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Review Article

Cannabis Use and Performance in Adolescents

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ABSTRACT

Cannabis is a widely used illicit drug among adolescents, many of whom perceive little risk from cannabis. Cannabis use is associated with poor academic performance and increased school drop-outs. It is also associated with high-risk behaviors in adolescents like crime, violence, unprotected sexual encounters, and car accidents. Many of these adolescents have conduct, disorders, ADHD and learning disorders. There is some evidence to suggest that cannabis use leads to use of 'harder' drugs. It is well documented that it produces acute cognitive effects that last for several hours after its ingestion. However, it is debatable whether it produces cognitive dysfunction beyond the period of acute intoxication.

Key words: Adolescents; Cannabis; acute cognitive effects; long-term cognitive effects

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INTRODUCTION

Cannabis has been a traditional drug of use in India with moderate consumption being ritualized in social gatherings.[1] Majority of the cannabis users start using the drug in their adolescence but some leave it after initial experimentation, while others go on to develop abuse/dependence.

Issues regarding the effects of cannabis on cognitive and psychomotor performance remain ill understood. These issues attain more importance because of the fact that an ever greater number of adolescents are abusing cannabis and that too at earlier ages.[2-5] Cannabis use has been associated with poor school performance and school dropout,[6,7] and with reinforcement of conduct symptoms in adolescents,[8] which may further affect academic performance and dropout prior to high school.

Epidemiology

Several researchers have documented cannabis abuse among various sections of the society including school and college students, non-student youth, psychiatric patients and in the general population. General population surveys like the National Household Survey (NHS) in India show that lifetime use of cannabis was 4.1% and current use was 3.0%.[9] Among those who were current abusers of cannabis, 25.7% fulfilled dependence criteria. Age wise distribution of cannabis use revealed that 3% of children and adolescents (12-18 years) abused cannabis. Only 4% of the current abusers contemplated and sought treatment for their problems.[10]

The Drug Abuse Monitoring System (DAMS) that studied patients attending the Governmental de-addiction centers under Ministry of Health and Family Welfare (India) found that 11.6% of patients abused cannabis. Of those abusing cannabis, 3.5% were students. The data from the NGOs (under Ministry of Social Justice and

Empowerment, Government of India) however, revealed that a larger percentage of subjects were introduced to cannabis at a young age (below 15 years and 16-20 years). The Rapid Assessment Survey (RAS) conducted on street drug abusers (i.e. not in treatment network) in India showed that although only about 3% of cannabis abusers were below 18 years, majority of the older population reported initiation of cannabis use at 15-20 years of age. A significant point of the survey was that cannabis was the first illicit drug used by most subjects. Some information on drug abuse by youth is also available from the data obtained from NGOs serving children and adolescents and Nehru Yuva Kendras (NYKs) who participated in the Category B component of DAMS. The results from this component of DAMS show that 28.5% of children and adolescents were abusing cannabis and the age of first use of cannabis was less than 15 years in 63.6% of cases.[10]

Similar trends are reported in Western literature, which show that 4.4% of new users start the use of cannabis at the age of 12 years, 9.3% start its use by 13 years of age and 15.1% by 15 years of age. For males, the highest proportion of all recent initiates was at ages 15 and 16 (both at 14.8 percent).[11-13]

Cannabis: A Gateway Drug

The fear that cannabis use might cause, as opposed to merely precede, the use of drugs that are more harmful ("harder") is of great concern. The gateway analogy evokes two ideas that are often confused. The first, more often referred to as the "stepping stone" hypothesis, is the idea that progression from cannabis to other drugs arises from pharmacological properties of cannabis itself. The second is that cannabis serves as a gateway to the world of illegal drugs in which youths have greater opportunity and are under greater social pressure to try other illegal drugs. The latter interpretation is most often used in the scientific literature, and it is supported, although not proven, by the available data.

There are strikingly regular patterns in the progression of drug use from adolescence to adulthood. Four stages were identified: 1) beer and wine; 2) cigarettes and spirits; 3) cannabis; and 4) other illegal drugs.[14] It was found that younger age of onset of abuse and intensity of abuse were the two factors that determined the extent to which an individual would climb in the drug hierarchy.[15,16] More recent and methodologically well-conducted studies (including large prospective studies) have shown that, even after controlling for the effects of other known and suspected factors, there remains a strong association between cannabis smoking and moving on to harder drugs.[17-19] Cannabis abuse therefore can be considered as an independent specific factor and in all likelihood a cause of the progression to "hard drugs".

Acute Cognitive Effects of Cannabis

The immediate and short-term effects of cannabis (minutes to a few hours) have been the most studied, and have yielded consistent and least controversial findings. Studies on adolescents have uniformly shown that cannabis often impairs cognitive and psychomotor functioning that involves impairment in attentional processes, reaction time, perceptuomotor functions, temporal integration, concept formation, goal direction, decision making, and immediate and short-term memory, though recall and recognition for items learnt in drug-free state remain largely unimpaired.[20-23]

Research has also demonstrated that adolescent users of cannabis have impaired performance on some but not all neuropsychological tests.[24] The hypothesis postulated for differential results on subscales of various tests include: (1) lifetime use was as yet limited, and (2) in adolescents the toxic effects of drug abuse might also be manifested as a decrease in the rate of cognitive development rather than simply a general cognitive decline.

Long-Term Residual Cognitive Effects of Cannabis

More recent data have also demonstrated a "drug residue" effect on attention, psychomotor tasks, and short-term memory during the twelve to twenty-four hour period immediately after cannabis use.[25] The residual effects of heavy cannabis use on adolescent development are of special concern for a number of reasons. Firstly, adolescents are minors whose decisions about whether or not to use drugs are not conventionally regarded as free and informed in the way that adult choices are.[26] Secondly, adolescence is an important period of transition from childhood to adulthood, in which regular cannabis intoxication may be expected to interfere with educational achievement, disengagement from dependence upon parents, the development of peer relationships and making important life choices.[27,28] Thirdly, early initiation of cannabis use predicts an increased risk of escalation to heavier cannabis use, and to the use of other illicit drugs. It also means a longer period of heavy use, and hence, an increased risk of experiencing adverse health effects that chronic cannabis use may have in later adult life.[26, 28] Fourth, since adolescence is a time of risk-taking, the use of any intoxicant, whether alcohol or cannabis while driving a car, increases the risks of accidental injury, and hence of premature death. [26, 28] The type of evidence that initially shifted the focus about the effects of chronic cannabis use on adolescents came from clinical case studies in which use of cannabis in ‘bright adolescents' escalated to daily cannabis use, and the use of other illicit drugs, leading to declining social and educational performance, as evidenced by high school drop-out, and immersion in the illicit drug subculture.[29-32] In some of these cases, the syndrome remitted after the adolescent had been abstinent from cannabis for some months.[32]

However, the cognitive effects of long-term cannabis use and their implications are insufficiently understood.[33] The major psychological effects of chronic heavy cannabis use, especially daily use over many years, in adolescents remain uncertain. This is an area, which is plagued by inconsistent, even directly conflicting reports and numerous methodological problems, some of which are inherent to such research.[34] There are several issues of interest in residual effects of cannabis. Firstly, the residual effects must be distinguished from acute effects of cannabis. As reviewed above, cannabis undoubtedly produces a syndrome of acute intoxication with characteristic cognitive and perceptual changes lasting or a few hours after it is consumed. Many chronic users take cannabis regularly, even multiple times a day, and thus may display acute effects almost perennially. Therefore, the approach to investigating long lasting effects include clinical assessment of long term users,[35-37] observations of cultures in which long-term daily use of cannabis has been the cultural norm for decades,[38] and in addicts who are given the drug under controlled laboratory settings after various periods of abstinence.[39-41] To study residual long-term effects in such individuals, it would be mandatory to stop their drug intake for a certain period, which should outlast the acute effects of cannabis. Ideally, this abstinence should be supervised. A major flaw in previous studies[40-43] assessing long-term cognitive dysfunction in heavy cannabis users has been that the abstinence period was only one or two days, when it is well known that cannabinoid metabolites can be detected in the urine of long-term cannabis users, weeks or even months after achieving abstinence.[44-46] Ideally, residual-effect studies should test their chronic users after 48 hours of supervised abstinence. Very few studies have fulfilled this condition. An ideal study to assess the long-term residual effects of cannabis would be one, which has comparison groups that are as very similar to the drug-using group and which allow for a prolonged abstinence period.

Secondly, residual effects must not be confused with background characteristics of heavy cannabis users as compared to non-using control subjects.

Such background attributes like premorbid intellectual, psychological and social functioning as also comorbid psychiatric disorders (conduct disorder, learning disorders and delinquent behavior) and use of other psychoactive substances (especially alcohol) may heavily influence the findings and confound the interpretations. Some earlier studies have been flawed on such methodological grounds as well. Of these, the remarkable study by Schwartz et al used a 6-week abstinence period for ensuring complete wash-off of any residual cannabis effect and still found significant impairment of short-term memory (auditory/verbal and visual/spatial memory) in the ten adolescents.[37] It was concluded that cannabis-dependent adolescents have selective short-term memory deficits that continue for at least 6 weeks after the last use of cannabis.

Several studies provide more direct data on the effects of cannabis use on the adolescent's cognition. "Heavy" cannabis use (defined as use seven or more times weekly) was associated with deficits in mathematical skills and verbal expression on the Iowa Test of Educational Development and with selective impairments in memory retrieval processes in Buslike's Test.[43] Drug abusers achieved lower numbers correct and made more errors on Benton's Revised Visual Retention Test, which assesses visuographic functions.[47] Pope and Yurgelun-Todd assessed premorbid intelligence and considered it in their statistics.[41] They also ensured a strictly supervised abstinent period of 19 hours. Also, rather than taking totally non-users as controls, they used infrequent users (smoking about 1 day in the past 30 days) because the latter may be expected to differ less from heavy users in some possible confounding variables than would control subjects who had never used cannabis at all. In this study, heavy users displayed significantly greater impairment than light users on attentional executive functions, as evidenced particularly by greater preservations on card sorting and reduced learning of word lists. These differences remained after controlling for potential confounding variables such as estimated levels of premorbid cognitive functioning, and for use of alcohol and other substances in the two groups. Thus, in studies where residual effect have been reported, the most consistent findings are impairment of performance on tests of focused attention, short-term memory, perceptuomotor functions, and ‘executive functions’ (shifting of set). It must, however, also be noted that the impairment in these areas are mostly modest in magnitude, often just reaching statistical significance. It is debated to what extent these subtle cognitive impairments reflect themselves in daily functioning of an individual vis-à-vis the culturally normative functional demands in his/her relevant society. Curiously enough, even the heaviest cannabis users of Pope et al[41] study did not exhibit any significant differences on prevalence of other psychiatric disorders and scores on mental health and functional inventory when compared with the lightest users.[48]

Traditional research evidence is as yet insufficient to support or refute the existence of a prolonged "drug residue" effect and toxic effects on the central nervous system that persist after drug residues have left the body. Furthermore, chronic cannabis use does not produce cognitive impairment of comparable severity as alcohol but there is suggestive evidence that chronic cannabis use may produce subtle defects in cognitive functioning that may or may not be reversible after abstinence.

Cannabis and academic performance

Researchers have suggested that cannabis use in adolescents may interfere with the capacity to 1) concentrate 2) organize information and 3) use information.[41, 43,49,50] Regular cannabis use has been shown to be associated with cognitive deficits and poor academic performance/achievements.[7,22,51] This is particularly problematic during teens’ peek learning years. This effect seems to last several weeks after use.

In the study by Pope & Yurgelun-Todd, 57% of students in the sample reported using cannabis while studying, and over 60% of those who did study after using cannabis said it impaired academic performance.[41] In terms of specific effects of cannabis on academic performance, majority reported adverse effects of forgetfulness (75%), impaired attention (66%), day-dreaming (77%), slowing down (75%) and distractibility (64%). Another study found that children and adolescents with an average grade of "D" or below were more than four times as likely to have used cannabis in the past 1 year as those who reported an average grade of "A".[51] Cannabis use was proportionately higher for students who have learning disabilities.[52] Not surprisingly, cannabis users displayed overall poorer school performance, spent less time on homework, and had more school absenteeism than non-users.[53] However, a large study in New Zealand that followed up 1265 children for 25 years reported that though cannabis use in adolescence was linked to poor school performance, there was no direct connection between the two. The study hypothesized that cannabis use simply encouraged a way of life that didn't help with schoolwork.[54]

There are conflicting results on the issue of absenteeism as well. A study found that students who smoked cannabis within the past 1 year were more than twice as likely to bunk classes as those who did not smoke.[49] Furthermore, this report stated that health problems related to smoking of cannabis could also keep students from attending school. In a recent study on educational behaviors of adolescents, it was found that 63% of the current users as against 17% of nonusers skipped school in past month. The current users of cannabis were 2 times more likely to hate/dislike school as compared to non-users.[55,56]

There are several explanations by researchers regarding the association between cannabis and early school leaving. One theory is that daily cannabis use may produce an "amotivational syndrome", which could result in a reduced commitment to school with predictable results in school performance. Though, research has not supported the existence of this unique "amotivational syndrome" nonetheless cannabis may impair motivation and school performance due to the immediate effects of cannabis intoxication. The second theory is that daily cannabis use produces changes in thinking processes that may affect school performance. However, there are no evidences that regular cannabis users have the same severe memory deficits and cognitive impairment that is found in people who use alcohol heavily. Proponents of this theory believe that cognitive changes, which occur in adolescents, are the result of "cannabis intoxication"- an effect on memory and attention, which occurs immediately after use. The third theory is that cannabis use is associated with precocious adoption of adult styles by adolescents who are not equipped to handle them. There is some support to this hypothesis from a number of studies that show that adolescent cannabis use is associated with early marriage, early pregnancy and childbirth as well as early school leaving.[57]

Behavioral consequences of cannabis

Although the causes of the association are uncertain, Robins recently concluded that it is more likely that conduct disorders generally lead to substance abuse than the reverse.[58-60] Such a trend might, however, depend on the age at which the conduct disorder is manifested. Many chronic users of cannabis become involved in the street scene and its related sex trade practices. Its use is associated with sexually transmitted diseases, unsafe sex practices and other risky behaviors in adolescents. The illegal marketing of cannabis promotes weapon carrying, violence, minor crime and vandalism, and sexual exploitation. The marketing of cannabis to adolescents significantly impacts the juvenile justice system and child welfare resources.[55] In a recent study on cannabis use and associated risk behaviors in adolescents, it was found that 57% of the current users had unprotected sexual intercourse as against 7%

of non-users.[55] Moreover, current users were more than 2 times likely to be involved in violence as compared to non-users. More than 2/3rd of the current users (as against 9% of non-users) drive vehicle under the influence of cannabis.

Studies show that adolescents between the ages of 12 and 17 who use cannabis weekly are nearly four times more likely to engage in violence than those who do not, and are more prone to behaviors that include destruction of property, stealing and physical violence against others.[49] A recent study found that early adolescent cannabis use correlated with future deviant behavior, including dropping out of school, taking risks and behaving violently.[61]

Conclusions

This review summarizes the harmful effects of cannabis on adolescent users. The harmful effects on individuals were considered from the perspective of cannabis use and can be divided into acute and chronic effects. For most people the primary adverse effect of acute marijuana use is diminished psychomotor performance; it is inadvisable for anyone under the influence of marijuana to operate any equipment that might put the user or others in danger (such as driving or operating complex equipment). Whereas acute affects of cannabis on human cognitive and psychomotor performance are consistent and robust, the long-term sequelae of chronic cannabis use are much more difficult to ascertain. Inspite of the many methodological obstacles, research conducted over the last decade suggests that the long-term cognitive deficits are more subtle, however, they can affect the adolescent's development by decline in academic and occupational functioning. In the face of this lack of sound, adolescent-specific scientific knowledge and given that this is the era of evidence-based medicine; the acceptance of marijuana as being 'safe' in adolescents is unacceptable.

The paper can be best concluded with the editors comments on the Pope and Yurgelun-Todd[41] paper in JAMA: "It will be interesting to see whether reporters exaggerate the findings of Pope and Yurgelun-Todd. Physicians should not. There is far more extensive, consistent evidence of cognitive deficits associated with heavy use of alcohol relative to cannabis. Most of the cognitive impairments observed by Pope and Yurgelun-Todd are not large relative to normal cognitive variability among individuals; such impairment would not make heavy cannabis user 'stand out from the crowd'. With continued use of cannabis, however, the impairments might increase over the years."[61]

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