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Original Research Article

Neuropsychological Profile of Persons with Alcohol Use Disorder: Findings from De-addiction Centres of Delhi-NCR

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ABSTRACT

Background: Persons with alcohol use disorder exhibit mild-to-moderate deficits in cognitive functioning including attention span, working memory, executive functions, visuospatial abilities and verbal fluency. Depression is also known to play a mediating role during this decline.

Aim: This study aims to understand differences in the cognitive functioning among the persons with alcohol use disorder and non-users.

Method: For this study, a purposive sample of 50 male patients with alcohol dependence and 50 male normal participants was collected from different de-addiction centres located in Delhi and NCR. PGI Memory Scale, NIMHANS Neuropsychological Battery and BDI-II were used for the purpose of this study. To analyse the data t-test, Chi-Square/Fishers Exact Test and Correlation were used.

Results: The results of the study revealed that majority of the participants in the alcoholic group were unmarried, having undergraduate degree. The family history of alcohol abuse was seen in 64% of the participants in the alcoholic group. The minimum and maximum initiation age of alcohol consumption was 15 and 27 years respectively. Mild impairment in cognitive functioning like attention & concentration, executive functioning, abstraction and comprehension was reported in the alcoholic group. However, minimal impairment was found in verbal learning & memory, visual learning & memory and visuomotor gestalt along with mild depression among the persons with alcohol use disorder; although, there was no difference in the performance between depressed and non-depressed alcoholics in terms of verbal fluency and free recall deficits.

Conclusions: Long-term use of Alcohol affects cognitive functions. This knowledge can be used as awareness campaign against alcohol use and by clinical psychologists in planning effective psychotherapeutic interventions.

Keywords: *Alcohol Consumption, Addiction, Cognitive Functioning, Disorder*

INTRODUCTION

Alcohol is one of the most commonly used substances. Overall, 14.6% (around 16 crore) Indian population consumes alcohol (Ambekar et. al., 2019). Alcohol related disorders have become matter of global concern because of negative impacts of alcohol use on individual health, families, and social systems. It is also known to cause dramatic impacts on the national productivity and steep shifts in economic balance due to various disabilities associated with it at individual level.. Global data suggests alcohol consumption led to 99.2 million Disability Adjusted Life Years (DALY) & 4.2 millions of all DALY. However, the burden of disease attributable to alcohol use is associated with other health outcomes. (GBD 2016 Alcohol and Drug Use Collaborators, 2018).

Alcohol use is associated with multiple cognitive deficits including attention, working memory, executive functions, visuospatial abilities, impulsivity, learning, memory and verbal fluency (Gooden et al., 2021). In some severe cases, individuals may also develop alcohol related dementia, Korsakoff's syndrome and Wernicke's encephalopathy. The cognitive decline is found to be significant during the early abstinence period (Stavro et al., 2013). Excessive consumption of alcohol results in memory impairment. Studies have highlighted significant impact on episodic memory, whereas implicit memory remains intact (Berre et al., 2017). Persons with alcohol use disorder are also found to be depressed resulting in increased craving for alcohol (Kuria et al., 2012).

Many researchers have studied the impact of chronic alcohol use on attention and other cognitive functions. Parada et. al., (2012) analysed binge drinking and cognitive functions in university students using WMS-III on which poorer scores were reported among binge drinkers. Freydier et al., (2014) studied divided attention among drivers due to alcohol intoxication using car-following task and found decrease in additional task performance, and divided attention task due to a higher blood alcohol concentration (BAC $\geq$ 0.5g/L). Combination of alcohol and sleep deprivation results in reductions in vigilant attention, and slowing down the voluntary allocation of attention (Lee et al., 2015). In another study, significant impairment was found in selective attention during alcohol hangover (Devenney et. al. 2019). In a systematic review binge drinking & heavy alcohol consumption was found to be linked with poor scores on several domains of cognitive functioning including attention, learning, memory,

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visuospatial functioning, psychomotor speed, executive functioning, and impulsivity (Lees et. al., 2020).

In a longitudinal study, Peeters et al. (2014) found that working memory functions in a 2-way- it can be negatively influenced by alcohol use as well as it can also act as a risk factor for the alcohol consumption due to its poor development in at-risk adolescents. In another study, alcohol consumption was found to be associated with slower improvement on letter fluency and global cognition over time (Beydoun et al., 2014). Despite of prevailing notions for genetic associations between alcohol use and cognitive functions, Kumari et al., (2014) could not see any stronger evidences in favour such as a relationship between alcohol intake and cognitive functions (immediate and delayed word recall, verbal fluency and processing speed). In an investigatory study, Monnig et al., (2016) reported highest rates of neuro-cognitive impairment in learning (50.8%), executive function (41.9%), and memory (38.0%) for 5.6 ± 3.5 as an average number of drinks per drinking day. Domagała et. al., (2017) reported significant disturbances of cognitive functions and presence of severe frontal cerebral cortex dysfunctions affecting verbal fluency and working memory in alcohol-dependents. Martins et. al., (2017) explored a relationship between executive functioning, affect-regulation, drinking motives & alcohol related problems and found that both enhancement and coping motives predicted the pattern of alcohol use and consequences related to it. Brion et. al., (2017) observed that alcohol-dependent patients showed slowing down of reaction time, deficit in inhibition & impairment for shifting and updating executive functions. In an observational cohort study, Topiwala et. al., (2017) reported severe brain damage and a swift decline in cognitive functions like lexical fluency due to moderate or heavy drinking (more than 14 units/week). In a meta-analysis, 77 studies with 5140 sample seen the effects of alcohol use on the individual subcomponents of executive functioning and impulsivity. It was reported that planning, problem solving, and inhibitory abilities were significantly affected by alcohol abuse (Stephan et al., 2017). In another study, participants having affected working memory with poorer executive functioning or behaviour dysregulation are more likely to consume alcohol (Looby et al., 2018). Gunn et. al., (2020) reported increased errors in task switching, n-back and continuous performance test during a hangover indicating impairment of core executive functions due to alcohol consumptions.

Several studies attempted to find out a relationship between alcohol and depression. Rabassa et. al., (2020) found a positive correlation between alcoholism and depression & executive dysfunctions in an alcoholic group along with mental co-morbidities. By analysing data from a cross-sectional study, Jacob et. al., (2021) found that the prevalence of depressive symptoms was higher for those who reported an increase in the amount of alcohol during COVID-19. Bing-Canar et. al., (2021) examined effect of depressive symptoms on alcohol use and alcohol cue reactivity in trauma-exposed young adults currently using alcohol. It was found that depressive symptoms were associated with elevated drinking coping motives, symptom severity, and alcohol use problems at baseline.

Such cognitive impairments due to alcohol use make it difficult for an individual to access the treatment. Neuropsychological assessments can be conducted to evaluate the cognitive functioning of the individuals, and providing them with the correct diagnosis and treatment plan. This paper aims to study the neuropsychological profile of the persons with alcohol use disorder and non-alcoholics and study significant differences between both the groups.

METHODS

Settings:

The data was collected from different de-addiction centres located in Delhi-NCR.

Participants:

A purposive sample of 100 males was divided into experimental (n=50) & control group (n=50). Experimental group comprised of 50 in-patients diagnosed with alcohol dependence syndrome from de-addiction centres located in Delhi-NCR. Control group comprised of 50 male participants who were patient's relatives and friends without alcohol use disorder. All the participants were recruited as per the inclusion and exclusion criteria. Participants were informed that the collected data will be used for research purposes.

Inclusion criteria for experimental group: Male patients between 20 & 50 years, with the diagnosis of alcohol dependence syndrome, can read and understand Hindi and willing to give written consent were included.

Exclusion Criteria: Any major psychiatric or medical illness which may hinder the assessment process.

Inclusion and exclusion criteria for control group included all above except the diagnosis of alcohol dependence syndrome.

Measures:

Socio demographic data sheet: Socio-demographic details of the participant were recorded in a proforma, specifically designed for the purpose of this study which included details like age, sex, occupation, marital status, domicile, religion, age of onset, total duration of alcohol consumption, family history etc.

PGI Memory Scale: Developed by Pershad & Wig (1977). There are 10 subscales assessing mainly recent & remote memory recognition and retention etc. It takes around 45 minutes to one hour to complete this test. This is a highly reliable and valid test. The test-retest reliability was found to be between .70 & .80, and split half reliability was found to be .91. Its validity was also found to be high as its correlation with Boston memory scale .71 & .81 with Wechsler memory scale.

NIMHANS Neuropsychological Battery: It is used for neuropsychological assessment intended to examine both the working brain and dysfunctional brain. It was developed by Rao (2004) at NIMHANS, Bangalore. There are 5 tests and 18 subtests assessing various cognitive domains. It takes around 2 To 2 ½ hours to complete this test. This is a highly reliable and valid tool. In the present study, we have used following sub-tests: attention and concentration, executive functions, abstraction, comprehension,

visuomotor coordination (BGT), recognition, verbal and visual memory.

Beck Depression Inventory II: Developed by Beck (1987) to assess the severity of depression. It is a 21-items self-rating scale and, in each item, there are 3 or 4 statement with increased severity (0-3). Patient has to select one of the statement scores that will be added up which gives a total score (0-63). It takes around 20-30 minutes for administration. It is a highly reliable & valid tool. It has been found that most of the substance dependent patients report depressive feelings & thoughts.

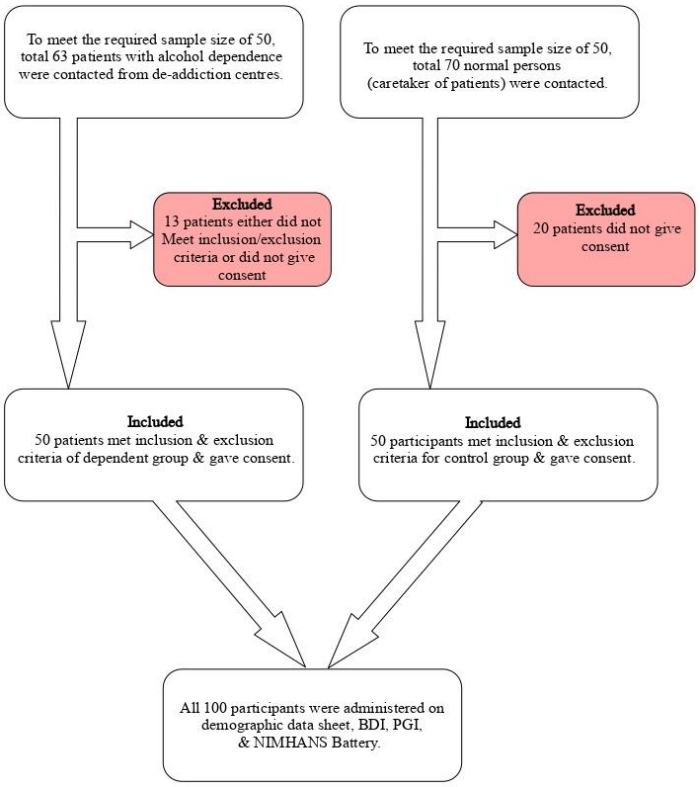
Data Analysis:

Data was analysed using Frequency, Percentage, Mean, SD, t-test, Chi-Square/Fishers Exact Test and Correlation were used to analyse the data.

Procedure:

Total 100 participants were included in the study. Fifty male patients diagnosed with alcohol dependence by the psychiatrists at de-addiction centres as per ICD-10 (WHO-1993) were recruited. Fifty male participants were recruited in control group who were patient's relatives or friends without alcohol use disorder. Participants were explained about the study and their written informed consent was taken. All the participants were interviewed and information regarding demographic and clinical details was collected. Filling of Socio-demographic data sheet was followed by administration of PGI Memory scale, NIMHANS Neuropsychological Battery and BDI. All tools were administered within a week by giving adequate time gaps between the tests to eliminate the effect of boredom and fatigue during assessment. Procedure is depicted in flow chart as follows:

FLOW CHART (PROCEDURE)



RESULTS

Participant Characteristics:

A total of 100 participants were recruited for the study, 50 in experimental group and 50 in the control group. The mean age of the experimental group was 34.22±5.82 years and 35.24±5.17 years for control group. Seventy per cent were unmarried in the experimental group whereas in control group 66% were unmarried. Fifty-two per cent of persons with alcohol use disorder (AUD) and 58% participants of control group were under graduates. In persons with AUD, family history of abuse was seen in 64% participants whereas in control group it was reported by 16% participants only. Characteristics of participants are presented in table 1.

Table 1: Characteristics of Participants

Demographics		**Groups**		**Total**
		Persons with alcohol use disorder (n=50)	Controls (n=50)	
Marital Status	Unmarried	35(70%)	33(66%)	68
	Married	12(24%)	17(34%)	29
	Separated	3(6%)	------	3
Education	Primary	3(6%)	3(6%)	6
	High	21(42%)	17(34%)	38
	UG & Above	26(52%)	30 (60%)	56
Occupation	Unemployed	3(6%)	2(4%)	5
	Labourer	7(14%)	9(18%)	16
	Regular Job	29(58%)	31(62%)	60
	Self-Employed	11(22%)	8(16%)	19
Domicile	Urban	48(96%)	49(98%)	97
	Rural	2(4%)	1(2%)	3
Religion	Hindu	45(90%)	43(86%)	88
	Muslims	1(2%)	5(10%)	6
	Others	4(8%)	2(4%)	6
Types of family	Nuclear	45(90%)	45(90%)	90
	Joint /Extended	5(10%)	5(10)	10
Family History of Alcohol Use	Present	32(64%)	8(16%)	40
	Absent	18(36%)	42(84%)	60

Clinical characteristics of experimental group:

The mean age of initiating alcohol use was 18.88±2.16 years. Mean duration of illness was 15.38±6.09 years. Clinical characteristics are presented in table 2.

Table 2: Mean & SD of Age of Onset and Duration of Illness in Experimental group (n=50)

Variables	**Minimum**	**Maximum**	**Mean**
Age of onset	15.00	27.00	18.88 (±2.16)
Duration of Illness	5.00	26.00	15.38 (±6.09)

Performance of both the groups on different tests:

The performance on Neuropsychological Battery of both the groups (i.e. Persons with alcohol use disorder & Controls) was recorded as Intact (No Impairment), Minimal impairment and moderate impairment. Attention and concentration were found to be minimally impaired in 22 and 3 participants of experimental and controlled group respectively ($p<0.01$). Eleven participants in alcoholic group have minimal difficulty in executive functions whereas in control group only one subject has difficulty ($p<0.01$). Minimal impairment was found in Abstraction in 19 participants of experimental group and 3 participants in control group ($p<0.01$). Verbal Learning & Memory minimally impaired in 28 participants of alcoholic group and 3 participants of the control group ($p<0.01$). Minimal difficulty in Visual learning and memory was seen in 21 participants of alcoholic group and 5 participants of control group ($p<0.01$). Nine participants in alcoholic group and 2 participants control group had minimal difficulty in comprehension ($p<0.05$). The visuomotor gestalt was intact in alcoholic group in 46 participants whereas it was intact in all the 50 participants of control group ($p<0.05$). Recognition was found to be intact. Only 4 participants in alcoholic group and 2 participants in control group had minimal difficulty in recognition (not significant).

The result of performance of both the groups on different tools is presented in table 3.

Table 3: Performance of both the groups on different tools

Tests	Experimental		Control		Fisher's exact test
	Intact	Mild	Intact	Mild	
Attention & Concentration	28	22	47	3	19.06**
Executive Functions	39	11	49	1	9.35**
Abstraction	31	19	47	3	14.77**
Comprehension	41	9	48	2	4.96**
Visuo-Motor (BGT)	46	4	50	0	4.13**
Recognition	46	4	48	2	0.70 NS
Verbal Learning & Memory	22	28	47	3	28.93**
Visual Learning & Memory	29	21	45	5	13.17**

**= significant at 0.01 level; NS= Not Significant

On PGI Memory Scale, a total of 7 participants from the experimental group performed below 40th percentile whereas, none of the participants from the control group performed that low ($p<0.01$). Thirty-three participants in experimental group and 10 participants in control group reported mild depression on the BDI-II ($P<0.01$). The result of PGI Memory Scale of both groups is presented below in table 4.

Table 4: PGI Memory Scale (Total Score)

Test Percentile (PGI Memory Scale)	Experimental group	Control group
Above 60th percentile	10	40
40th to 60th percentile	33	10
Below 40th percentile	7	0

Table 5: Correlation matrix of different sub-scales

	Executive functions	Abstraction	Comprehension	BGT	Recognition	Verbal Learning Memory	Visual Learning Memory	PGI Total	BDI
Attention & concentration	.593**	.696**	.356**	.438**	.314**	.513**	.309**	.566**	.430**
Executive functions		.472**	.165	.553**	.425**	.351**	.272*	.454**	.363**
Abstraction			.353**	.384**	.272**	.427**	.181	.524**	.416**
Comprehension				.091	.046	.317**	.229*	.244*	.211*
BGT					.593**	.305**	.228*	.470**	.235*
Recognition						.195	.330**	.311**	.121
Verbal Learning & Memory							.589**	.534**	.466**
Visual Learning & Memory								.484**	.452**
PGI Total									.634**

** = Correlation is significant at the 0.01 level &
* = significant at the 0.05 level.

Correlation among different tests was seen using correlation matrix (Table 5). Attention and concentration were significantly correlated ($P<.01$) with executive functions, Abstraction, Comprehension, BGT, Recognition, Verbal and Visual learning & memory, PGI Memory scale and BDI. Executive function was also significantly correlated ($P<.01$) with all the other subtests except comprehension. Abstraction was also significantly correlated ($P<.01$) with all tests except visual learning & memory. Comprehension was not correlated with executive function, BGT and recognition only. BGT was correlated with all except comprehension. Recognition was correlated with all except comprehension, verbal learning & memory and BDI. Verbal Learning & Memory was significantly correlated with all except recognition. Visual learning & memory was correlated at .01 with attention, recognition, verbal learning & memory, PGI and BDI. It was not correlated with abstraction and with rest of the tests it was significant at .05. PGI memory scale was significantly correlated at .01 level with all tests except comprehension ($P<.05$). BDI was also significantly correlated with all the scales except recognition.

DISCUSSION

This study was aimed at understanding the differences in the cognitive functioning among the persons with alcohol use disorder and non-alcoholics. A total of 100 participants were taken for the study where, 50 were in experimental group and 50 in control group.

The results revealed that majority of the participants in the alcoholic group were unmarried, having undergraduate degree. Three percent of the alcoholic population was divorced which means that alcoholism could be a reason for the divorce. The family history of alcohol abuse was seen in 64% of the participants in the experimental group. Therefore, people with positive family history of alcoholism should be considered as a high risk group (Sarkar et al., 2013).

The minimum and maximum initiation age of alcohol consumption was 15 and 27 years respectively and the mean year of duration of alcohol intake was 15.38 years. The onset of initiation of consumption of alcohol and the amount consumed was found to be good predictors cognitive and motor impairment (Sullivan et al., 2000). A total of 52% of persons with alcohol use disorder and 58% controls participants were under graduates. Although, educational background generally does not influence performance on neuropsychological test, however, some reading and writing skills are required to complete the assessment. The majority of the sample was having regular job. However, persons with alcohol use disorder (58%) were not regular in the job due to alcohol intake.

In a study by Schottenbauer et. al., (2007), deficits in memory & learning were reported among alcohol consumers even after controlling for age. The significance of age was reduced as a predictor when number of years of heavy drinking were entered into regression equation. Results suggest about the existence of a direct link or relationship between alcohol use & memory impairments beyond the effects of age or education. In our study also, though age was matched but neuropsychological deficits were shown mainly by alcoholic patients.

Attention and concentration was found to be significantly impaired ($p<0.01$) between both the groups. The groups also differed significantly in executive functioning ($p<0.01$), which is supported by the finding of study conducted in year 2007 and 2010 (Green et al., 2010; Noël et al., 2007). Group comparisons revealed cognitive as well as affective humour processing deficits of alcoholics. The observed impairments related to executive functions (Uekermann et al., 2007). Abstraction and comprehension was also found to differ significantly among the control and the alcoholic group ($p<0.01$) and ($p<0.05$) respectively, can be supported with the study (Oscar-Berman & Marinković, 2007).

The alcoholic group was also found to be minimally impaired in Verbal Learning & Memory ($p<0.01$), Visual learning and memory ($p<0.01$) and Visuomotor gestalt ($p<0.05$).

On total scores of PGI Memory Scale only 7 participants of alcoholic group performed below 40^{th} percentile, 33 between 40^{th} – 60^{th} percentile and 10 participants above 60^{th} percentile. In control group 10 participants were between 40^{th} -60^{th} percentile and 40 participants were above 60^{th} percentile. Fisher's Exact Test was found to be significant. This shows both the groups differed significantly on PGI total scores.

A study investigated the effects of alcoholism on components of memory and meta-memory. Results revealed deficits in accuracy, with the alcoholic patients providing overestimations. There were also links between inaccuracy, executive decline, and episodic memory impairment in patients. Episodic memory deficit and executive dysfunction explained meta-memory decline in this clinical population (Berre et al., 2010).

33 participants in experimental group and 10 participants in control group reported mild depression on the BDI-II ($P<0.01$). Free call deficits along with verbal fluency were reported among depressive patients. However, performance remained invariably similar among both groups (depressed & non-depressed alcohol consumers). There is a relationship between depression and executive deficits in persons with AUD with evidence of major depression.

It was a well-planned study on persons with alcohol use disorder & cognitive functions. The neuropsychological functions were assessed using standardized test and BDI was included to rule out the effects of depression on cognitive functions. Control group was taken to compare the performance on neuropsychology so the difference of scores can be attributed to alcohol use and the large sample size increased the validity of the findings.

However, there are some limitations of this study. All the patients who were assessed on neuropsychological test were abstinent for just 1or 2 weeks, so the deficits seen may not be observed after a month or so. So, a prospective study can be planned to see the cognitive deficits in alcohol dependent patients periodically. The study was limited to Delhi-NCR only and duration of addiction was not controlled. Other impacts of alcohol dependence were not studied.

CONCLUSION

Long-term use of Alcohol affects cognitive functions. This knowledge can be used as awareness campaign against alcohol use and by clinical psychologists in planning psychotherapeutic interventions.

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