Comparative-Cognitive-Performance-in-Adults-with-Cannabis-Use-Disorder

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Cognitive Performance in Adults with Cannabis Use Disorder vs. Opioid Use Disorder : A Comparative Study

Sushma Rathee

Ph. D., M. Phil (Clinical Psychology),
Assistant Clinical Psychologist.
Psychiatry Department, PGIMER, Chandigarh,
Email: sushmaratheecp@gmail.com

Abstract

Background: Drug addiction is a chronic and relapsing brain disorder. All types of substance directly and indirectly related with the influence on various cognitive functions. These cognitive functions varied from decision making to memory. **Aim:** 1) To assess the difference between cannabis and opium users in cognitive functions. **Method:** Sample: A group of 180 participants were selected from various drug treatment hospital located in Haryana and Punjab. Tools: Socio-demographic data sheet, Socio Economic Status Scale, *Rey Osterrieth Complex Figure Test,* Stroop Test, Number Letter Sequencing Test, Arithmetic Test and Digit Span Test, Memory Scale from AIIMS Battery, Wisconsin Card Sorting Test. **Results and Discussion:** In the results it has been seen that both group differ significantly on processing speed of brain (t=2.15), response inhibition (t=3.32), cognitive interference (t=3.23). Further results also found that cannabis users were significantly differ on domains of Preservative Error (t=2.62), Non-Preservative Error (t=7.14), Conceptual Level Response (t=1.97) and Number of Category Completed (t=14.22) of the Wisconsin Card Sorting Test. **Conclusion:** Cannabis and opium use is a progressively important public health issue, and clinical research is focused on investigate the effect of these substance on developing brain.

Keywords: Executive functions, Cannabis, Opium, Memory, Response Inhibition

Correspondence Address:

Dr Sushma Rathee
Ph. D., M. Phil (Clinical Psychology),
Assistant Clinical Psychologist.
Psychiatry Department, PGIMER, Chandigarh,
Email: sushmaratheecp@gmail.com

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Introduction

Cannabis is derived from the plant known as cannabis sativa, which grows wild all around the world including India. At low dose, cannabis causes a state of well-being (high) and a dreamy, state of enjoyment. This is generally followed by a period of drowsiness. Even relatively modest amounts of cannabis can impair coordination and make the operation of heavy machinery hazardous. Perceptual and sensory distortions also occur. Cannabis is available in various forms vis: Bhang- paste of leaves of the plant or dried leaves, Ganja – dried flowering stem of the plant and Charas or hashish – extracted from the resin covering the plant. It can be smoked in cigarettes, or in clay pipes (most common method in religious settings and rural areas) or in water pipes like the traditional hookah. Bhang, which is used in various religious festivals, is legal in India. Charas and Ganja which are also obtained from the same

cannabis plant are illegal (Lal, 2009, p. 154-163). In the opposite side approximately 3.7 million individuals have used heroin and other opiate substances in their lifetime. Despite increasing knowledge of the effects of heroin, it remains the most abused opiate and use among adults has recently increased.

Research findings indicated that there is strong association between abuse of certain substance and psychiatric illness. Besides, there are so many researches indicating that some psychiatric illness and substance abuse also damage some areas of the brain, those handles the higher cognitive functions. Amongst all of harmful substance abuse, cannabis and has been found too much related to deterioration in cognitive functions. However, findings to date suggest that the use of opiates and cannabis has both acute and long-term effects on cognitive performance. Neuropsychological data indicate deficits in attention, concentration, recall, visuospatial skills and psychomotor speed with both acute and chronic opioid use. The long-term effects of opiate use appear to have the greatest impact on cognitive functions, including the ability to shift cognitive set and inhibit inappropriate response tendencies. These processes can be seen as belonging to the executive functions; functions in which drug-dependent patients have repeatedly shown cognitive deficits com - pared with healthy controls. In a recent review described deficits in executive functions in opiate-dependent patients and among others, in the area of inhibition (Holst & Schilt, 2011).

Cannabis dependent had higher global oxygen extraction fraction and cerebral metabolic rate of oxygen than normal controls which is beneficial for higher cognitive functions (Francesca et al, 2017). Cannabis use has more pronounced effect on cognition compared to that of long term tobacco use. How much cannabis is used i.e. the dose also has had variable effect on cognitive functions (Lovell et al, 2018). Persistent heavy use results in moderate level of impairment whereas moderate use results in pronounced effect on cognitive functions (Ashley et al, 2016). Another study revealed the strong relationship between amount of cannabis and impaired decision-making, but the episodic memory was not affected by amount of cannabis (Raul et al, 2015).

After scanning the literature different types of results were found. In some studies it has been seen that cannabis and opium has an adverse effect on cognitive and executive functions. But in the review there is no study has been found that is there any difference between these two or which substance is more adverse effective on cognitive functions. In the review it is also seen that in opium users mostly study focused on particular part of cognitive functions such as; inhibition, verbal fluency etc. Thus on the basis of gap between literature present study was planned to assess the cognitive functions in both substance users as well as difference between both groups.

Methodology

Aim: 1). To assess the difference between cannabis and opium users in cognitive functions.

Sample: A group of 180 participants (90 cannabis users & 90 opium users) were selected from various drug treatment hospital located in Haryana and Punjab. The data was collected during Oct. 2017 to June, 2018.

Ethical Consideration: This study is the sub-part of the work done for purpose of the thesis for Doctorate during session of 2015-2020. The proposal of the research was approved by the ethical committee of University campus. These is no another fully developed ethical committee in the university. All the participants were involved after their written inform consent for work and they fully aware about the purpose of the study.

Design: This is a cross-sectional study.

Inclusion Criteria and Exclusion Criteria: Participants who have primary diagnosis of cannabis dependence according to ICD-10 criteria,

participants who have at least primary education, only male participants were selected, only middle socio-economic status participants were enrolled. Participants having primary diagnoses of psychiatric illness, presence of any major medical or neurological illness, participants having multiple substance dependence, refuse to give informed consent.

Tools: Socio-demographic and clinical data sheet:-A socio-demographic record sheet was prepared for collecting the information about various areas of social, demographic and clinical variables. Information relating to age, sex, residence, marital status, education, types of family, occupation, onset of substance abuse, duration of substance abuse, past psychiatric history, history of multiple substance dependence, family history of psychiatric and substance abuse were recorded in structured interview setting and the investigator recorded the information.

The following standard psychometric tests were used:

1. Socio Economic Status Scale (SES) by Singh et al, (2007).

2. *Rey* **O***sterrieth Complex Figure Test by Rey (1941).*

3. Stroop Neuropsychological Screening Test (Stroop, 1935; 1938). The DQ is calculate with the following formula:- DQ= C-CW÷C×100.

4. **Working Memory Index:**- Number Letter Sequencing Test, Arithmetic Test, and Digit Span Test these are taken for measurement of Working Memory Index, from Wechsler Adult Intelligence Scale-III (Wechsler, 1955).

5. **Memory Scale:** This scale is sub-part of AIIMS neuropsychological battery (Adult form) developed by Gupta et al (2000).

6. **Wisconsin Card Sorting Test (WCST)**: It was developed by Berg (1948).

   All tests are standardized and have good reliability and validity.

Procedure: The sample was selected from various drug-de addiction treatment hospitals of Haryana and Punjab. The participants were assured for confidentiality of their information as well as their comfort during the testing and also clear them about the purpose of the study. All the participants were recruited only after their written informed consent for testing. After 'Inform Consent' from participants an interview session for clinical information was conduct and developed a working therapeutic alliance. After that the actual administrations of the tests were started and instructions of all tests were given them. The estimated time for administration of tests was around 50 to 60 minutes.

Results

Statistical Analysis: The Statistical Package for Social Sciences 20 was used. The demographic variables were analyzed with frequency and percentages. The Descriptive analysis including Mean and Standard Deviation was used for analysis of demographic and clinical variables. For find out the difference between groups the inferential analysis was used i.e. Independent One sample t test.

Table 1

Showing the frequency and percentage of the demographic variables

Variables		Opium Users	Cannabis Users
		Frequency (%)	Frequency (%)
Residence	Rural	41 (59)	39 (56)
	Urban	28 (40)	29 (41)
	Sub-urban	1 (1)	2 (3)
Marital Status	Married	46 (66)	34 (49)
	Unmarried	23 (33)	35 (50)
	Separated	1 (1)	1 (1)
Family Type	Joint	43 (61)	30 (43)
	Nuclear	27 (39)	40 (57)
Occupation	Farmer	13 (19)	18 (26)
	Private Job	8 (11)	9 (13)
	Self-business	22 (31)	24 (35)
	Labourer	7 (10)	1 (1)
	Driver	13 (19)	3 (4)
	Unemployed	6 (9)	7 (10)
	Govt. Job	1 (1)	1 (1)
	Student	0	7 (10)
Religion	Hindu	43 (62)	68 (97)
	Sikh	19 (27)	0
	Muslim	8 (11)	2 (3)
History of Illness in past due to substance	Present	5 (7)	10 (14)
	Absent	65 (93)	60 (86)
History of psychiatric or Medical illness in family	Present	34 (49)	30 (43)
	Absent	36 (51)	40 (57)

The Table 1 showed that 59% of the sample from opium users and 56% cannabis users belongs to rural background, 40% sample were belongs to urban background and 1% to 3% from sub-urban background. In the marital status 66% opium users 49% cannabis users were married and 33% in opium users and 50% in cannabis group were married and only 1% in both groups was separated. 61% participants from opium group and 43% from cannabis group were belongs to joint family and 39% and 57% were from nuclear family in both group respectively. In the domain of occupation 19% opium users and 26% cannabis users were farmer, 11% to 13% were working in private sector in both group, 31% to 35% were doing their own business in both group. In the opium group 10% participants were labourer whereas in cannabis group only 1%. 19% were found driver in opium group and 4% in cannabis group, 9% to 10% were unemployed in both group, and 10% were student in cannabis group. In

the domain of religion the participants from opium user 62% were Hindu, 27% Sikh and 11% Muslim, whereas 97% in cannabis users were Hindu and 3% Muslim. In the opium users group 7% were reported history of psychiatric illness in their past due to use of opium and 14% from cannabis group report same history and 49% to 43% in respective both group report history of psychiatric or medical illness in family.

Table 2

Showing the results of descriptive and inferential analysis of demographic and clinical variables (df=178)

Variables	Opium Users		Cannabis Users		t	p value
	Mean	SD	Mean	SD		
Age	32.46	6.86	28.53	7.50	3.23	0.002
Education in years of schooling	9.14	3.09	9.76	3.11	1.17	0.243
Socio Economic Status	87.79	12.38	75.30	21.13	4.27	0.001
Age of onset of Substance Abuse	22.43	4.95	19.74	5.58	3.01	0.003
Duration of Substance Abuse	9.10	5.62	7.87	5.61	1.30	0.196
Frequency of drug use	11.36	5.15	11.70	7.51	0.32	0.753

Significant at $p<0.05$ and $p<0.01$ level

In the results it has been found that there is significant difference between both group in term of age ($t=3.23$, $p<0.002$) and mean value showed that participants from cannabis group were younger than opium users. The education of the both group more or less similar their Mean (SD) is 9.14(3.09) and 9.76(3.11) respectively, which indicates that all participants have minimum primary level of schooling and maximum they have 12 years of schooling. Similarly in the duration of substance abuse and frequency of drug use both groups not differ from each other. In the other side they significantly differ on variable of socio-economic status ($t=4.27$, $p<0.001$) and age of onset of substance abuse ($t=5.58$, $p<0.003$). The results depicts that cannabis users have low socioeconomic status than opium users and they started abuse of cannabis earlier in their life as compare to opium users (Table 2).

On the basis of table it has been depicts that more or less all the demographic and clinical variables has been controlled such as education, amount or frequency of substance, duration of substance etc. so that the effect of these variables should not influence the results of the study. A recent study found in their study that the duration of opiate abuse and maintenance treatment, as well as additional substance consumption (alcohol, amphetamines, and cocaine) are the main variables contributing to cognitive impairment in the domains of attention and executive function. There was no evidence for the role of demographic variables like age and education on cognitive functioning (Loeber et al, 2012).

Table 3

Showing the results of descriptive and inferential analysis of clinical variables (df=178)

Variables	Opium Users		Cannabis Users		t	p value
	Mean	SD	Mean	SD		
Color Task time	69.39	11.00	73.60	12.20	2.15	0.034
Color-Word Task	60.87	21.81	48.56	22.03	3.32	0.001
Dispersion Quotient	45.65	19.47	56.65	19.67	3.32	0.001
Working Memory	23.84	5.82	22.94	6.50	0.86	0.390
Verbal Memory	62.73	10.16	62.00	10.63	0.42	0.679
Visual Perception	33.19	4.93	33.37	4.46	0.23	0.816
Immediate Visual Memory	17.54	7.98	12.28	6.78	4.21	0.001
Long Term Visual Memory	15.63	8.46	8.94	7.45	4.96	0.001

Significant at $p<0.05$ and $p<0.01$ level

In the Table 3 the results of the both group on clinical variables including cognitive interference, working memory, verbal memory, visual perception, immediate and long term visual memory has been depicts.

Cognitive interference has been assessed with the help of dispersion quotient. Color Task time showed the processing speed of the brain and color-word assess the response inhibition. In all there the above stated domains both group differ significantly. The t value for processing speed is 2.15, with $p<0.03$, for response inhibition $t=3.32$, $p<0.001$, and on cognitive interference $t=3.23$, $p<0.001$. Mean value shows that opium users have fast brain process (M=69.39, SD=11) than cannabis users (M=73.60, SD=12.20), opium users have high on response inhibition (M=60.87, SD=21.81) means they able to manipulate the actual response as per situation than cannabis users (M=48.56, SD=22.03), and overall they had better flexibility and low cognitive interference (M=45.65, SD=19.47) than cannabis users (M=56.65, SD=19.67). Similarly results has been found on the task of immediate and long term visual memory, their t value respectively is 4.21 and 4.96, significant at $p<0.001$ level. Mean value of the both group suggests that opium users has better function on immediate visual memory (M= 17.54, SD=7.98) and long term visual memory task (M=15.63, SD= 8.46) than cannabis users (M=12.28, SD= 6.78 & M=8.94, SD=7.45). On other task i.e. working memory, visual memory, and verbal memory they were not differ from each other (Table 3). Results of a recent study on 74 non-users to heavy users using trail making test, and arithmetic test, indicate that heavy cannabis consumption is associated with impaired verbal memory. Further it was also reported that moderate use was less adverse effect than heavy use of cannabis (Christian et al, 2016). Similar results have been found in the previous few studies, which clearly indicate adverse effect of chronic use of cannabis in cognitive functions such as verbal learning, memory, decision making, planning and working memory (Becker, Collins and Schultz, 2018; Auer R, Vittinghoff, et al, 2016; Cousijn et al, 2014; Tait, Mackinnon and Christensen, 2011). In review effect of abstinence period on the basis of their 3 years longitudinal study that the abstinence period for longer time showed a significant improvement in verbal memory (Setién-Suero et al, 2018).

Table 4

Showing the results of descriptive and inferential analysis of Wisconsin Card Sorting Test (df=178)

Variables	Opium Users		Cannabis Users		t	p value
	Mean	SD	Mean	SD		
Trials	128.00	0.00	127.71	1.81	1.32	0.189
Correct Response	61.47	9.99	58.66	11.67	1.53	0.128
Error Response	35.34	3.83	34.86	4.59	0.68	0.498
Preservative Response	30.70	3.57	31.41	5.24	0.94	0.348
Preservative Error	65.93	13.67	60.03	13.02	2.62	0.010
Non-preservative error	49.56	4.89	46.89	7.14	2.58	0.011
Conceptual Level Response	36.53	3.39	35.19	4.60	1.97	0.051
Number Of Category Completed	31.74	13.11	25.59	14.22	2.66	0.009
Total Trial in Complete First Category	31.80	21.38	40.67	70.64	1.01	0.316
Failure To Maintain Set	24.24	32.87	19.07	27.97	1.04	0.317
Learning to Learn	18.00	20.76	17.43	21.99	0.16	0.876

Significant at $p<0.05$ and $p<0.01$ level

In the table 4 it has been depicts that opium users and cannabis users were significantly differ on domains of Preservative Error (t=2.62, p<0.01), Non-Preservative Error (t=7.14, p<0.01), Conceptual Level Response (t=1.97, p<0.05) and Number of Category Completed (t=14.22, p<0.009) of the Wisconsin Card Sorting Test. The Mean (SD) value showed that cannabis users is low on preservative error (M=60.03, SD=13.02), low on non-preservative error (M=46.89, SD=7.14) low on conceptual level (M=35.19, SD=4.60), and low ability in completing the category (M=25.59, SD=4.60) than opium users. The mean value of opium users group on the above stated domain is as, M (SD)= 65.93(13.67), M (SD)= 49.56 (4.89), M (SD)=36.53(3.39), & M (SD)=31.74 (13.11) respectively. On other domains i.e. trial, correct response, error response, preservative response, total trial in complete first category, and learning to learn both group performed equally. On the basis of the table it has been summarized that overall cannabis group performed poor on most of the executive functions as compare to opium users. A meta-analysis of few studies showed that acutely, all drugs create a disharmony in the neuro-psychological network, which caused the decrease activity in those areas whom responsible for short-term memory and attention, but exception for heroin. Cannabis induces loss of internal control and cognitive impairment, especially of attention and memory, whereas heroin users may have a negative effect on impulse control, and selective processing (Lundqvist, 2005). In the context of use of cannabis, some studies from review of literature suggest that use of cannabis effect on overall/global cognition and executive functions (Cohen and Weinstein, 2018; Gonzalez-Pinto et al, 2016; Verdejo-Garcia et al, 2006). In another recent study the significant negative effect of use of cannabis executive functions, impulse control, attention and psychomotor functions. Results of our study also support the results of all these previous studies in term of adverse effect of cannabis on executive functions (Ramaekers et al, 2016).

Strength and limitation: The present research explains only differences not the cause effect relationship of the cannabis or opium and cognitive functions. The premorbid cognitive functions of the

participants were not recorded. All the participants were age ranged between 18 years to 40 years and therefore the result may be not applicable to adolescents. Only male participants were taken, and therefore further research need to be focused on identifying the effect in female users and gender difference.

Future direction: Future researchers should be planned for longitudinal study in context of cause effect relationship of cannabis and cognitive deficits. Large sample with varied age range could be taken so that better generalization could be possible. In the present research only quantitative account has been taken, hence future research may take qualitative account as well to magnify the effect of age of onset of substance abuse, duration of substance abuse, and gender on effect of cannabis, opium and cognitive functions.

Conclusion

Cognitive functions play an important role in the treatment and rehabilitation of drug-dependent patients because they are of prime importance for the ability to work and for mental performance in general. Cannabis use is a progressively important public health issue, and clinical research is focused on investigate the effect of this substance on developing brain, effect on cognitive and higher executive functions, and effectiveness of psychological treatments for cannabis dependence. The present study is the only study which focuses on use of cannabis, opium and cognitive function. In India opium is major concern for health department because of its severe dependence tendency but still cannabis is ignored whereas on the basis of results of present study it is clear that cannabis has high adverse effect on brain functions than opium. So, it is necessary to focus on this aspect also.

Declaration Section

Ethical Approval and Consent to participate: The present study was a part of research work conducted for the award of Doctorate of Philosophy Degree to the author. The proposal (ID= IGR-07-IGR-1471) was cleared by statutory bodies of the university (Maharshi Dayanand University, Rohtak, Haryana, India). Inform consent was taken from each and every participant besides seeking permission from the centers.

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