Published in final edited form as:

Psychol Addict Behav. 2020 February ; 34(1): 230–241. doi:10.1037/adb0000472.

Cannabis Use, Problem-Gambling Severity, and Psychiatric Disorders: Data from the National Epidemiological Survey on Alcohol and Related Conditions

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Abstract

Cannabis use and related disorders are common in adults and frequently co-occur with subsyndromal and pathological gambling. However, understanding how cannabis use may moderate relationships between problem-gambling severity and psychiatric disorders remains poorly understood. Data from the National Epidemiological Survey on Alcohol and Related Conditions (N=43,093 adults) were examined to investigate how cannabis use moderated associations between problem-gambling severity (with gambling groups based on the 10 DSM-IV inclusionary criteria for pathological gambling) and Axis I and Axis II psychiatric disorders.

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Conflict of Interest and Disclosures: The authors report no conflicts of interest with respect to the content of this manuscript.

Problem-gambling severity groups included low frequency/non-gambling (LFG/NG), low-risk gambling (LRG), at-risk gambling (ARG), and problem/pathological gambling (PPG). Among both the group with lifetime cannabis use and that which never used cannabis, greater problem-gambling severity was associated with more psychopathology across mood, anxiety, substance-use and Axis II disorders. Significant cannabis-use-by-problem-gambling-severity-group interactions were observed between PPG and major depression (OR=0.35, 95% CI=[0.14–0.85]), cluster A personality disorders (OR=0.37, 95% CI=[0.16–0.86]) - especially paranoid personality disorder (OR=0.34, 95% CI=[0.14–0.81]), and cluster B personality disorders (OR=0.36, 95% CI=[0.18–0.75]) - especially antisocial personality disorder (OR=0.25, 95% CI=[0.11–0.60]). In all cases, associations between problem-gambling severity and psychopathologies were weaker among the lifetime-cannabis-using group as compared to the never-using group.. Cannabis use moderates the relationships between problem-gambling severity and psychiatric disorders, with cannabis use appearing to account for some of the variance in the associations between greater problem-gambling severity and specific forms of psychopathology.

Keywords

marijuana; cannabis; comorbidity; gambling; psychopathology

Gambling is common in the United States, with approximately two of three adults reporting gambling in the previous year (American Psychiatric Association, 2013). While most adults gamble recreationally without problems, approximately 0.4 to 1% exhibit lifetime pathological gambling (PG), now termed gambling disorder (GD) in the fifth edition of the *Diagnostic and Statistical Manual* (DSM-5) (American Psychiatric Association, 2013; Kessler et al., 2008; Petry et al., 2005). GD is associated with psychiatric symptoms and disorders including depression, substance-use and addictive disorders, suicidal ideations and attempts, reduced quality of life, bankruptcy, and legal problems such as divorce and incarceration (Potenza, 2001; Argo and Black, 2004; Lorains et al., 2011; Petry et al., 2005; Ronzitti et al., 2017). However, subsyndromal levels of problem-gambling severity (i.e., those not meeting full diagnostic criteria for PG or GD) have also been associated with negative health measures including mood, anxiety, substance-use and personality disorders (PDs) (American Psychiatric Association, 2000; Desai et al., 2007; Desai and Potenza, 2008). Given these findings, an improved understanding of factors that influence associations between problem-gambling severity and psychopathology is important for improving treatment and prevention efforts for vulnerable populations. Prior studies have found that both tobacco- and alcohol-use disorders moderated the relationships between problem-gambling severity and psychopathology (Brewer et al., 2010; Grant et al., 2009). In both studies, weaker associations were found among individuals with tobacco- or alcohol-use disorders and specific Axis-I and Axis-II disorders, suggesting that these substance-use disorders accounted for some of the variance in the relationships between problem-gambling severity and psychopathologies. Although cannabis use and cannabis-use disorders (CUDs) frequently co-occur with gambling problems (Hammond et al., 2014), the potential impact of cannabis use on these relationships has not been investigated to date.

Cannabis is the most widely used illicit drug in the world (United Nations Office on Drugs and Crime, World Drug Report, 2017), although its status as a licit versus illicit drug has been changing in the United States. Thirty-one states have legalized medical marijuana and eight states and Washington DC have recently legalized its non-medical use. In this context, the prevalence estimates of cannabis use has increased (Davenport and Caulkins, 2016), and approximately four million Americans meet criteria for a CUD (Substance Abuse and Mental Health Services Administration, 2017). However, increase in prevalence of CUDs is mixed (Compton et al., 2016; Davenport, 2018; Grucza et al., 2016; Hasin et al., 2015), and dependence among heavy users appears to have fallen (Davenport, 2018). Cannabis use and CUDs have been associated with, sometimes in complex manners, multiple psychiatric disorders including depression, anxiety disorders, psychosis, and non-cannabis substance-use disorders (Danielsson et al., 2016; Hasin et al., 2016; Pacek et al., 2013). Cannabis use has also been associated with the development of paranoia (Freeman et al., 2014; Kalayasiri et al., 2010). However, some of the other relationships appear more complex, with some of the relationships with major depression linked to non-cannabis-use factors including co-occurring psychiatric disorders (Feingold et al., 2017; Kalayasiri et al., 2010). Although previous studies have linked gambling, cannabis use, and psychiatric problems among adolescents (Hammond et al., 2014), no current studies have systematically examined how cannabis use may moderate relationships between problem-gambling severity and psychiatric disorders in a large community sample of U.S. adults.

In the present study, we examined data from the first wave (2001–2002) of the National Epidemiological Survey on Alcohol and Related Conditions (NESARC), a large, national survey of non-institutionalized U.S. adults, to examine relationships between problem-gambling severity and psychopathology in individuals with and without cannabis use. At the time of data collection of the first wave of the NESARC, medical cannabis use had been legalized in eight states; however, its recreational or non-medical use had not been legalized in any state. In addition, prevalence estimates of past-year use during this time period has ranged from 4.1% (Hasin et al., 2015) to 11% (Azofeifa, Mattson, Schauer, McAfee, Grant, & Lyerla, 2016). We hypothesized that greater problem-gambling severity would be associated with more psychopathology (psychiatric disorders) in: (1) individuals with cannabis use; and, (2) individuals without cannabis use. Additionally, we hypothesized that associations between problem-gambling severity and non-cannabis psychopathology would be weaker among individuals reporting lifetime cannabis use as compared to those reporting never having used, and these relationships would be observed among disorders showing frequent co-occurrence with cannabis use including depression, anxiety, and non-cannabis substance-use Axis I disorders and cluster A (particularly paranoid PD) and cluster B (particularly antisocial PD) Axis II disorders.

Method

Study Design and Sampling

Data from the 2001–2002 NESARC, described elsewhere (Grant et al., 2004; Grant et al., 2003b) were analyzed. While the use of more recent waves of the NESARC was considered, data from wave II and NESARC III did not include measures of problem-gambling severity.

Thus, we analyzed data from NESARC Wave I. The NESARC, conducted by the National Institute of Alcohol Abuse and Alcoholism and the Census Bureau, surveyed a nationally representative sample of non-institutionalized U.S. residents (citizens and noncitizens) aged 18 years and older. Respondents were identified using a multi-stage cluster sampling technique, and the sample was enhanced with members of group-living environments, such as dormitories, group homes, shelters, and facilities for housing workers. Jails, prisons, and hospitals were not included. The study over-sampled black and Hispanic households, as well as young adults between the ages of 18 and 24 years. Weights have been calculated to adjust for these over-samples, the cluster sampling technique, and non-response (Grant et al., 2003a). The final sample consisted of 43,093 respondents, representing an 81% response rate. Informed consent was obtained from all study participants. The current investigation utilizes what was at the time publicly accessible, de-identified data and was thus exempted from full review by the Yale University institutional review board.

Measures

The Alcohol Use Disorder and Associated Disabilities Interview Schedule-Diagnostic and Statistical Manual of Mental Disorders, 4th Ed., version (AUDADIS-IV) (Grant et al., 2003a), a structured diagnostic assessment instrument, was administered by trained lay interviewers. This instrument has demonstrated good reliability and validity for detecting psychiatric disorders in community-based samples (Grant et al., 2003a). The NESARC data contain diagnostic variables derived from AUDADIS-IV algorithms and based upon DSM-IV criteria (American Psychiatric Association, 2000). These data contain diagnostic variables for major depression, dysthymia, mania, hypomania, panic disorder, social phobia, simple phobia, generalized anxiety disorder, alcohol abuse and dependence, drug abuse and dependence, nicotine dependence, PG, and cluster A (paranoid and schizoid), cluster B (antisocial and histrionic), and cluster C (avoidant, dependent, and obsessive-compulsive) DSM-IV Axis II PDs (Grant et al., 2003a). The AUDADIS-IV assesses past-year and lifetime psychiatric diagnoses and provides exclusions for substance-induced symptoms or symptoms related to a general medical condition. We used past-year Axis I psychiatric diagnoses excluding cases where symptoms may have been related to medical illness or substance-induced as defined by the AUDADIS-IV. Lifetime PD diagnoses were used given the notion that personality disorders are less prone to changes over time than Axis I disorders.

Demographic and Health/Functioning Variables

Sociodemographic variables entered into the analyses included self-reported age, gender, race/ethnicity, education, marital status, current employment status, and income. Dummy variables for 3 race/ethnicity groups (black, white, and Hispanic) were created. These groups were not mutually exclusive, and respondents could identify as more than one race/ethnicity.

Cannabis-Use Variables

Lifetime cannabis use was determined from AUDADIS-IV questions about licit and illicit drug use. Participants were asked whether or not they had used any form of cannabis, e.g. marijuana, hashish, pot, weed, blunt or joint. Respondents were dichotomized into those with and without lifetime cannabis use and those who reported never having used cannabis.

Gambling Variables and Gambling Groups

Problem-gambling severity was based on the 10 DSM-IV diagnostic inclusionary criteria for PG (Association, 1994). For a diagnosis of PG, 5 out of 10 criteria must be met. The sample was divided into four problem-gambling severity groups: non-gambling and low frequency gambling (LFG/NG) with < five episodes of gambling in a single year in their lifetime; low-risk gambling (LRG) with > five episodes of gambling in a single year and no criteria for PG in the past year; at-risk gambling (ARG) with one or two criteria for PG in the past year; and problem/PG (PPG) with > three criteria for PG in the past year. This approach follows directly our previous studies and permits direct comparison with how other substance-use behaviors/disorders influence relationships between problem-gambling severity and psychopathologies (Brewer et al., 2010; Grant et al., 2009).

Data Analysis

Similar to previous NESARC analyses including studies in which we investigated how tobacco use and alcohol use disorders moderated relationships between problem-gambling severity and psychopathology (Brewer et al., 2010; Grant et al., 2004; Grant et al., 2009), we first examined the associations between problem-gambling severity and sociodemographic characteristics stratified by lifetime cannabis-use status using χ^2 analyses in order to identify potential sociodemographic variables that might influence the relationships between problem-gambling severity, cannabis use, and psychiatric disorders. Next, we examined unadjusted weighted rates of psychiatric disorders, stratified by both problem-gambling severity and cannabis use. Finally, we fit a series of logistic regression models in which DSM-IV Axis I and Axis II psychiatric disorders were the dependent variables of interest and the four-level problem-gambling-severity variable, cannabis use, and an interaction between cannabis use and problem-gambling severity were the independent variables of interest, adjusting for the previously identified sociodemographic variables (all sociodemographic variables listed in Table 1) and for Axis I psychiatric disorders including mood, anxiety and non-cannabis substance-use disorders, removing from the adjustment variables the diagnosis that was the dependent variable in the model. Analyses were performed using SUDAAN (Research Triangle Institute) software and the NESARC calculated weights to adjust for sampling design and non-response.

Results

Significant between-group differences were found between the lifetime-cannabis-using and never-using groups for problem-gambling severity ($\chi^2=505.0$, $p<0.001$). The findings suggest that a larger percentage of lifetime-cannabis-using (versus never-using) individuals reported features of PG at each level of problem-gambling severity except for non-gambling/low-frequency gambling (Table 1). Sociodemographic differences were also observed with respect to gender, education, employment, marital status, race and ethnicity and annual household income (Table 1). In unadjusted bivariate analyses, problem-gambling severity was associated with multiple Axis I and Axis II psychiatric disorders among both the lifetime-cannabis-using and never-using groups (Table 2).

In adjusted models, greater problem-gambling severity was associated with more psychopathology in both the lifetime-cannabis-using and never-using groups (Table 3), with LFG/NG respondents reporting, in general, the lowest frequencies of psychiatric disorders. Significant cannabis-use-by-problem-gambling-severity interactions across mood, anxiety, substance-use, and Axis-II disorders were observed, with the LFG/NG gambling group as the reference. At the LRG level, interactions were observed for mood disorders (OR=0.76, 95%CI=[0.60–0.96]), specific phobias (OR=0.81, 95%CI=[0.65–0.99]), alcohol-use disorders (OR=0.73, 95%CI=[0.59–0.89]), cluster A PDs (OR=0.73, 95%CI=[0.57–0.94]), and cluster B PDs (OR=0.68, 95%CI=[0.53–0.86]), and antisocial PD (OR=0.58, 95%CI=[0.43–0.78]). At the ARG level, interactions were observed for panic disorder (OR=0.45, 95%CI=[0.21–0.99]), non-cannabis substance-use disorders (OR=0.67, 95%CI=[0.45–0.98]), nicotine dependence (OR=0.52, 95%CI=[0.36–0.76]), cluster A PDs (OR=0.46, 95%CI=[0.27–0.79]), paranoid PD (OR=0.54, 95%CI=[0.29–0.98]), and antisocial PD (OR=0.41, 95%CI=[0.21–0.82]). At the PPG level, interactions were observed for major depression (OR=0.35, 95%CI=[0.14–0.85]), cluster A PDs (OR=0.37, 95%CI=[0.16–0.86]), paranoid PD (OR=0.34, 95%CI=[0.14–0.81]), cluster B PDs (OR=0.36, 95%CI=[0.18–0.75]), antisocial PD (OR=0.25, 95%CI=[0.11–0.60]), and avoidant PD (OR=0.29, 95%CI=[0.08–0.99]). In all cases, associations between problem-gambling severity and psychopathologies were weaker among the lifetime-cannabis-using group as compared to the never-using group. See Figure 1 and Table 3 for additional information.

Discussion

In the present study, the moderating influences of lifetime cannabis use on the relationships between problem-gambling severity and psychopathology were examined in a large nationally representative sample of adults. Cannabis use was associated with greater problem gambling severity and sociodemographic measures including gender, education, employment, marital status, race/ethnicity, and income. Among both individuals with and without cannabis use, greater problem-gambling severity was associated with increased odds of psychopathology across DSM-IV mood, anxiety, substance-use, and Axis II disorders. Furthermore, cannabis-use status moderated the relationships problem-gambling severity and specific psychiatric disorders including major depression, panic disorder, alcohol-use disorders, nicotine dependence, cluster A PDs (especially paranoid PD), and cluster B PDs (especially antisocial PD). In all cases, weaker relationships were observed in the cannabis-using group as compared to the non-using group, suggesting that cannabis use accounts for some of the variance in the relationships between increased problem-gambling severity and specific psychopathologies. Implications of the findings are discussed below in each subsection, with a focus on findings from the adjusted logistic regression models.

Sociodemographics

Significant differences were noted between the lifetime-cannabis-using group compared to the never-using group. Specifically, the cannabis-use group was more likely to be male, have attained a higher level of education, be employed full-time, never have been married, be white and earn more money annually. The nature of these findings warrants additional

investigation. For example, it is possible that individuals with higher incomes or sustained employment may be more able to afford purchasing cannabis than individuals with lower incomes. Gender-related differences in the effects of cannabis have been reported, with women showing greater sensitivity (Bassir Nia et al., 2018). Further, social factors, in conjunction with motivations, may operate in gender-specific manners in ways that impact cannabis use (Sherman et al., 2016). The extent to which the current findings extend to other groups and operate in the current cannabis environment in the US also needs further examination, particularly as cannabis use in a French sample was associated with lower socioeconomic status (Redonnet et al., 2012) and cannabis use during adolescence has been linked to disability later in life in a Swedish cohort (Danielsson et al., 2014). With the expansion of casino and gambling activities (e.g., sports wagering) across the United States in conjunction with the legalization of cannabis in many states with legalized gambling, more research is needed to understand how gambling and cannabis-use behaviors may interact with sociodemographic factors such as gender and income in the current environment.

Cannabis Use and Problem-Gambling Severity

In general, substance misuse has been associated with heavier gambling (Liu et al., 2009). Cannabis use has been related to greater frequency of gambling among individuals with subsyndromal gambling (Leppink et al., 2014). In the present study, there were higher frequencies of LRG, ARG, and PPG among the lifetime-cannabis-using group compared to the never-using group, with the former having over twice the frequency of ARG and PPG participants.

Mood and Anxiety Disorders

Cannabis use moderated the relationships between LRG and any mood disorders and PPG and major depression. Cannabis use, and especially heavy cannabis use, has been associated with the development of major depression (Lev-Ran et al., 2014). In the NESARC, problem-gambling severity has been associated with major depression, particularly for women with PPG (Desai and Potenza, 2008). Shared genetic contributions may explain the frequent co-occurrence of PG and major depression (Potenza et al., 2005) whereas both genetic and environmental contributions have been linked to the co-occurrence of PG and cannabis-use disorders (Xian et al., 2014), at least in men. It is possible that some of the shared genetic contributions to PG and depression and PG and cannabis-use disorders may overlap, although this notion is currently speculative and requires additional investigation. Further research is needed to understand the motives of cannabis use among individuals who gamble, including those with mood and anxiety disorders. As one example, cannabis use could be used to regulate mood or anxiety associated with gambling losses. Likewise, negative reinforcement motivations have been linked to gambling and cannabis-use behaviors, whereby individuals may engage in the addictive behavior as a maladaptive coping mechanism to avoid or escape from negative emotions (Hyman & Sinha, 2009; Thomas, Allen, Phillips, & Karantzas, 2011). Additional research is needed into the potential overlap between avoidance/escape mechanisms and how they may concurrently relate to engagement in problematic gambling and cannabis use and co-occurring psychopathology. Nonetheless, the current findings suggest that some of the strength of the

relationship between PPG and depression is related to cannabis use. The extent to which some of these relationships may relate to certain types, patterns and phases of cannabis use (e.g., withdrawal versus intoxication, particularly given that withdrawal may be associated with depressed mood, particularly among individuals with psychiatric disorders (Schuster et al., 2017) requires additional investigation.

Similar to major depression, cannabis use moderated relationships between problem-gambling severity and anxiety disorders. Odds ratios were stronger in the relationship between ARG and panic disorder in the non-cannabis-using group than in the cannabis-using one. Cannabis use has been associated with anxiety disorders (Kedzior and Laeber, 2014), and cannabinoids have been used either recreationally or therapeutically to reduce anxiety, including panic (Blessing et al., 2015; Tambaro and Bortolato, 2012). PPG shares both environmental and genetic contributions with panic disorder and cannabis-use disorder, at least in men (Giddens et al., 2011; Xian et al., 2014). The current findings suggest that some of the variance in the relationship between ARG and panic disorder is accounted for by cannabis use. The extent to which effective treatment of panic disorder may help to reduce cannabis use and ARG also warrants further exploration.

Cannabis Use and Substance-Use Disorders

Cannabis use is associated with the use of other illicit drugs (Blanco et al., 2016), and common and unique genetic and environmental contributions have been identified across substances (Kendler et al., 2003; Tsuang et al., 2001) and in relationship between substance-use disorders and PPG (Slutske et al., 2000; Slutske et al., 2013; Xian et al., 2014). In the present study, relationships between LRG and alcohol abuse/dependence and ARG and nicotine dependence were weaker in cannabis-using as compared to non-cannabis-using respondents. These findings suggest that at recreational and risky levels of gambling, the concurrent use of multiple licit or largely socially acceptable substances warrants further investigation. How gambling behaviors may be influenced by the possibly concurrent use of these substances warrants examination, particularly as alcohol use has been linked to longer and deeper gambling behaviors leading to losses (Kygndon and Dickerson, 1999). Such studies may have important implications for the regulation of substance use in gambling venues in efforts to promote responsible gambling practices for patrons. Furthermore, given the deleterious health measures associated with alcohol-use disorder and gambling problems, more research is needed to examine relationships between cannabis use and gambling behaviors, particularly in states that have recently legalized recreational cannabis use and have expanded gambling (e.g., in the setting of the Supreme Court overturning the Professional and Amateur Sports Protection Act).

Personality Disorders

Similar to individuals with greater problem-gambling severity (Desai and Potenza, 2008), cannabis-using respondents were more likely than non-using respondents to meet criteria for cluster A diagnoses. Adjusted models indicated weaker relationships between LRG, ARG and PPG and cluster A diagnoses among cannabis-using respondents as compared to non-using respondents, especially for ARG and PPG in relation to paranoid PD. Previous research has demonstrated an increased rate of paranoid PD among cannabis-using

individuals (Stinson et al., 2006). Additionally, cannabis use has been linked to the emergence of paranoia and psychotic disorders (Davis et al., 2013; Malone et al., 2010). As PPG has been found to be frequent among individuals with psychotic disorders, conditions that often have paranoia as an important element (Desai and Potenza, 2009), further research is warranted to examine the extent to which paranoia as a transdiagnostic feature relates to problem-gambling severity, and the extent to which this may be in part attributable to long-term cannabis use.

As with cluster A PDs, adjusted models indicated weaker relationships between LRG, ARG and PPG and cluster B diagnoses among individuals with cannabis use as compared to cannabis-non-using individuals, especially for antisocial PD. PPG has been associated with antisocial PD across gender groups (Desai and Potenza, 2008), and this relationship may be determined (at least in men) by shared genetic and environmental contributions (Slutske et al., 2001). The extent to which cannabis use may contribute to antisocial behaviors related to problem-gambling severity (e.g., lying about gambling behaviors, illegal activities to support gambling) warrants further attention, particularly given relationships between antisocial PD, problem-gambling severity and suicidality (Ronzitti et al., 2018).

Cannabis use largely did not moderate relationships between problem-gambling severity and cluster C PDs, with the possible exception of avoidant PD. Avoidant PD involves feelings of social isolation, rejection sensitivity, and feelings of inadequacy and may include avoiding work, school or social activities, especially in social situations. Avoidant PD has been linked to PPG in an independent sample (Sacco et al., 2008). Further research is warranted to evaluate how cannabis use may influence the relationship between PPG and avoidant PD, perhaps through motivational systems, low self-esteem, social discomfort or other domains.

Future studies should investigate the nature of the co-occurrences between psychiatric disorders, problem-gambling severity, and cannabis use. For example, investigating the extent to which depressed individuals may use cannabis and gamble problematically for negative reinforcement motivations (e.g., stress relief, coping method for dysphoric mood) awaits further examination. Other competing possibilities (e.g., that cannabis use may lead to depression and cognitive problems that may be associated with PPG) also warrants study, particularly in longitudinal studies of cannabis-using adults. This is particularly important given recent increases in legalized recreational cannabis use in the United States in many states that have legalized gaming establishments.

The strengths of this work should be considered in light of its limitations. The data were cross-sectional in nature, which limits the ability to identify specific factors that may precede psychiatric disorders or symptoms. The current study did not examine the severity of cannabis use. Given that cannabis use may be differentially linked to psychopathology based on cannabis-use severity, further research should examine how cannabis-use severity may influence problem-gambling-severity-to-psychopathology relationships. A limitation of the study is its age. Because the data are now 17 years old and there have been state-by-state changes in the legalization of cannabis use (both medical and recreational), state-by-state changes in the legalization and availability of specific forms of gambling, and changes in the diagnostic criteria for gambling disorder in DSM-5, the relationships found within the

present study may differ if the same study were to be conducted today. A strength of the study is that it may offer an important historical context with which to contrast changes between 2001–2002 and present/future studies, especially since during the time of data collection, only 8 states had legalized medical use of cannabis and none had legalized its recreational use.

Additionally, lifetime cannabis use was used in analyses. While this approach permitted sample sizes that could be informative when assessing how cannabis use moderated relationships between PPG and psychopathologies, further research is needed to examine how recency, frequency or other measures of severity of cannabis use may moderate relationships between problem-gambling severity and psychopathology. Similarly, future studies should also examine such relationships with chronicity of cannabis use among individuals who use cannabis. Further, the NESARC did not assess all psychiatric diagnoses, and as such, the absence of assessments for somatization disorders, psychotic disorders, specific PDs (borderline, narcissistic) and multiple impulse-control disorders is a limitation, and these should be examined in new data collection efforts. Additional research is needed to understand underlying mechanisms of the problem-gambling-severity-to-psychopathology relationships among both the cannabis-using and non-using groups to understand factors influencing associations and identify potential points of intervention. It is likely that the shifting landscape of cannabis use and relevant policy changes in states that have legalized or decriminalized cannabis may impact availability and cost of the drug, which could potentially alter how cannabis use may influence gambling-psychopathology relationships. Additionally, as multiple delivery options (edibles, vaping) for cannabis and multiple strains with varying potencies become more prevalent, how different patterns and types of cannabis use relate to gambling behaviors warrants additional investigation. For instance, the frequency to which cannabis use is occurring while individuals are engaged in gambling behaviors (e.g., using electronic gambling (“slot”) machines, buying instant (“scratch-off”) lottery tickets) remains poorly understood and awaits further examination.

In general, elevated odds for many psychiatric disorders and greater problem-gambling severity were observed among cannabis-using and non-using respondents, and data suggest that cannabis use accounts for some of the relationships between greater problem-gambling severity and psychopathologies. As the legalization of cannabis continues in the United States, it is important to understand better how legalization and social acceptance may influence patterns of use and the potential development and progression of problem gambling. Many states may rely on gambling as a source of revenue; thus, efforts should be made to establish safeguards for individuals vulnerable for developing co-occurring psychiatric disorders, particularly those with serious mental illness (Kim et al., 2018). A better understanding of the nature of the relationships between cannabis use, problem-gambling severity and psychopathology should be achieved over time and this understanding should be translated into improved interventions, clinical care and policies.

Acknowledgement:

The authors would like to acknowledge Dr. Corey Glenn (nee Pilver) for Assistance with statistical analyses.

This work has not been published previously and has been presented by Nicolas Potenza, Christopher J. Hammond, Corey E. Pilver, Linda C. Mayes and Marc N. Potenza at the Yale Child Study Center in July, 2016 with the title “Cannabis Use, Problem Gambling Severity and Psychiatric Disorders.” Although the data were publically accessible when we acquired them, they are no longer publically accessible but may be requested from the Census (see <https://healthdata.gov/dataset/national-epidemiologic-survey-alcohol-and-related-conditions-nesarc—wave-1–2001–2002-and>).

Role of Funding Source: This research was supported in part by grants K12 DA000357, K12 DA000167, R01 DA019039, and RL1 AA017539 from the National Institutes of Health, Bethesda, MD; the Connecticut State Department of Mental Health and Addiction Services, Hartford, CT; the Connecticut Council on Problem Gambling,

Wethersfield, CT; the Yale Center for Clinical Investigation, New Haven, CT; the Connecticut Mental Health Center, New Haven, CT; Massachusetts Gaming Commission, and a Center of Excellence in Gambling Research Award from the National Center for Responsible Gaming. The funding agencies did not provide input or comment on the content of the manuscript, and the content of the manuscript reflects the contributions and thoughts of the authors and do not necessarily reflect the views of the funding agencies. Steven D. Shirk and Shane W. Kraus are employed by the Department of Veterans Affairs are supported by VISN 1 New England MIRECC.

Dr. Hammond has received support from the American Psychiatric Association Child & Adolescent Fellowship, an unrestricted education grant supported by Shire Pharmaceuticals and the American Academy of Child & Adolescent Psychiatry Pilot Research Award for Junior Investigators supported by Lilly USA, LLC. Dr. Marc Potenza has received financial support or compensation for the following: Dr. Potenza has consulted for and advised Shire, INSYS, RiverMend Health, Opiant/Lakelight Therapeutics, and Jazz Pharmaceuticals; has received unrestricted research support from Mohegan Sun Casino and grant support from the National Center for Responsible Gaming; has participated in surveys, mailings or telephone consultations related to drug addiction, impulse control disorders or other health topics; has consulted for legal and gambling entities on issues related to impulse control disorders; has provided clinical care in the Connecticut Department of Mental Health and Addiction Services Problem Gambling Services Program; has performed grant reviews for the National Institutes of Health and other agencies; has edited journals and journal sections; has given academic lectures in grand rounds, CME events and other clinical or scientific venues; and has generated books or book chapters for publishers of mental health texts. The other authors report no disclosures. The authors alone are responsible for the content and writing of this manuscript. The contents of this study do not represent the views of the Department of Veterans Affairs, the National Institutes of Health, or the United States Government.

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Figure 1.

Associations between problem-gambling severity and psychopathology among lifetime-cannabis-using and never-using groups. Figures compare odds ratios for specific disorders in association with low-risk gambling (LRG), at-risk gambling (ARG), and problem/pathological gambling (PPG), using of non-gambling/low frequency gambling as a reference group. Specific disorders are those as follows: A. Interactions with cannabis use in the associations between major depression and problem-gambling severity. B. Interactions with cannabis use in the associations between panic disorder and problem-gambling severity. C.

Interactions with cannabis use in the associations between alcohol abuse/dependence and problem-gambling severity. D. Interactions with cannabis use in the associations between nicotine dependence and problem-gambling severity. E. Interactions with cannabis use in the associations between cluster A personality disorder and gambling severity. F. Interactions with cannabis use in the associations between cluster B personality disorders and problem-gambling severity. * Indicates statistically significant odds ratios at $p < 0.05$. ** Indicates statistically significant interactions at $p < 0.05$.

Table 1

Sociodemographic Characteristics of NESARC Sample

Variable	Cannabis Use Status				χ^2 statistics	
	Users (n=8,043)		Non-Users (n=33,901)		χ^2	<i>p</i>
	Total	%	Total	%		
Gambling Group					505.00	0.000
Non/LF-Gamblers	5,164	63.8	25,659	74.4		
Low-Risk	2,491	31.3	7,455	23.3		
At-Risk	286	3.7	656	2		
PPG	102	1.3	131	0.4		
Gender					100.77	0.000
Female	3,717	42.2	20,268	54.8		
Male	4,326	57.8	13,633	45.2		
Education					25.20	0.000
Less than High School	892	10.6	6,727	16.9		
High school graduate	2,047	25.6	10,155	30.3		
Some College	2,869	35.6	9,472	28.8		
College or higher	2,235	28.2	7,547	24.1		
Employment					68.93	0.000
Full-Time	5,207	64.5	16,431	50.5		
Part-Time	881	11.6	3,279	10.2		
Not Working	1,955	24.0	14,191	39.3		
Marital Status					38.69	0.000
Married	3,923	57.9	17,708	63.0		
Previously Married	1,690	15.1	9,090	17.9		
Never Married	2,430	27.0	7,103	19.1		
Race/Ethnicity					13.14	0.000
White	5,258	77.6	18,611	69.2		
Black	1,279	9.5	6,703	11.4		
Hispanic	1,158	7.7	6,958	12.6		
Asian/NA	348	5.3	1,629	6.8		
Income					18.41	0.000
0–19,999	1,600	16.5	9,982	22.6		
20,000–34,999	1,628	17.9	7,507	20.5		
35,000–69,999	2,666	33.8	10,297	33.2		
70,000 and up	2,149	31.8	6,115	23.7		

Ns represent actual number of respondents in each category; %s indicate weighted percentages Race and ethnicity categories are not mutually exclusive

Non/LF-gamblers = non-gamblers and low-frequency gamblers, PPG = problem/pathological gambling, NESARC = National Epidemiological Survey on Alcohol and Related Conditions Income = mean annual household income (in US dollars)

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Table 2
Rates of Psychiatric Diagnoses by Problem Gambling Severity Level and Past Year Cannabis Use Status

Diagnosis	Cannabis Users					Cannabis Non-Users					χ^2	p value
	Non/LF Gamblers	Low-Risk Gamblers	At-risk Gamblers	Problem Pathological Gamblers	χ^2	p value	Non/LF Gamblers	Low-Risk Gamblers	At-risk Gamblers	Problem Pathological Gamblers		
Any mood disorder	16.3	14.2	23.3	30.7	5.98	0.001	7.4	7.5	14.3	19.2	8.01	0.000
Major Depression	13.2	10.7	14.2	15.7	2.47	0.070	5.8	5.3	9.5	15.4	5.41	0.002
Dysthymia	3.5	2.7	5.3	7.3	2.39	0.077	1.4	1.5	1.9	4.4	0.92	0.440
Mania	3.5	4.0	5.8	13.8	2.39	0.076	1.0	1.3	2.3	3.5	2.92	0.041
Hypomania	1.7	1.7	6.2	2.7	2.87	0.043	0.9	1.2	2.8	2.4	2.98	0.038
Any anxiety disorder	16.9	18.2	24.6	35.8	5.72	0.002	9.0	11.0	16.6	24.5	9.70	<0.0001
Panic Disorder [†]	4.1	3.9	6.8	10.3	1.64	0.190	1.6	1.6	5.6	4.1	3.46	0.021
Agoraphobia	0.1	0.2	0.0	0.0	1.65	0.186	0.0	0.0	0.1	0.0	3.7	0.016
Social phobia	4.6	4.7	7.2	11.6	1.81	0.150	2.2	2.5	3.3	7.7	1.87	0.140
Specific phobia	10.5	11.2	18.9	26.1	6.15	0.001	5.8	7.5	10.1	16.8	7.33	0.000
Generalized anxiety	3.6	4.5	6.3	10.4	2.09	0.110	1.6	1.7	1.3	5.0	0.9	0.450
Any substance-use disorder	36.3	47.8	60.2	73.7	24.41	<0.0001	10.6	17.2	30.4	38.5	30.68	<0.0001
Alcohol ab/dep	19.5	25.6	41.2	41.7	15.04	<0.0001	3.9	6.7	13.5	20.2	22.7	<0.0001
Nicotine dep	24.6	32.9	40.0	61.2	17.49	<0.0001	7.4	11.8	22.6	26.7	23.02	<0.0001
Drug ab/dep	2.7	3.4	9.2	3.9	2.30	0.086	0.3	0.4	0.6	0.2	0.53	0.660
Any Cluster A PD	10.7	11.0	14.6	28.9	4.28	0.008	4.7	5.6	12.1	27.1	11.35	<0.0001
Paranoid	7.6	8.1	12.4	26.3	5.07	0.003	3.3	3.7	8.9	25.5	9.51	<0.0001
Schizoid	5.3	5.2	7.5	19.5	2.89	0.042	2.3	3.1	5.2	12.3	6.79	0.0005
Any Cluster B PD	12.5	15.7	26.2	37.8	11.73	<0.0001	2.2	3.7	7.5	19.1	14.35	<0.0001
Antisocial	10.2	13.5	19.9	28.8	8.12	0.0001	1.2	2.4	5.6	13.0	14.66	<0.0001
Histrionic	3.7	3.5	9.4	16.9	4.88	0.0040	1.2	1.4	3.1	10.0	4.12	0.0097
Any Cluster C PD	13.8	15.9	21.6	33.0	6.62	0.0006	7.5	9.2	17.1	25.2	11.33	<0.0001

	Cannabis Users				Cannabis Non-Users							
Avoidant	4.5	3.6	8.0	9.4	3.13	0.032	1.9	1.5	3.1	9.9	3.59	0.018
Dependent	0.9	1.0	0.9	3.4	0.67	0.58	0.4	0.3	0.4	2.3	2.47	0.069
Obsessive-Compulsive	11.3	13.7	17.8	31.2	7.13	0.0003	6.2	8.1	15.0	19.4	12.55	<0.0001

Numbers in the table represent weighted percentages, stratified by cannabis use status

Non/LF Gamblers = non-gamblers and low-frequency gamblers, ab/dep = abuse or dependence, PD = personality disorder

[†]With or without agoraphobia

Bold indicates $p < 0.05$

Table 3
Adjusted Associations between Gambling and Psychiatric Diagnoses, by Cannabis Use Status

	Cannabis Users						Cannabis Non-Users						Interaction OR: Users vs. Non-Users					
	LRG vs. LFG/NG		ARG vs. LFG/NG		PPG vs. LFG/NG		LRG vs. LFG/NG		ARG vs. LFG/NG		PPG vs. LFG/NG		LRG vs. LFG/NG		ARG vs. LFG/NG		PPG vs. LFG/NG	
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	
DSM-IV Diagnosis																		
Any mood disorder	0.96 (0.81-1.15)	1.72 (1.22-2.43)	2.21 (1.33-3.69)	1.27 (1.10-1.48)	2.36 (1.73-3.21)	3.39 (2.02-5.68)	0.76 (0.60-0.96)	0.73 (0.45-1.18)	0.65 (0.30-1.41)									
	0.90 (0.73-1.11)	1.22 (0.82-1.81)	1.20 (0.61-2.38)	1.14 (0.98-1.32)	1.94 (1.35-2.80)	3.47 (2.00-6.04)	0.79 (0.61-1.03)	0.63 (0.36-1.10)	0.35 (0.14-0.85)									
Major Depression	0.87 (0.61-1.24)	1.77 (1.02-3.07)	1.87 (0.72-4.87)	1.31 (1.00-1.71)	1.52 (0.83-2.78)	3.75 (1.29-10.89)	0.66 (0.42-1.04)	1.17 (0.50-2.70)	0.50 (0.12-2.09)									
Dysthymia	1.27 (0.92-1.75)	1.73 (0.97-3.10)	3.78 (1.76-8.10)	1.67 (1.24-2.25)	2.39 (1.30-4.40)	3.79 (1.49-9.65)	0.76 (0.48-1.19)	0.73 (0.33-1.61)	1.00 (0.30-3.34)									
Mania	1.12 (0.74-1.70)	3.54 (1.95-6.45)	1.31 (0.25-6.92)	1.76 (1.24-2.50)	3.40 (1.94-5.95)	2.63 (0.68-10.09)	0.64 (0.38-1.06)	1.04 (0.48-2.25)	0.50 (0.06-4.22)									
Hypomania	1.24 (1.08-1.44)	1.88 (1.36-2.60)	3.02 (1.82-5.01)	1.47 (1.32-1.64)	2.36 (1.73-3.22)	4.10 (2.29-7.33)	0.85 (0.70-1.02)	0.80 (0.51-1.24)	0.74 (0.34-1.59)									
Any anxiety disorder	1.11 (0.82-1.50)	2.07 (1.17-3.65)	2.85 (1.18-6.87)	1.23 (0.92-1.65)	4.55 (2.72-7.60)	3.61 (1.29-10.12)	0.90 (0.59-1.37)	0.45 (0.21-0.99)	0.79 (0.22-2.77)									
Panic Disorder ¹	2.17 (0.34-13.84)	0.00 (0.00-0.01)		1.26 (0.25-6.33)	2.21 (0.28-17.33)		1.72 (0.13-22.35)											
Agoraphobia	1.11 (0.83-1.49)	1.69 (1.02-2.79)	2.69 (1.28-5.45)	1.30 (1.05-1.62)	1.65 (1.00-2.75)	4.53 (1.60-12.78)	0.85 (0.61-1.20)	1.02 (0.49-2.13)	0.58 (0.17-2.04)									
Social phobia	1.24 (1.05-1.47)	2.40 (1.69-3.40)	3.41 (1.91-6.11)	1.54 (1.35-1.74)	2.15 (1.47-3.14)	4.25 (2.12-8.53)	0.81 (0.65-0.99)	1.17 (0.68-1.82)	0.80 (0.33-1.96)									
Specific phobia	1.47 (1.06-2.04)	2.17 (1.24-3.80)	3.15 (1.31-7.60)	1.25 (0.96-1.64)	0.91 (0.42-1.97)	4.02 (1.41-11.42)	1.17 (0.75-1.83)	2.39 (0.92-6.24)	0.78 (0.20-3.10)									
Generalized Anxiety																		
Any substance use	1.61 (1.41-1.83)	2.40 (1.77-3.28)	4.38 (2.64-7.29)	1.90 (1.70-2.12)	3.59 (2.80-4.53)	5.29 (3.36-8.23)	0.85 (0.71-1.01)	0.67 (0.45-0.95)	0.83 (0.41-1.69)									

	Cannabis Users						Cannabis Non-Users						Interaction OR: Users vs. Non-Users					
	LRG vs. LFG/NG		ARG vs. LFG/NG		PPG vs. LFG/NG		LRG vs. LFG/NG		ARG vs. LFG/NG		PPG vs. LFG/NG		LRG vs. LFG/NG		ARG vs. LFG/NG		PPG vs. LFG/NG	
	OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)		OR (95% CI)	
disorder	1.84		3.25		7.29		2.13		4.62		8.32		1.01		0.98		1.66	
Alcohol ab/dep	1.43 (1.24-1.66)		2.53 (1.85-3.46)		2.72 (1.72-4.31)		1.97 (1.68-2.31)		3.68 (2.71-4.99)		5.75 (3.19-10.37)		0.73 (0.59-0.89)		0.69 (0.44-1.07)		0.47 (0.22-1.04)	
Nicotine dep	1.50 (1.30-1.73)		1.86 (1.38-2.50)		4.22 (2.58-6.92)		1.79 (1.58-2.02)		3.56 (2.67-4.73)		4.57 (2.88-7.24)		0.84 (0.69-1.02)		0.52 (0.36-0.76)		0.92 (0.46-1.84)	
Drug ab/dep	1.34 (0.95-1.89)		3.44 (1.89-6.25)		1.11 (0.38-3.22)		1.64 (0.86-3.12)		2.02 (0.61-6.74)		0.74 (0.09-5.94)		0.82 (0.40-1.69)		1.70 (0.38-7.58)		1.50 (0.14-15.67)	
Any Cluster A PD	1.07 (0.87-1.31)		1.36 (0.88-2.09)		2.79 (1.63-4.78)		1.46 (1.26-1.70)		2.96 (2.13-4.11)		7.52 (4.00-14.13)		0.73 (0.57-0.94)		0.46 (0.27-0.79)		0.37 (0.16-0.86)	
Paranoid	1.14 (0.90-1.45)		1.68 (1.05-2.70)		3.52 (1.96-6.33)		1.45 (1.21-1.74)		3.13 (2.17-4.53)		10.50 (5.57-19.79)		0.78 (0.58-1.05)		0.54 (0.29-0.98)		0.34 (0.14-0.81)	
Schizoid	1.00 (0.76-1.31)		1.39 (0.76-2.54)		3.66 (1.96-6.83)		1.53 (1.24-1.88)		2.32 (1.56-3.46)		5.54 (2.46-12.44)		0.65 (0.46-0.93)		0.60 (0.30-1.20)		0.66 (0.23-1.90)	
Any Cluster B PD	1.29 (1.09-1.52)		2.20 (1.48-3.28)		3.38 (2.11-5.39)		1.91 (1.59-2.30)		3.33 (2.20-5.04)		9.29 (5.36-16.07)		0.68 (0.53-0.86)		0.66 (0.36-1.22)		0.36 (0.18-0.75)	
Antisocial	1.31 (1.08-1.58)		1.84 (1.20-2.83)		2.70 (1.59-4.61)		2.26 (1.78-2.87)		4.43 (2.83-6.96)		10.73 (5.51-20.91)		0.58 (0.43-0.78)		0.41 (0.21-0.82)		0.25 (0.11-0.60)	
Histrionic	1.03 (0.75-1.41)		2.60 (1.54-4.40)		4.36 (2.17-8.78)		1.48 (1.14-1.93)		2.70 (1.60-4.55)		8.72 (4.07-18.70)		0.70 (0.46-1.05)		0.97 (0.45-2.09)		0.50 (0.17-1.43)	
Any Cluster C PD	1.23 (1.05-1.45)		1.77 (1.20-2.61)		3.10 (1.91-5.02)		1.33 (1.16-1.53)		2.66 (2.00-3.54)		4.48 (2.49-8.08)		0.93 (0.74-1.16)		0.67 (0.42-1.07)		0.69 (0.31-1.53)	
Avoidant	0.87 (0.63-1.21)		1.88 (1.06-3.34)		1.82 (0.83-3.98)		0.96 (0.75-1.24)		1.72 (1.00-2.97)		6.33 (2.50-16.01)		0.91 (0.58-1.42)		1.09 (0.48-2.50)		0.29 (0.08-0.99)	
Dependent	1.25 (0.72-2.19)		1.11 (0.27-4.62)		2.99 (0.96-9.33)		0.77 (0.44-1.36)		1.05 (0.27-4.09)		6.59 (1.91-22.79)		1.62 (0.70-3.76)		1.06 (0.15-7.30)		0.45 (0.08-2.58)	
Obsessive-compulsive	1.27 (1.06-1.53)		1.76 (1.15-2.69)		3.73 (2.30-6.03)		1.37 (1.19-1.58)		2.74 (2.04-3.68)		3.60 (2.14-6.03)		0.93 (0.72-1.19)		0.64 (0.39-1.07)		1.04 (0.49-2.18)	

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Bold indicates $p < 0.05$

LFG/NG=Low frequency gambler/Non gambler; LRG=low risk gambler; ARG=at risk gambler; PPG=problem/pathological gambler; OR=odds ratio; PD=Personality disorder. Models adjusted for sociodemographics and psychiatric disorders as described in the methods.