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Research Article

Marijuana Use Predicts Cannabis Withdrawal in Adolescents: A Model of Psychological Dysregulation

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Abstract

Research on adolescent cannabis withdrawal and factors that perpetuate these symptoms is limited. Marijuana frequency was hypothesized to predict withdrawal symptoms. Psychological dysregulation was examined as a moderator. Frequency of marijuana use, related consequences, and psychological dysregulation was assessed in 123 high school students. High frequency marijuana use was found to significantly predict cannabis withdrawal symptoms and psychological dysregulation arose as a moderator. Trait dysregulation further complicates the experience of withdrawal in high frequency marijuana use. Understanding the role of affective, behavioral, and cognitive dysregulation in the perpetuation of substance use can better inform relapse prevention efforts.

Introduction

High frequency marijuana use is associated with a variety of negative outcomes in adolescents - such as cannabis withdrawal. While experiences specific to adolescent cannabis withdrawal remain under represented in research, evidence has supported these symptoms within adult samples [1-8]. This motivated the addition of cannabis withdrawal as a substance induced disorder in the fifth edition of the Diagnostic Statistical Manual [9]. Cannabis withdrawal includes symptoms related to aggression, anxiety, depression, physical discomfort, psychomotor agitation, as well as disturbances in sleep and appetite. These symptoms need to be further investigated in youth because adolescence is the most common developmental stage in which marijuana use is initiated. Understanding the factors that contribute to severity of withdrawal symptoms is important to promote efficacious relapse prevention efforts.

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The Neurobehavioral Disinhibition Theory

Trait dysregulation has been identified as a predisposing factor for substance use [10]. Maturational deviations *in utero* lead to psychological dysregulation, which becomes triggered by the environment and is an instigating factor for adolescents to initiate marijuana use [11]. This developmental trajectory known as the neurobehavioral disinhibition theory [12] encompasses measures such as behavioral control, emotion modulation, and executive cognitive functioning.

Affect dysregulation (e.g., emotional reactivity, arousal, and irritability) has been empirically supported as a risk factor associated with developing substance use disorders [13]. Emotional dysregulation has been shown to be a predisposing factor in perpetuating the use of marijuana [14]. Specifically, depression and irritability predict higher levels of marijuana use in adolescents [15]. Adolescents who exhibit cannabis use disorder have shown high comorbity rates of mood and anxiety disorders, which include substantial amounts of withdrawal symptoms as part of their diagnostic criteria.

Behavioral dysregulation includes inattention, hyperactivity, aggressivity, impulsivity, as well as sensation-seeking behaviors [16,17]. Tarter and colleagues [12] found that adolescents whom exhibit behavioral dysregulation predicted higher frequency of marijuana use than those without the trait. In addition, recent analyses have found that adolescents with behaviors reflective of inattention and hyperactivity - such as Attention Deficit Hyperactive Disorder (ADHD), Operational Defiant Disorder, and Conduct Disorder - were at higher risk for using marijuana [18]. In a study conducted by Jester and colleagues [19], aggression predicted marijuana problems while hyperactivity and inattention established earlier onset of use. Furthermore, the combination of aggressivity and inattention influenced severity of marijuana use. Sensation-seeking behaviors, such as impulsivity in childhood, manifest as positive or negative urgency; these have been correlated with increased marijuana use and a higher risk of continuing sensation-seeking within adolescence [20]. It was determined that impaired impulse control during early adolescence, such as delayed response or response inhibition, may contribute to the increased probability of marijuana use.

Cognitive dysregualtion includes the aspects of cognitive inflexibility as well as the inability to make a plan, carry out a plan, and/or learn from mistakes [16]. Giancola and Tarter [10] found that executive cognitive functioning through the aspects of making a plan, carrying out a plan, and cognitive flexibility were linked to marijuana use. Adolescent marijuana-users also exhibit poor performance in decision making abilities and tend to choose an option that gives them immediate gratification, regardless of the consequences they experience over time. Also, physical and relational aggression in early adolescence was correlated with a greater likelihood of marijuana use later in adolescence [21]. The aforementioned affective, behavioral, and cognitive factors contribute to the transition from recreational use to problematic drug seeking behaviors associated with withdrawal symptoms [22]. These predisposing symptoms are similar to the withdrawal symptoms that arise in response to disruptions in marijuana use. The same psychological factors that precipitate use may help explain the severity of withdrawal.

Cannabis Withdrawal in Adolescents

Adolescents who engage in high frequency marijuana use are at risk for withdrawal similar to adults. Research has found adolescent participants experienced acute withdrawal symptoms such as "craving for marijuana, depressed mood, irritability, restlessness, sleep difficulty, increased anger, decreased appetite, increased aggression, nervousness/anxiety, and headache" [23]. Duffy and Milin [24] recognized a withdrawal syndrome characterized by insomnia, irritable mood, and drug craving within adolescent case studies prior to the DSM-5 inclusion of cannabis withdrawal. Another adolescent case study found anxiety/irritability, decreased appetite, and abdominal pain were significant within hours of abstinence from cannabis [17]. Restlessness, cravings, and appetite change were found to be experienced by adolescents through the third week following the interruption in marijuana use [25]. High comorbidity rates of mood disturbances in chronic cannabis using adolescents demonstrates an association with symptoms of withdrawal [26]. The period of withdrawal seems to fluctuate; however, chronic marijuana use has been shown to elicit withdrawal symptoms as early as one day after cannabis cessation. At this point, the withdrawal symptoms peak and predict a series of indicative responses that became perpetuating factors to reinitiate use [1]. Understanding the factors that intensify withdrawal is important.

Psychological Dysregulation Moderates Cannabis Use and Withdrawal Symptoms

Few studies have clearly investigated how affect, behavioral, and cognitive dysregulation predict the severity of cannabis withdrawal in high frequency users. Individuals with anxiety have been found to experience symptoms of cannabis withdrawal more frequently than their nonanxious peers [27]. The experience of withdrawal also enhances the state of anxiety in these individuals. In a similar fashion, marijuana-use is related to behavioral dysregulation and withdrawal through the form of aggressivity in adults [28]. Marijuana-users who have preexisting aggressive tendencies display higher levels of aggression during withdrawal than those without a previous history of aggression. To date, there are no studies that show the effect of cognitive dysregulation on withdrawal. Research should illuminate the ways in which factors related to making a plan, carrying out a plan, learning from mistakes, and cognitive flexibility affect withdrawal symptoms. This research sought to investigate the direct effect of psychological dysregulation on cannabis withdrawal in adolescents.

The Current Study

Psychological dysregulation has been established as a predisposing factor of marijuana use. High frequency marijuana use produces physical and psychological withdrawal symptoms. This research sought to investigate the impact trait dysregulation has on withdrawal in high frequency marijuana users. This study hypothesized that frequency of marijuana use would significantly predict severity of withdrawal symptoms and that psychological dysregulation would moderate the relationship. The proposed model is displayed in figure 1.

Method

Participants

This experiment was conducted with 123 individuals. All participants were adolescent high school students from Western Washington regions. Participants' ages ranged from 13-18 years old (M = 16.28, SD = 1.08), with average age of first drug use at 13 years (SD = 2.40).

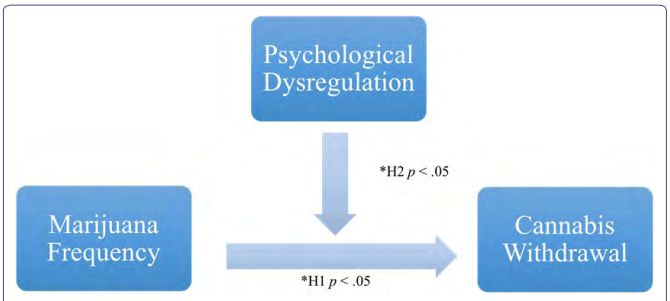

Figure 1: This figure illustrates the model that psychological dysregulation moderates the relationship between marijuana frequency and related withdrawal symptoms.

Gender demographics indicated that 76% of the sample identified as male and 24% identified as female. Participants' ethnicities were self-identified as 55% Caucasian, 15% Asian/Pacific Islander, 13% Hispanic, 11% Multiethnic, 5% African American, and 1% Native American.

Marijuana use

The Customary Drinking and Drug Use Record [29] was used to measure marijuana frequency. This structured interview is designed to assess substance use over the previous three months. The CDDR has internal consistency for each measured domain. Alpha coefficients for cannabis psychological and behavioral dependence consistently increased for the misuse (alpha = .89) and population (alpha = .78). The CDDR has also been shown to have high test-retest reliability (cannabis use r = .83). The CDDR has been presented to have high convergent validity when compared to comparable measures based on the three domains: marijuana frequency (r = .68, p < .001), marijuana dependence (r = .56, p < .001), and marijuana withdrawal (r = .57, p < .001 [29].

Psychological dysregulation

The Dysregulation Inventory [16] was developed to measure psychological dysregulation experienced by adolescents. The DI measures psychological dysregulation through three different categories: affective, behavioral, and cognitive phenotypes specific to the substance use disorder in an accountable and structured format. Psychological dysregulation items loaded onto different factors for the three subcategories. Factors of affective dysregulation included emotional arousal, reactivity, and irritability. For behavioral dysregulation, factors included aggression, inattention/hyperactivity, and impulsivity. Cognitive dysregulation included cognitive inflexibility, as well as difficulties making a plan, carrying out a plan, and learning from mistakes.

The DI has been found to have sound psychometric properties including satisfactory to superior internal consistency (alpha = .88 for affect; alpha = .92 for behavior; alpha = .71 for cognition), split-half reliability (r = .86 for affect; r = .81 for behavior; r = .68 for cognition), and inter-rater reliability [16]. The inventory has established strong construct and concurrent validity.

Withdrawal

Withdrawal experiences were measured by using a composite of two self-report measures known as The Alcohol and Drug Use Consequences Questionnaire (ADUCQ), which includes the Rutgers Alcohol Problem Index [30] and the diagnostic items from the CDDR [31]. Withdrawal included anxiety, irritability, aggressivity, restlessness, nervousness, decreased sleep, decreased appetite, tolerance, and

withdrawal. Participants were asked to rate the frequency of drug and alcohol consequences in the last year according to the following scale: 0 = Never, 1 =1 or 2 times, 2 = 3 to 5 times, 3 = 6 to 10 times, and 4 = More than 10 times. An example item includes "How many times in the last year have you experienced any withdrawal symptoms when you stopped or cut down on your use of drugs? e.g., headaches, nausea, vomiting, shaking". Internal consistency from the original sample was .986.

Procedure

The current study analyzed intake data from an IRB approved randomized control school-based intervention. Adolescents were referred by high-school administrators. Participants were informed of the purpose of the study, the confidential nature of the information collected, and that their participation was voluntary. Investigators met with each participant one-on-one during school hours to administer the assessments. The CDDR was administered as a face-to-face interview, which took approximately one hour. Research assistants were trained in motivational interviewing and utilized these principles during the interview. Participants were asked, "How often did you use marijuana in the last 90 days?" The ADUCQ and DI surveys were administered in paper and pencil format. The intake process took approximately one hour and thirty minutes. Participants were provided personalized feedback based on their results as a part of debriefing procedures.

Results

The relationship between marijuana frequency, withdrawal symptoms, and psychological dysregulation was examined. Marijuana use and dysregulation were the predictors, while the criterion variable was cannabis withdrawal. Descriptive analysis indicated that participants used an average of 13.89 days per month (SD = 11.05). Descriptive statistics are presented in table 1. Correlations between marijuana frequency, psychological dysregulation, and drug withdrawal are found in table 2.

Variables	Mean	Standard Deviation
Marijuana frequency (per month)	12.73	11.18
Psychological dysregulation		
Arousal	4.77	2.74
Emotional reactivity	16.16	6.05
Irritability	8.88	5.26
Impulsivity	9.21	4.00
Inattention	15.58	5.46
Hyperactivity	8.87	4.28
Aggression	8.63	5.42
Make a plan	9.19	4.22
Do a plan	8.73	3.78
Learn from experience	9.68	3.29
Cognitive flexibility	10.31	3.33
Drug withdrawal	0.52	0.50

Table 1: Descriptive statistics for the variables.

Multiple regressions were used to analyze the effects of marijuana frequency on withdrawal. The results of this analysis $R^2 = .05$, $F(1, 121) = 6.85$, $p < .05$, indicate that marijuana frequency significantly predicted cannabis withdrawal. Psychological dysregulation was added as a second step. Psychological dysregulation accounted for a significant amount of the variance, $R^2 = .08$, $F(1, 120) = 11.68$, $p < .05$. Therefore, psychological dysregulation appeared to moderate the relationship between marijuana use and withdrawal symptoms - as illustrated in figure 1.

Variables	Withdrawal
Marijuana frequency	.28**
Psychological dysregulation	
Arousal	.22**
Emotional reactivity	.22**
Irritability	.24**
Impulsivity	.27**
Inattention	.26**
Hyperactivity	.20**
Aggression	.24**
Make a plan	0.12
Do a plan	.17*
Learn from experience	.16*
Cognitive flexibility	.14*

Note: * p < .05, ** p < .01

Table 2: Correlations between predictor and outcome variable.

Discussion

Marijuana frequency was found to significantly predict the severity of cannabis withdrawal. This is consistent with previous research [1,17]. Psychological dysregulation moderated the relationship between marijuana use and related withdrawal symptoms. Therefore, this supports the account of how psychological dysregulation intensifies the association between marijuana use and increased cannabis withdrawal. While psychological dysregulation has been examined as a predictor of marijuana use in the past [14,15] little research has examined affective, behavioral, and cognitive dysregulation as moderating factors.

Marijuana use and related withdrawal symptoms were independently and significantly correlated with psychological dysregulation [20,26]. Specifically, these variables were related to emotional reactivity, affective arousal, irritability, impulsivity, inattention/hyperactivity, aggressivity, ability to carry out a plan, ability to learn from mistakes, and cognitive flexibility. The ability to make a plan was the only measure of psychological dysregulation that was not significantly correlated with marijuana use and cannabis withdrawal symptoms. One explanation for the lack of significance may be related to the age of the participants and their developing prefrontal cortexes, which affects long-term thinking abilities utilized in making a plan [32]. Furthermore, the structure of the DSM-5 classification of withdrawal does not include many cognitive symptoms [9]. This helps explain why ability to make a plan may not be related to withdrawal.

The variance in people's experiences with cannabis withdrawal are further clarified here in. Substance use treatment facilities would find benefits from heeding clients' psychological dysregulation and their frequency of marijuana use. This information will prepare practitioners in addressing the cannabis withdrawal symptoms as they arise during the course of treatment. Inversely, a participants' heightened experience of cannabis withdrawal symptoms may indicate trait psychological dysregulation. This scenario would call for an appropriate mental health assessment, possibly an alteration in their treatment plan, and a referral to a specialized mental health practitioner. Paying

attention to particular markers within clients will lead to more holistic treatment and possibly better outcomes.

Strengths and Limitations

Several strengths were present in the current methodology. This is one of the first studies to examine cannabis withdrawal symptoms in adolescents. Also, it is one of the first studies to examine moderating factors of high frequency cannabis use and withdrawal. Investigators were concurrently trained and utilized motivational interviewing to ensure systematic implementation of interview procedures [31]. Motivational interviewing promoted further understanding of the participants' symptoms and whether they met clinical criteria. It also allowed rapport to be built and have participants feel comfortable being honest about their drug use. While the instruments were administered, interviewers were available to help clarify what was being asked. Finally, this study used valid and reliable assessments that have been evaluated by past research.

One limitation of the study was a lack of verification method to confirm participants' reports of current substance use (e.g., urinalysis); however, the utilization of confidentiality encouraged participants to be honest. Comorbidity of mental health disorders was not analyzed concurrently and may present a confounding variable within the analyses. While the majority of adolescents were referred to the study following a school-reported substance related incident, several students self-referred or referred their peers to the program. Adolescents who were referred by a third party may have had significant differences than those who self-refer. The sample was predominately male (76%) and may not be indicative of the experiences of female substance users. Finally, the demographics of the study were representative of students who attend public schools in Western Washington and may under represent populations within other ethnicities, genders, and socioeconomic statuses.

Future Research

Further research should investigate withdrawal as an underlying mechanism in the progression from adolescent substance use to related disorders in adulthood. Longitudinal studies are needed to determine how withdrawal continues to affect substance use in individuals who have psychological dysregulation. These studies may also reveal how withdrawal symptoms perpetuate use and whether there is a reciprocal interaction. These findings could be used to inform treatment efforts that focus on reduction of use. By educating their clients on withdrawal symptoms and the psychological factors that further intensify the experience, professionals may prepare them to effectively cope.

Conclusion

Prior to the release of the DSM-5 in 2013, cannabis withdrawal was not identified as a substance induced disorder. This research confirmed that chronic cannabis use among adolescents predicts accelerated withdrawal symptoms. Psychological dysregulation is a predisposing factor in cannabis use [22]. Furthermore, individuals who demonstrate trait psychological dysregulation are not only at greater risk for chronic cannabis use, but experience more severe withdrawal symptoms. The current research is not only consistent with the neurobehavioral disinhibition theory, but extends understanding of how high frequency cannabis users experience greater salience of withdrawal symptoms.

References

1. Agrawal A, Pergadia ML, Lynskey MT (2008) Is there evidence for symptoms of cannabis withdrawal in the national epidemiologic survey of alcohol and related conditions? Am J Addict 17: 199-288.
2. Allsop DJ, Norberg MM, Copeland J, Fu S, Budney AJ (2011) The Cannabis Withdrawal Scale development: patterns and predictors of cannabis withdrawal and distress. Drug Alcohol Depend 119: 123-129.
3. Budney AJ, Hughes JR (2006) The cannabis withdrawal syndrome. Curr Opin Psychiatry 19: 233-238.
4. Budney AJ, Hughes JR, Moore BA, Vandrey RA (2004) Review of the validity and significance of cannabis withdrawal syndrome. American Journal of Psychiatry 161: 1967-1977.
5. Budney AJ, Moore BA, Vandrey R (2008) Handbook of the medical consequences of alcohol and drug abuse. In: Brick J (ed.). Health consequences of marijuana use, (2nd edn), The Haworth Press/Taylor and Francis Group, New York, USA. Pg No: 251-301.
6. Budney AJ, Moore BA, Vandrey R (2008) Health consequences of marijuana use. In: Brick J (ed.). Handbook of the Medical Consequences of Alcohol and Drug Abuse, (2nd edn.). The Haworth Press/Taylor and Francis Group, New York, USA. Pg no: 251-301.
7. Chung T, Martin CS, Cornelius JR, Clark DB (2008) Cannabis withdrawal predicts severity of cannabis involvement at 1-year follow-up among treated adolescents. Addiction 103: 787-799.
8. Cornelius JR, Chung T, Martin C, Wood DS, Clark DB (2008) Cannabis withdrawal is common among treatment-seeking adolescents with cannabis dependence and major depression, and is associated with rapid relapse to dependence. Addict Behav 33: 1500-1505.
9. American Psychiatric Association (2013) Diagnostic and Statistical Manual of Mental Disorders (DSM–5), (5th edn), American Psychiatric Association, Arlington, USA.
10. Giancola PR, Tarter RE (1999) Executive cognitive functioning and risk for substance abuse. Psychological Science 10: 203-205.
11. Tarter RE, Vanyukov M, Giancola P, Dawes M, Blackson T, et al. (1999) Etiology of early age onset substance use disorder: a maturational perspective. Dev Psychopathol 11: 657-683.
12. Tarter RE, Kirisci L, Mezzich A, Cornelius JR, Pajer K, et al. (2003) Neurobehavioral disinhibition in childhood predicts early age at onset of substance use disorder. Am J Psychiatry 160: 1078-1085.
13. Cheetham A, Allen NB, Yücel M, Lubman DI (2010) The role of affective dysregulation in drug addiction. Clin Psychol Rev 30: 621-634.
14. Bonn-Miller MO, Vujanovic AA, Zvolensky MJ (2008) Emotional dysregulation: association with coping-oriented marijuana use motives among current marijuana users. Subst Use Misuse 43: 1653-1665.
15. Supple AJ, Aquilino WS, Wright DL (1999) Collecting Sensitive Self-Report Data With Laptop Computers: Impact on the Response Tendencies of Adolescents in a Home Interview. Journal of Research on Adolescence 9: 467-488.
16. Mezzich AC, Tarter RE, Giancola PR, Kirisci L (2001) The Dysregulation Inventory: A New Scale to Assess the Risk for Substance Use Disorder. Journal of Child & Adolescent Substance Abuse 10: 35-43.
17. Chesney T, Matsos L, Couturier J, Johnson N (2013) Cannabis withdrawal syndrome: An important diagnostic consideration in adolescents presenting with disordered eating. Int J Eat Disord 47: 219-223.
18. Storr CL, Accornero VH, Crum RM (2007) Profiles of current disruptive behavior: association with recent drug consumption among adolescents. Addict Behav 32: 248-264.
19. Jester JM, Nigg JT, Buu A, Puttler LI, Glass JM, et al. (2008) Trajectories of childhood aggression and inattention/hyperactivity: differential effects on substance abuse in adolescence. J Am Acad Child Adolesc Psychiatry 47: 1158-1165.

20. Dougherty DM, Mathias CW, Dawes MA, Furr R, Charles NE, et al. (2013) Impulsivity, Attention, Memory, and Decision-Making among Adolescent Marijuana Users. Psychopharmacology 226: 307-319.

21. Skara S, Pokhrel P, Weiner MD, Sun P, Dent CW, et al. (2008) Physical and relational aggression as predictors of drug use: gender differences among high school students. Addict Behav 33: 1507-1515.

22. Mezzich AC, Tarter RE, Feske U, Kirisci L, McNamee RL, et al. (2007) Assessment of risk for substance use disorder consequent to consumption of illegal drugs: psychometric validation of the neurobehavior disinhibition trait. Psychology of Addictive Behaviors 21: 508-515.

23. Vandrey R., Budney AJ, Kamon JL, Stanger C (2005) Cannabis withdrawal in adolescent treatment seekers. Drug Alcohol Depend 78: 205-210.

24. Duffy A, Milin R (1996) Case study: withdrawal syndrome in adolescent chronic cannabis users. J Am Acad Child Adolesc Psychiatry 35: 1618-1921.

25. Milin R, Manion I, Dare G, Walker S (2008) Prospective assessment of cannabis withdrawal in adolescents with cannabis dependence: a pilot study. J Am Acad Child Adolesc Psychiatry 47: 174-178.

26. Dorard G, Berthoz S, Phan O, Corcos M, Bungener C (2008) Affect dysregulation in cannabis abusers. European Child & Adolescent Psychiatry 17: 274-282.

27. Van Dam NT, Bedi G, Earleywine M (2012) Characteristics of clinically anxious versus non-anxious regular, heavy marijuana users. Addictive behaviors 37: 1217-1223.

28. Smith PH, Homish GG, Leonard KE, Collins R (2013) Marijuana withdrawal and aggression among a representative sample of U.S. marijuana users. Drug Alcohol Depend 132: 63-68.

29. Brown SA, Myers MG, Lippke L, Tapert SF, Stewart DG, et al. (1998) Psychometric evaluation of the Customary Drinking and Drug Use Record (CDDR): a measure of adolescent alcohol and drug involvement. J Stud Alcohol 59: 427-438.

30. White HR, Labouvie EW (1989) Towards the assessment of adolescent problem drinking. J Stud Alcohol 50: 30-37.

31. Miller WR, Rollnick S (2013) Motivational interviewing: Helping people change, Guilford Press, New York, USA. Pg no: 482.

32. Wetherill R, Tapert SF (2013) Adolescent brain development, substance use, and psychotherapeutic change. Psychol Addict Behav 27: 393-402.