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A Comparision of Neuro Cognitive Deficits between Alcohol Dependents and Social Drinkers

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ABSTRACT

Chronic use of alcohol has been consistently associated with neuropsychological impairments with respect to cognitive flexibility, problem solving and decision making. Few studies have mentioned that there is impairment in psychomotor speed and cognitive flexibility in social drinkers. The present study aimed to compare the Neuro cognitive deficits between alcohol dependents and social drinkers. This was a cross sectional hospital based study conducted at the Department of Psychiatry, in SRM Medical College, Hospital & Research Centre, Kancheepuram, Tamil Nadu and purposive sampling was used. The sample consists of 60 participants with Alcohol dependents and Social drinkers (30 each group), diagnosed as per ICD-10 (WHO, 1992) fulfilling the inclusion and exclusion criteria. After taking informed consent from patients Alcohol use disorder identification test (AUDIT), Wisconsin Card Sorting Test (WCST), Trail Making Test (TMT), Working Memory Index from WAIS-IV, Rey Auditory Verbal Learning Test and Rey-Osterrieth Figure Complex Test were administered to all participants. Data was analyzed using (SPSS) 16.0 version. Mann – Whitney U Test was applied to observe the significant difference between the groups. Result showed that social drinkers performed significantly better in neurocognitive functions than the Alcohol Dependents. Alcohol dependents performed poorly on executive function, they showed mild impairment in perseverative response, perseverative error, total number of errors and categories completed in WCST. Furthermore, alcohol dependents showed less psychomotor speed and cognitive flexibility, than the social drinkers. Additionally, Social drinkers were better at working memory, total learning, visuospatial learning and memory than alcohol dependence.

Key Words: Visuospatial learning, Working Memory, Executive function.

INTRODUCTION

Executive functioning (EF) broadly refers to higher-order cognitive processing involved in the planning, initiation, and regulation of purposeful behavior (Elliott, 2003; Giancola, 2000). Chronic use of alcohol has been consistently associated with neuropsychological impairments with respect to cognitive flexibility, problem solving and decision making (Moselhy et al., 2001). Furthermore, there is considerable evidence that prolonged alcohol consumption may lead to brain atrophy and altered regional brain metabolism (Bendszus et al., 2001). In a study by Chanraud et al. (2007), who documented that alcohol-dependent patients were impaired with regard to their performance in the TMT-B and the WCST, but not in the Letter–Number-Sequencing Test (Wechsler, 1997), which provides a measure of working memory. Various cross-sectional studies have shown impaired TMT performance in alcohol-dependent individuals with 2 to 7 weeks of abstinence compared with nondependent controls (Fitzhugh, Fitzhugh, & Reitan, 1965).

Duning, et al. (2008) found impaired TMT performance in social drinkers with a Blood alcohol content (BAC) of approximately 110%, but not in social drinkers with a BAC of approximately .030% or .065%, relative to their own baseline performance, whereas Gilbertson, Ceballos, Prather, and Nixon (2009) found impaired TMT performance only in older social drinkers with a BAC of approximately .040% relative to their own baseline performance. However, high and medium alcohol dose participants (participants with target BACs of .100% and .075%, respectively) displayed impaired performance on the WCST and TMT.

Working Memory is widely considered a critical component of decision making. Working memory is generally defined as a limited-capacity mechanism (or set of mechanisms) that temporarily maintains and stores information for possible further cognitive processing (Ecker et al., 2010). Perhaps, the process of working memory most relevant to drug addiction is the executive process because it deals with the ability to manipulate information held in memory and the

ability to act on this information. Attentional processes, such as attention capacity, attentional control, and attention shifting, are critical components of the working memory system (Cowan, 1999; Finn, 2002; Kimberg & Farah, 1993).

Studies have shown that alcohol-dependent individuals often express distinct impairments in visual processing abilities, whereas verbal functions are relatively preserved (Fabian, et al., 1984; Stavro et al., 2013; Wegner et al., 2001). Cognitive assessment in Alcohol Dependence individuals has significant practical and clinical applications. It is generally accepted that poor cognitive functioning increases the risk for relapse in Alcohol Dependence patients (Allsop et al., 2000; Parsons et al., 1990). Effective coping with external and internal cues that may provoke drinking is supposed to be a function of efficient executive control (Giancola & Moss, 1998). Inhibition and working memory deficits predict early relapse (Noel et al., 2002). The Operational definition for social drinker in this study is that, those individual who do not meet the criteria for alcohol dependence, do not experience withdrawal symptoms, no legal encounters, accident not due to the consumption of alcohol were considered as social drinkers. Those whose volume of drinking not exceeded beyond the average level of consumption. The specific objectives of this study was to compare the Neuro cognitive deficits between alcohol dependents and social drinkers.

METHOD

Sample:

This was a cross sectional hospital based study conducted at the Department of Psychiatry, in SRM Medical College, Hospital & Research Centre, Kancheepuram, Tamil Nadu and purposive sampling was used. The sample consists of 60 participants with Alcohol dependents and Social drinkers (30 each group), diagnosed as per ICD-10 (WHO, 1992) fulfilling the inclusion and exclusion criteria.

Inclusion Criteria for Alcohol dependents

- Those who fulfilled the ICD-10 (DCR) criteria for Alcohol dependents
- Those who score above 11 in AUDIT
- Age range between 18 to 45 years.
- Minimum 8 years of education
- Only Male patients

Exclusion Criteria for Alcohol dependents

- Those with a primary diagnosis of other psychiatric condition
- Dependence on any psychoactive substance, except alcohol, nicotine and caffeine
- History of seizures, Mental retardation, head injury and other neurological condition.

Inclusion Criteria for Social Drinkers

- Participants identified alcohol as their primary drug of use
- Participants who did not meet the ICD-10 criteria for Alcohol dependence and Harmful Use
- Age range between 18 to 45 years.
- Minimum 8 years of education
- Only Male patients

Exclusion Criteria for Social Drinkers

- Those with a primary diagnosis of other psychiatric condition
- Dependence or harmful use of any psychoactive substance, except nicotine and caffeine
- History of seizures, Mental retardation, head injury and other neurological condition.

DESCRIPTION OF THE TOOLS

Socio Demographic and Clinical Data Sheet:

A socio demographic and clinical data sheet was specifically designed for the study to record relevant details of each case. The semi-structured Performa contained socio-demographic and clinical characteristics which include age, education, marital status and occupation.

Alcohol Use Disorders Identification Test (AUDIT) (WHO, 1993)

The 10 AUDIT questions consist of 3 domains: question 1–3 (domain 1) measure alcohol consumption by frequency of drinking, typical quantity and frequency of heavy drinking. Question 4–6 (domain 2) refers to dependence symptoms measured by the respondents' impaired control over drinking, increased salience of drinking and morning drinking. Questions 7–10 (domain 3) refer to behavioral, cognitive and physiological consequences that may develop after repeated alcohol use. All 10 items were summed up to an AUDIT total score (ranging from 0 to 40). Higher scores in AUDIT total score indicate greater likelihood of hazardous and harmful drinking.

Wisconsin Card Sorting Test (Heaton et al., 1993)

The Wisconsin card sorting test (WCST) consists of four stimulus cards and two deck of 64 response card that depict figures of varying form, colours and numbers. The four stimulus card are placed before the subject and is instructed to match each consecutive cards from the deck with one of the four stimulus cards whichever he or she thinks matches with the stimulus card. The examiner simply gives a feedback to the subject of whether each response is right or wrong and is never told the correct sorting principles. Once the client is made a specified number of consecutive correct matches to the initial sorting principle (usually to colour) the sorting principle is changed without any warning, requiring the client to use the examiners feedback to develop a new sorting strategy, the test proceeds in this manner through a number of shifts in set.

Comprehensive Trail Making Test (CTMT) (Reynolds, 2002)

The CTMT comprises a standardized set of five visual searches. The basic task of trail making test, is to connect a series of stimuli in a specified order as rapidly as possible. The primary score derived for each trail is the number of seconds required to complete the task. Trail 1 consists of number 1 through 25, each contained in a plain black circle, trail 2 consist of numbers 1 through 25 with plain black circle along with empty circle, trail 3 consist of numbers 1 through 25 with plain black circle along with empty circle and distracter circles containing irrelevant lines, trail 4 consist of numbers 1 through 20, where 11 of the numbers are presented as Arabic numerals and remaining are spelled out in English language form, trail 5 consist of alternating sequence the numbers 1 through 13 and the letters A through L (A-1, B-2, C-3). The time required to complete CTMT is approximately 5 to 12 minutes.

Working Memory Index from WAIS-IV (Wechsler, 2013, Indian Version)

This test assesses focused attention. The subject listens to a series of numbers read by the examiner and repeats the numbers aloud. For the Digits Forward trial, the subject repeats the digits in the order that they were presented. In the Digits Backward trial, the subject repeat the digits in the reverse order. The number of correct responses is recorded for each trial and summed as a measure of focused attention and working memory (Digit Span total).

Rey Auditory Verbal Learning Test (Schmidt, 1996)

RAVLT was used for assessing learning and memory. The Auditory Verbal Learning and Memory was assessed using two separate measures, namely, learning and memory for list of words and for Logical Memory. With respect to the same, the sub-domains of Auditory Verbal Learning and Memory that were assessed were Immediate Recall of List of words, Delayed Recall of List of words, Total Learning of List of words, Long Term Percentage Retention of List of words, Delayed Recall of List of words, Recognition for List of words, Immediate Recall for Logical Memory, Delayed Recall for Logical Memory.

Rey-Osterrieth Figure Complex Test (Meyers & Meyers, 1995)

The subject is asked to copy an abstract geometric figure. After 3 min, the participant is asked to draw the figure from memory. The score for the memory component of this test is the number of correctly drawn aspects of the original figure after the 3-min delay.

Procedure for Data Collection

After getting approval from the institutional ethics committee of SRM University, individual who were fulfilling the inclusion and exclusion criteria were taken up for the study. Written informed consent was taken from the patient and the normal's after explaining the objectives and procedure of the study in detail. Socio-demographic data was also collected. After that, Alcohol use disorder identification test (AUDIT) was administered to screen the alcohol dependents and those who are above the mean score of 11 in AUDIT were taken for the study. Executive function tests were administered in the following order. Wisconsin Card Sorting Test (WCST), Trail Making Test (TMT), Working Memory Index from WAIS-IV, Rey Auditory Verbal Learning Test and Rey-Osterrieth Figure Complex Test.

DATA ANALYSIS

The statistical package for social sciences (SPSS) 16.0 for windows was used for statistical analysis. Descriptive statistics calculated for socio-demographic variables. We have checked the data for normality and found to be non-nominal. Mann – Whitney U Test was applied to observe the significant difference between the groups.

RESULTS

Table-1: Socio demographic variables of alcohol dependent and social drinker group

Variables		Alcohol dependent Mean ± SD/ n(n%)	Social drinker Mean ± SD/ n(n%)	χ2 / F	p
Age (years)		31.30±8.44	31.40 ± 5.80	0.05	0.95
Education (years)		13.03±2.42	14.90±1.84	3.353	.18
Marital status	**Married**	11 (36.7)	12(40)	1.00	1.00
	Unmarried	18 (60)	18 (60)		
	Divorced	1 (3.3)	0		
Occupation	**Student**	0	2 (6.7)	3.68	0.133
	Employed	21 (70)	24 (80)		
	Not employed	9 (30)	4 (13.3)		

Table 1 shows descriptive statistics of socio demographic variable of both alcohol dependent and social drinker. It was observed that the mean age of alcohol dependent was 31.30±8.44 and the mean age of social drinker was 31.40 ± 5.80. Similarly, the mean years of education of alcohol dependent and social drinker was 13.03±2.42 and 14.90±1.84 respectively. Majority of the alcohol dependent and social drinker group were not married 18 (60) and 18 (60) respectively. Furthermore, majority of the alcohol dependent group and social drinker group were employed 21(70) and 24(80) respectively.

Table 2: The Mean Rank of Wisconsin Card Sorting Test (WCST) between Alcohol Dependents and Social Drinkers groups (N = 60)

Variables	Alcohol dependents		Social drinkers		U	Z	p
WCST	**Mean Rank**	**Sum Rank**	**Mean Rank**	**Sum Rank**			
Perseverative Response	22.60	678.00	38.40	1152.00	213.0	3.510	.000***
Perseverative Error	24.17	725.00	36.83	1105.00	260.0	2.813	.005**
Total Number of Errors	22.13	664.00	38.87	1166.00	199.0	3.716	.000***
No. of Categories Completed	22.10	663.00	38.90	1167.00	198.0	4.064	.000***

***p<.001 **p<.01

Table 2 shows the comparison of Wisconsin Card Sorting Test between Alcohol Dependents and Social Drinkers using Mann Whitney test. The analysis reported the mean rank of alcohol dependents in perseverative response is 22.60 and social drinkers is 38.40 with the significant Z value of 3.510 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents. Similarly, the mean rank of alcohol dependents in perseverative error is 24.17 and social drinkers is 36.83 with the significant Z value of 2.813 (p<.01). The mean rank is significantly higher in social drinkers than in alcohol dependents. Furthermore, the mean rank of alcohol dependents in total error is 22.13 and social drinkers is 38.87 with the significant Z value of 3.716 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents. The mean rank of alcohol dependents in categories completed is 22.10 and social drinkers

is 38.90 with the significant Z value of 4.064 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents

Table 3: The Mean Rank of Comprehensive Trail Making Test (CTMT) between Alcohol Dependents and Social Drinkers groups (N=60)

Variables	Alcohol dependents N=30		Social drinkers N=30		U	Z	p
CTMT	**Mean Rank**	**Sum Rank**	**Mean Rank**	**Sum Rank**			
Trail 1	20.72	621.50	40.28	1208.50	156.50	4.347	.000***
Trail 2	19.87	596.00	41.13	1234.00	131.00	4.723	.000***
Trail 3	21.20	636.00	39.80	1194.00	171.00	4.137	.000***
Trail 4	20.12	603.50	40.88	1226.50	138.50	4.615	.000***
Trail 5	18.60	558.00	42.40	1272.00	93.00	5.295	.000***

***p<.001

Table 3 shows the comparison of Comprehensive Trail Making Test between Alcohol Dependents and Social Drinkers using Mann Whitney test. The mean rank of alcohol dependents and social drinkers in CTMT Trail1 was found to be 20.72 and 40.28 respectively with the significant Z value of 4.347 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents. Similarly, the mean rank of alcohol dependents in Trail 2 is 19.87 and social drinkers is 41.13 with the significant Z value of 4.723 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents. Also, the mean rank of alcohol dependents in Trail 3 is 21.20 and social drinkers is 39.80 with the significant Z value of 4.137 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents. Furthermore, the mean rank of alcohol dependents in Trail 4 is 22.12 and social drinkers is 40.88 with the significant Z value of 4.615 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents. The mean rank of alcohol dependents in Trail 5 is 18.60 and social drinkers is 42.40 with the significant Z value of 5.295 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents.

Table 4: The Mean Rank of Working Memory Index (WMI) between Alcohol Dependents and Social Drinkers groups (N = 60)

Variables	Alcohol dependents N=30		Social drinkers N=30		U	Z	p
Working Memory	**Mean Rank**	**Sum Rank**	**Mean Rank**	**Sum Rank**			
Working memory index	22.57	677.00	38.43	1153.00	212.00	3.542	.000***

***p<.001

Table 4 shows the comparison of Working Memory Index between Alcohol Dependents and Social Drinkers using Mann Whitney test. The mean rank of alcohol dependents and social drinkers in working memory was found to be 22.57 and 38.43 respectively with the significant Z value of 3.542 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents.

Table 5: The Mean Rank of Rey Auditory Verbal Learning Test (RAVLT) between Alcohol Dependents and Social Drinkers

Variables	Alcohol dependents N=30		Social drinkers N=30		U	Z	p
RAVLT	**Mean Rank**	**Sum Rank**	**Mean Rank**	**Sum Rank**			
Total learning	25.57	767.00	35.43	1063.00	302.00	2.199	.028*

Long Term Percent Retention (LTPR)	29.67	890.00	31.33	940.00	425.00	.372	.710
Delayed Recall	23.00	690.00	38.00	1140.00	225.00	3.349	.001**
Recognition	23.23	697.00	37.77	1133.00	32.00	3.257	.001**

*p<0.05 **p<0.01

Table 5 shows comparison of Rey Auditory Verbal Learning Test between Alcohol Dependents and Social Drinkers using Mann Whitney test. The mean rank of alcohol dependents in RAVLT total learning is 25.57 and social drinkers is 35.43 with the significant Z value of 2.199 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents. Likewise, the mean rank of alcohol dependents in delayed recall is 23.00 and social drinkers is 38.00 with the significant Z value of 3.349 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents. The mean rank of alcohol dependents in delayed recall is 23.23 and social drinkers is 37.77 with the significant Z value of 3.257 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents. The mean rank of alcohol dependents in long term percent retention is 29.67 and social drinkers is 31.33 with the significant Z value of .372 (p<.001).

Table 6: The Mean Rank of Rey-Osterrieth Complex Figure Test (RCFT) between Alcohol Dependents and Social Drinkers groups (N = 60)

Variables	**Alcohol dependents N=30**		**Social drinkers N=30**		**U**	**Z**	**p**
RCFT	**Mean Rank**	**Sum Rank**	**Mean Rank**	**Sum Rank**			
Copy	22.73	682.00	38.27	1148.00	217.00	3.582	.001***
Immediate recall	20.47	614.00	40.53	1216.00	149.00	4.592	.001***
Delayed recall	21.40	642.00	39.60	1188.00	177.00	4.218	.001***

*** p<0.001

Table 6 shows comparison of Rey-Osterrieth Complex Figure Test (RCFT) between alcohol dependents and social drinkers using Mann Whitney test. The mean rank of alcohol dependents in RCFT copy phase is 22.73 and social drinkers is 38.27 with the significant Z value of 3.582 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents. Likely, the mean rank of alcohol dependents in immediate recall is 20.47 and social drinkers is 40.53 with the significant Z value of 4.592 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents. Furthermore, the mean rank of alcohol dependents in delayed recall is 21.40 and social drinkers is 39.60 with the significant Z value of 4.219 (p<.001). The mean rank is significantly higher in social drinkers than in alcohol dependents.

DISCUSSION

Comparison of Executive function in alcohol dependents and social drinkers

The present study found that alcohol dependents performed poorly on executive function, when compared with social drinkers. Alcohol dependent showed mild impairment in perseverative response, perseverative error, total number of errors and categories completed in WCST than the social drinkers. These results are in line with previous study, (Guillot et al., 2010) found that perseverative response was significantly higher among alcohol dependents but failed to find differences in total errors and categories completed. Similarly, Loeber et al., (2009) supports that alcohol dependent performed significantly worse than healthy controls related to executive and cognitive flexibility tasks. Perseverative error may be the most sensitive WCST measures of frontal lobe dysfunction as suggested by (Miyake et al, 2000). The increased perseverative errors found in the present study are the result of prefrontal cortex dysfunction caused by alcohol intoxication.

The present study found that alcohol dependents has less psychomotor speed and cognitive flexibility, than the social drinkers this finding was in concord with previous study by Uva et al., (2010). Additionally, compared to social drinkers, alcohol dependents performed poorly on stimuli inhibition. These finding are in agreement with previous

study by Fridrici et al., (2013). It appears that alcohol impairs set shifting, as evidenced by impaired performance on both Trail 4 & 5. These findings are in accord with Loeber et al., (2009) alcoholics were impaired with regard to the performance that comprised tasks assessing the ability to shift.

Social drinkers also showed below average level of performance on all five trails. This finding is consistent with Cromer et al., (2010) participants performance on visuomotor was better on the descending limb of blood alcohol concentration but the accuracy of executive function does not recover. One possible explanation for this was alcoholic patient exhibited impaired performance during the 3 week withdrawal. Finding showed attention switching or task switching is an important executive function of frontal lobe (Uva et al., 2010).

Comparison of Working Memory in alcohol dependents and social drinkers

The present study observed that working memory was significantly higher in social drinkers than in alcohol dependents, this finding was in concord with previous study by Bechara et al., (2004) reported that alcoholics performed poorly on the later part of the task indicate that poor working memory can impact decision making. The study also observed that in alcoholic the storage component of working memory was normal but the ability to manipulate the information held in working memory was impaired. Alcoholics responded similar to patients with frontal lesions, they made more errors than controls (Noel et al., 2002). Alcoholics uses inefficient cognitive strategies to compensate for impaired working memory (Pitel et al., 2007).
In contrast to the current findings, Chao Liu et al., (2010) found that the alcoholic male does not show any significant impairment on working memory.

Comparison of Verbal Learning and Memory in alcohol dependents and social drinkers

The present study observed that total learning was significantly higher in social drinkers than in alcohol dependents. This finding is in concordance with previous study (Hanson et al., 2011) where they found subsequent use of alcohol may negatively impact verbal working memory, whose alcohol use increased during adolescence had poorer verbal learning and memory and they had difficulty in recalling or recognizing information. Also found increasing alcohol withdrawal symptoms were associated with poorer verbal learning, recall and recognition. After several weeks of abstinence the dependent group showed no significant difference in neurocognitive performance except immediate recall in verbal learning (Mann et al., 1999).

Supporting to the current finding Beatty et al., (1995) identified alcoholic performance on delayed recall tasks was low which was not contrast to immediate recall. One explanation for this effect is that the increase in task related activity in the left frontal regions may reflects decreased or difficulties of alcoholics in their performance task (Chanraud – Guillermo et al., 2009). In contradictory to the present study, Noel (2012) found that alcoholics did not lose more information than controls and performance analysis revealed normal storage in alcoholics.

Comparison of Visual Learning and Memory in alcohol dependents and social drinkers

The present study found that social drinkers performed better on visuospatial learning and memory than the alcohol dependents. This finding was supported by the previous study by Hanson (2011) noted that individuals whose alcohol use increased during adolescence showed a visuospatial memory decline even when their use was decreasing. Metabolic alterations in the primary visual cortex may contribute to the neuropsychological impairment in visual information processing in alcohol dependents. MRI studies have shown a reduced activation in the occipital lobe for visuospatial and visual processing tasks in alcoholics compared with controls (Bagga et al., 2014).

In contrast, it has been observed in previous research that male alcoholics perform better on visuospatial tests (Squeglia et al., 2009).

CONCLUSION

Overall finding of this study shows that social drinkers performed significantly better in neurocognitive functions than the Alcohol Dependents. Alcohol dependents performed poorly on executive function, they showed mild impairment in perseverative response, perseverative error, total number of errors and categories completed in WCST than the social drinkers. Furthermore, alcohol dependents showed less psychomotor speed and cognitive flexibility, than the social drinkers. Additionally, Social drinkers were better at working memory, total learning, visuospatial learning and memory than alcohol dependence.

LIMITATIONS

The major limitations of the study include male represented the whole sample and female participants were not taken for the study. Second, the sample was not randomly selected. Third, only hospitalized patients were taken. Fourth, selecting social drinkers was completely relying on the persons self-report in AUDIT.

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