

Visual retention and inhibition of cognitive interference among adolescents with cannabis use

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ABSTRACT

Substance abuse is defined as a pathological use of alcohol or drugs, characterized by daily intoxication, inability to reduce consumption, and impairment in social or occupational functioning. Cannabis is one of the most commonly used recreational drugs among adolescents. Though cannabis was being used in India for over centuries for medicinal and recreational purposes, it is now one of the widely abused drugs of choice among the youth. Various researchers have contradictory views on neuropsychological effects of cannabis. With the objective of understanding the ability to inhibit cognitive interference among adolescents with cannabis use disorder the current study has selected 20 adolescent cannabis users and healthy participants each. The participants were matched by age and screened for individuals who met the inclusion/exclusion criteria of the study. The ability to retain visual stimulus was assessed using Benton Visual retention test and the ability to inhibit cognitive interference was assessed using Stroop Test. Findings reveal that there is significant difference in visual retention ability among cannabis users after a period of brief abstinence in comparison to healthy adolescents whereas no significant difference was observed in inhibition of cognitive interference among both the groups.

Keywords: *Cannabis Use, Visual Retention, Inhibition, Cognitive Interference*

It is a known fact that exposure to illicit and legal drugs is harmful to the brain. Developing brain is susceptible to the effects of drug and its abuse. Biological processes that ideally contribute in the development of executive function of the brain tend to be compromised due to exposure of illicit drug use during adolescence (Rosner, 2013).

Addiction is a chronic disease of brain that interferes with the reward, motivation, memory and related circuits of the brain. Dysfunction in these circuits leads to characteristic biological, psychological, social and spiritual manifestations. This is reflected in an individual's pathologically pursuing reward and/or relief by substance use and other behaviours (American Society of Addiction Medicine, 2011).

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The abuse of drugs hyper activates the ventral striatum or the nucleus accumbens that produces pleasurable feeling. The hyperactivity in this system triggers and leads to abrupt and large increase in nucleus accumbens dopamine signalling, producing intense sensations that motivates additional drug taking behaviour and promoting the formation of maladaptive drug stimulus association (Feltenstein,2008). Dopamine and serotonin are the two neurotransmitters which plays vital role in determining the addictive behaviour. Dopamine is a driving force in all addictive and risk taking behaviours and it acts directly on the frontostriatal circuit. Serotonin acts as a brake on dopamine and works to curb impulsive, sensation seeking and addictive behaviour (Schepisis, 2008).

Drug use behaviour is linked to positive reinforcement; the euphoria or high, experienced from the drug leads to quick learning to like the use of drugs. When an attempt is made to stop using the drug, a choice of abstinent behaviour that is made which has little to no immediate positive reward associated with it (Chadwik, 2013). When an individual makes a choice of staying abstinent, behaviour opposite to addiction which has an appealing reward is chosen. The choice of abstinence over drug use gets harder as the drug use behaviour increases and the harder it becomes to choose abstinence, because the brain is strengthening the link between the behaviour and reward. (Boucher, 2013).

Neuropsychological studies have shown that risky behaviour is a result of highly active motivational drives exerting exaggerated influence over cognitive control (Somerville,2010). From the neurobiological aspect, it can be inferred that the adolescent brain has a hyperactive ventral striatum that is responsible for reward seeking behaviour and myelinated prefrontal cortex that is responsible for impulse control (Chadwik , 2013).

In a psychological and neurological perspective, addiction is a disorder that alters cognition. Brain regions and processes that underlie addiction overlap extensively with those that are involved in essential cognitive functions, including learning, memory, attention, reasoning, and impulse control (Gould, 2010). Neuropsychological studies in nonhuman animals have shown that repeated drug use results in disruptions of the highly evolved frontal cortex.

Cannabis is the most commonly cultivated, trafficked and abused illicit drug: according to World Health Organisation (WHO). Cannabis plant contains the mind-altering chemical Delta-9- Tetrahydrocannabinol (THC) and other similar compounds (National Institute on Drug Abuse, 2017). Cannabis over activates parts of the brain that contain the highest number of sensory receptors, this causes the "high" that people feel.

Effects that chronic cannabis use often show disadvantages in neurocognitive performance, macro structural and microstructural brain development and alterations in brain functioning (Jacobus, 2015). It is been suggested that cannabinoid receptors increase during adolescence, have a role in genetic expression of neural development, and that alteration of the endocannabinoid system during adolescence may result in a cascade of neurochemical and neurostructural aberrations, thus leading to poorer cognitive and emotional outcomes in adulthood (Rubino 2008, Iversen 2003)

The short term use of cannabis is also known to impair functions such as attention, memory, learning and decision making. Those effects can last for days after high wears off. Heavy cannabis use in adolescence and early adulthood has been associated with a dismal set of life outcomes including poor school performance, higher dropout rates, increased welfare dependence, greater unemployment and lower life satisfaction (Weir, 2015).

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Cannabis use among adolescents and adults has resulted in various deficits in cognitive functions and executive functions. Though studies have shown that functions of attention and response inhibition are not impaired (Thomas 2005) whereas functions such as verbal learning and memory were found to be impaired (Bolla, 2002). A range of memory domains including immediate and delayed recall, learning rate, recognition, proactive and retroactive interference and primacy and recency (Schoeler, 2013).

The current study aims to identify the effect of cannabis use on visual retention and inhibition of cognitive interference among adolescents with cannabis use as literature shows contradictory views with regard to the neuropsychological functioning in adolescents with cannabis use and also studies are conducted across various populations especially among adults. The study research attempts to focus on visual retention and inhibition of cognitive interference among cannabis users so as to work on a cognitive intervention strategy that can enable them to overcome these deficits as they progress in to adulthood.

METHODOLOGY

The study aims to understand cannabis use effect on visual retention and inhibition of cognitive interference in comparison to healthy controls. The study sample consists of 40 participants (20 participants in case group and 20 control group). Case group participants were chosen from the inpatient ward and rehabilitation centres of Chennai. Control group participants were selected from Sri Ramachandra Medical College and Research Institute. The study adopts a case control research design. The protocol of the study was submitted to the Institutional Ethics Committee of Sri Ramachandra Medical College and Research Institute and approval was obtained to conduct the research. Written consent was obtained from the participants; the nature of the study was explained to the participants and was assured about the confidentiality of the information provided by them.

The sample criteria for the case group are male adolescents were in the age range of 12-21 years who fulfil the criteria of Cannabis Use Disorder Identification Test (CUDIT) for cannabis use disorder, with a minimum educational qualification of 7th standard and those who consumed alcohol and nicotine are also considered and also who consumed cannabis for at least a period of one year and those who were abstinent at least for a period of 21 days. Those adolescents who obtain high scores on Alcohol Use Disorder Identification Test and Fagerstrom Test for Nicotine Dependence and those with a history of neurological or medical condition were excluded from the study. They were compared with a control group of male adolescents in the same age range of the sample group, but do not have a history of substance use disorder, at least 7th standard education with no history of psychiatric or neurological illness were excluded from the study.

Instruments

General Health Questionnaire -12, Alcohol Use Disorder Identification Test (AUDIT) Cannabis Use Disorder Identification Test (CUDIT)-R, Fagerstrom Test for Nicotine Dependence (FTND) was used to screen the participants for the index group and control group.

Benton visual retention test (BVRT) (fifth edition) was used to measure visual perception and visual memory of the individual. Form C: allows the examiner to separate the memory from the perceptual –motor components of the task. With this administration, the examinee reproduces each design while the design remains in the examinee's view. Form D provides an interval between the encoding process and the execution of the drawing. It requires the

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examinee to retain the percept for a brief period of time. With this administration the examinee views each design for 10 seconds. After a delay of 15 seconds, he or she responds the design from memory. Scoring of the test is objectively done depending on the participants' reproduction of each design. It is judged on all or none basis. If the reproduction contains no errors, it is scored as correct and awarded 1 point. If the reproduction contains any errors it receives a point of 0. The error or errors are neither categorised nor specified. The range of possible scores for a single form of the test is 0-10

Stroop Test is a psychological test of mental (attention) vitality and flexibility. The test consists of three pages classified as word, colour and colour word page. The first page is a list of colour names repeated in a random order and printed in black ink. The second page consists of a non-meaningful pattern printed in the same ink colours as the colour names on the first page. The third page consists of the colour names on page one printed in coloured ink in such a manner that the colour of the ink and the words does not match. The total numbers of words read correctly by the participants within 45 seconds are taken into consideration to obtain raw score.

Procedure

Participants who fulfil the inclusion and exclusion criteria were inducted into the study group. They were explained about the nature of the study and the written informed consent was obtained from the participant. Each participant was assessed in a session and they were matched with equal number of healthy participants. The proposed sample size was around 40 (20 in each group). The sampling method adopted to this study is purposive sampling the sample was chosen depending on the inclusion and exclusion criteria.

The results obtained was analysed using paired t-test to find the differences in means.

RESULTS AND DISCUSSION

Table 1 Comparison between the index group and control group on visual retention

Variables		Group	Mean±SD	t	Significance
Benton visual retention test	Copy	Index	8.05±2.523	2.720	0.010
		Control	9.65±0.745		
	Recall	Index	5.35±3.100	4.312	0.001
		Control	8.75±1.682		

Visual retention includes two aspects namely Visual perception and visual memory, which is was assessed using Benton visual retention test. Test consists of two phases, copy phase (Form C) and recall phase (Form D).

Copy phase

Index group and control group participants obtained a Mean ±SD of 8.05±2.523, and 9.65±0.745 respectively. The obtained significance value is 0.010, which indicates control group performing better in visuo-perceptual ability task

Recall phase

Index group on recall phase obtained a Mean ±SD score of 5.35±3.10 comparing to control group obtained Mean ±SD score of 8.75±1.682 with a significance value of 0.001. This indicates control group performing better in visual memory

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This indicates, cannabis use affects visual retention ability even when assessed over a period of abstinence.

The findings of the current study are in agreement with the studies by Pope et al.,(2001 ; 2003), which concluded that cannabis use affects visual memory in comparison with control . Cannabis users demonstrate significantly poor abilities in visual memory also their skills for visual perceptual ability is comparatively lower than healthy controls.

Table 2 Comparison between the index group and control group on Inhibition of cognitive interference

Variables		Group	Mean \pm SD	t	Significance
Stroop test	Word	Index	81.35 \pm 15.115	0.757	0.635
		control	85.45 \pm 18.947		
	Color	Index	55.05 \pm 15.364	1.305	0.417
		control	61.05 \pm 13.675		
	Color word	Index	33.25 \pm 9.486	0.148	0.645
		control	34.80 \pm 9.944		

Stroop test on both index and control group participants were assessed on three domains ‘word’, ‘color’ and ‘color –word’ series. Index group participants on ‘word’ series obtained a Mean \pm SD score of 81.35 \pm 15.115, comparing to the control group participants who obtained a Mean \pm SD score of 85.45 \pm 18.947, that indicate a significance value 0.635. There lies a difference in the scores on word reading phase among index and control group participants.

On ‘Color’ naming series, index group obtained a Mean \pm SD score of 55.05 \pm 15.364, comparing to control group participants obtained Mean \pm SD score of 61.05 \pm 13.675, with a significance value of 0.417. Thus, indicating no impairment in the ability to name the color among index and control group participants.

A Mean \pm SD score of 33.25 \pm 9.486 is obtained by index group participants on ‘color –word’ series; the control group participants obtained a Mean \pm SD score of 32.80 \pm 9.693 . That indicate a significance of 0.745. This shows, no significant difference in color-word naming among index and control group participants. Hence, indicating that there will be difference in inhibition of cognitive interference among adolescents with cannabis use in comparison to healthy controls.

The findings of the current study reveal that cannabis users do not have a deficit in the ability to inhibit cognitive interference in comparison with healthy individuals over a period of abstinence. Implying that Cannabis use does not seem to have an effect on the ability to attend to the stimulus provided and also no effect has been found on cognitive flexibility and interference when an incongruent stimulus is presented.

A study by Battisti (2010), concluded that chronic cannabis use impairs the ability to inhibit responses which is evident from the attainment of lower scores in cannabis users on color-word series. In the current study no significance was noted in the color , word and color word series or otherwise have contradicted our findings . The mean score however indicate difference though not significant, implying that cannabis does have an effect.

It has been shown that this discrepancy in the outcome between the studies can be attributed to factors such as inclusion of short period of abstinence among cannabis users and the age of onset of cannabis use.

CONCLUSION

The study intended to understand the effects of cannabis use on visual retention and inhibition of cognitive interference. Samples were collected depending on the set criteria. In the phase of collecting the sample it was noted that most of the cannabis users had a co morbid usage of alcohol and tobacco. It was observed that most of the adolescents when approached for the control group also reported one or other form of substance use .Therefore finding index and control group participants was challenging with the given geography and age range .Cannabis users were ambivalent in participating in the study, so only a handful of sample were available for assessment.

In the process of evaluation, cannabis users demonstrated difficulty in tasks which required increased attention and sometimes the instructions had to be repeated to few participants. It was seen that cannabis users may have slight impairments in tasks requiring sustained attention, although a significant difference in attention was not observed in our study.

Cannabis users performed slightly lower on tasks in comparison to healthy adolescents. A significant difference was noted in the visual retention ability. This highlights the existence of deficits in visual perception and visual memory due to use of cannabis though an average abstinence of 68 days is present.

However, these mild variations that are evident in short term abstinence may intensify with longer term use or relapses. This can be evident on the long term use transacting to adulthood.

Limitations of the study

Sample size of the current study is small and there is a lack of diversity in the study sample as there was great difficulty in isolating cannabis users with no co morbid substance abuse and also due to the geographical constriction from which samples were chosen, these results cannot be generalized.

Implication of the study and scope for further research

The current study implies the need of neuropsychological training with more emphasis on tasks involving visual component should be involved on abstinence and rehabilitation also need for psycho education programs and awareness about the harmful and long lasting effects of cannabis use on the brain. Further research can be carried out using varied neuropsychological assessment tools to understand in-depth effects of cannabis can be studied and also in consideration of a large sample in a longitudinal study

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Conflict of Interest

The author declared no conflict of interests.

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