)
Lower middle	24 (48%)	11 (22%)
Middle	15 (30%)	20 (40%)
Upper middle	3 (6%)	0 (0%)
Duration of Alcohol Intake of the Cases (in years)		
1–5	18 (36%)	
6–10	28 (56%)	
11–15	1 (2%)	
16–20	2 (4%)	
21–25	1 (2%)	

was in the age range of 35 to 44 years (42%). These cases are mainly Hindu in religion (92%) and from the rural background (70%). The majority of the cases belonged to a joint family (62%), and 92% were married. Education wise majority of the cases were primary educated (68%) followed by secondary education (14%) while occupation wise most of the cases were servicemen (46%). Majority of the cases were from lower middle socioeconomic status (48%) followed by lower class (30%).

Figure 1 shows the duration of alcohol consumption among cases. The duration ranged from 1 to 25 years with a mean duration of 13.5 years. Maximum of the cases were in the range of 6 to 10 years (56%) followed by 1 to 5 years (36%).

The age range of the controls was from 25 to 65 as in the cases, and the majority fell in the 35 to 44 age group (40%). Majority of the cases were Hindu by religion (94%), from the rural background (72%) and belonged to joint families (70%). Ninety-two percent were married, and most of them had received primary education (64%). The controls were mainly businessmen (36%) and hailed from middle socioeconomic status (40%).

On carrying out the FAB on the cases and controls, we found out the score to assess the executive dysfunction in each case. Table 2 and Figure 2 show the mean scores of FAB of cases and controls.

Mean score in the FAB was 10.02 ± 2.64. In FAB, abstract reasoning was the most impaired domain followed by lexical fluency and mental flexibility. Relatively, environmental autonomy was found to be preserved among the participants. The majority (62%) of the participants had an average level of executive functions, and 38% had executive impairments.

On making a comparison of the scores of the FAB between the cases and the controls, it was found that the mean score of the cases was 10.02 with a standard deviation of 2.64 indicating more executive dysfunction whereas that of the controls was 16.96 with a standard deviation of 1.56 showing better executive functioning. On applying the unpaired t-test, the difference between the groups was found to be statistically significant with a p-value of <0.0001

Figure 3 shows the comparison of mean scores of montreal cognitive test of cases and controls. The mean score of the cases on Montreal Cognitive Test was 23 compared to the mean score of 27 in controls. The affected domains were-delayed recall, verbal fluency, visuospatial/executive and attention.

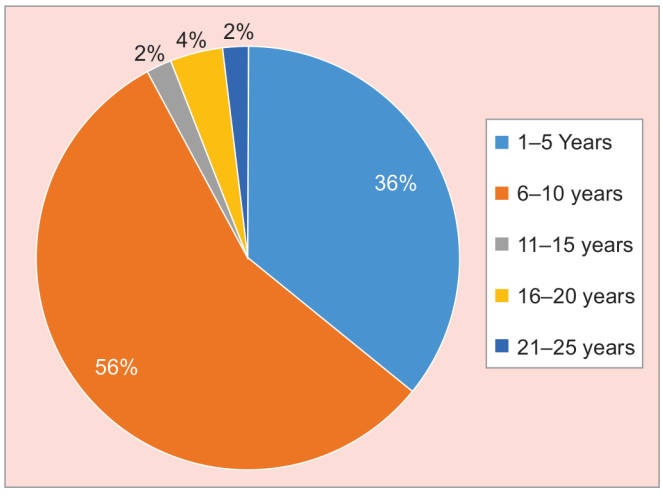

Fig 1: Duration of alcohol dependence among the cases

Table 2: Comparison of the means scores of the cases and the controls

	Cases	*Control*
Total	501	900
Mean Score	10.02	16.96
Standard dev	2.64	1.56
p-value	<0.0001	
Unpaired T-test score	21.3905	

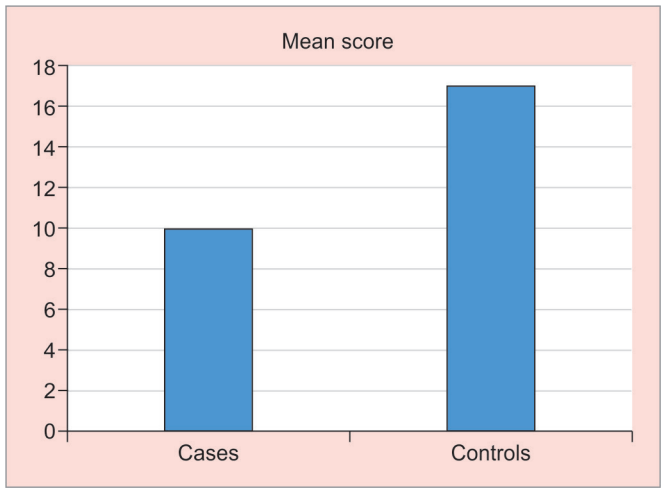

Fig 2: Comparison of mean scores of the functional assessment battery of the cases and controls

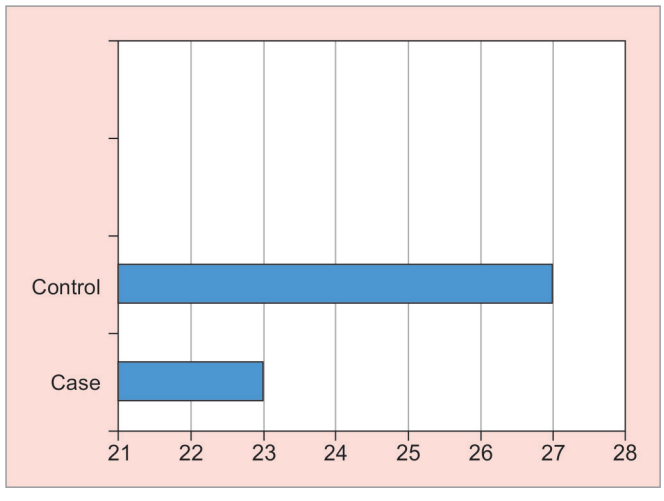

Fig 3: Comparison of mean scores of Montreal Cognitive Test of case and control

DISCUSSION

This study was to determine if chronic alcoholism had any effect on the executive functions of the individual. It was a hospital-based study in which 50 alcohol-dependent cases and 50 healthy controls were evaluated for cognitive impairment/executive dysfunction. The cases were chosen based on the ICD-10 criteria for alcohol dependence.[12] Alcoholism abuse results brain defects and associated cognitive, emotional, and behavioral impairments.

In this study, we found that the majority of the cases were in the age range of 35 to 44 years (42%) followed by the age range of 45 to 54 years (36%). This was similar to the findings of Singh et al. in which a maximum number of subjects (86%) belonged to the 36 to 45 years age group.[13]

Duration of alcohol consumption ranged from 1 to 25 years with a mean duration of 13.5 ± 8.54 years. The period of alcohol dependence ranged between 4 months to 12 years with a mean duration 3.97 ± 3.20 years. Most of the participants (52.5%) in the study had a moderate level of alcohol dependence, followed by severe (28%) and mild (19.5%) physical dependency. Similar findings were reported by Adhikari et al. in a study conducted at a tertiary hospital in Nepal involving 62 alcohol-dependent subjects.

The mean score of the Frontal Assessment battery of the cases was 10.02 while that of controls was 16.96 indicating poor executive functioning in the cases compared to the controls. Adhikari et al.[14] from Nepal reported a score of 12.33 ± 2.46 in the alcohol-dependent subjects. International studies conducted in New York also found that more the alcohol use poorer is the executive functioning.[17]

Different domains of executive functions were impaired in 38% of patients with alcohol dependence. Concept identification is a multistep task which needs memory, deductive reasoning, problem-solving and cognitive flexibility, which was impaired in most of the study participants.

Similarly mental flexibility indicates towards the problem in planning and ability to shift and maintain a cognitive set. These findings were consistent with the proposed hypothesis that alcohol dependents are poor in identifying the concept[18] and differed significantly in the task of abstract reasoning, memory discrimination, and timed tasks.[19] The three FAB's subtests; conceptualization, programming and mental flexibility which were more impaired with chronic alcohol use are found to be the tasks that have been associated with the functioning of different areas of the prefrontal cortex.[20]

Jha et al. assessed the conceptual ability of thirty alcohol-dependent subjects with Wisconsin card sorting test (WCST) and compared the findings with thirty-first-degree relatives and thirty normal controls and opined that–alcohol-dependent patients had poor conceptual ability than their first degree relatives or normal control. Alcohol dependents in this study demonstrated significant impairment of abstract ability, error utilization and persuading goal-directed behavior.[21] Earlier studies that investigated various executive functions among recently abstinent alcoholic individuals (i.e., sober for 3 weeks) reported deficits in inhibition of prepotent response[22] cognitive flexibility and decision making,[23] planning[24] and abstraction.[25,26]

In our study, the MoCA test was utilized for evaluating cognitive functions in alcohol-dependent subjects. Copersino et al.[15] assessed the validity, accuracy, and clinical utility of a brief (10-min) screening instrument, the MoCA, in identifying cognitive impairment among patients with substance use disorders. The neuropsychological assessment battery- screening module was used as the reference criterion for determining rates of correct and incorrect decision classifications, and criterion-related validity for the MoCA. The MoCA showed acceptable sensitivity (83.3%) and specificity (72.9%) for the identification of cognitive impairment. These findings indicate that the MoCA provides a time-efficient and resource-conscious way to identify patients with substance use disorders (SUDs) and neuropsychological impairment, thus addressing a critical need in the addiction treatment research community. We have found four areas of impairment in cognitive functions in alcoholics namely–delayed recall, verbal fluency, visuospatial/executive function, and attention. Adhikari et al. used PGI memory scale in alcoholics and reported that almost half of the subjects had impairment in–delayed recall, recognition, attention, and concentration.

Results of research employing a variety of different techniques have determined that the brain structures most vulnerable to the effects of alcoholism are the neocortex (especially the frontal lobes), the limbic system, and the cerebellum (reviewed by Moselhy et al. 2001). The frontal lobe, amygdala, hippocampus, and hypothalamus are the most affected regions in the brain and are vital organs involved in executive functions and memory.

These findings will help the clinician to recognize that a subgroup of chronic alcohol patients will manifest difficulty in treatment that is due to their lack of appreciation of the impact that advice and therapy will have on their lives. These patients fail to see the importance of ideas and events in treatment because they fail to recognize general rules and successful ways to cope effectively on neuropsychological test in question. Findings facilitate understanding that cognitively impaired alcoholic patients may not be able to comprehend the information imparted during therapy and, thus, may not make full use of the strategies presented, thereby limiting their benefit from intervention.

CONCLUSION

Our study found that the majority of the alcohol-dependent subjects were young and were Hindu by religion. The highest duration of alcohol intake was found to be in the range of 6 to 10 years. We can also conclude that regular and long-term alcohol intake significantly impairs the executive functions. Hence, routine neuropsychological assessment is of particular importance for early detection and remediation of underlying deficits, which completes the treatment of alcohol dependence.

LIMITATIONS

- It was a hospital-based study.
- We did not compare the executive dysfunction with various variables associated with alcoholism like the severity of dependence, duration of alcohol intake, amount of alcohol intake and age.

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