The relationship between problem gambling and substance use among American adolescents

LOREDANA A. MARCHICA[1], TINA GIORDANO[1], WILLIAM IVOSKA[2], JEFFREY L. DEREVENSKY[1]

[1] International Center for Youth Gambling Problems and High Risk Behaviors
McGill University
McTavish Street
Montreal, QC H3A 0G4
Canada

[2] Alcohol, Drug Addiction and Mental Health Services Board of Wood County Ohio
Haskins Road
Bowling Green, OH 43402
United States of America

Abstract
Adolescence is a developmental period marked by increased engagement in risky behaviors, including substance use and gambling. Previous research has consistently shown an increased risk of problem gambling among people with substance use disorders, however few studies have addressed the differences in problem gambling across the various substance types. Using data from the 2018 Alcohol, Drug Addiction and Mental Health Services (ADAMHS) Board/Wood County Educational Service Center Survey on Alcohol and Other Drug Use among junior high and high school adolescents in Wood County, Ohio, this study sought to understand the relationship and comorbidity levels between various substances used and problem gambling among American adolescents. Further, the current study aimed to test the effects of substance use on the likelihood of being identified as a problem gambler. Results indicated that individuals at-risk or reporting gambling problems were significantly more likely to regularly smoke marijuana, ingest painkillers, consume alcohol, and engage in binge drinking. Additionally, adolescents who regularly consumed alcohol or painkillers were twice as likely to be identified as being at-risk for a gambling problem. This study sheds light on the importance of assessing for comorbid addictive disorders in order to optimize treatment options for adolescents.

Keywords: Gambling, risky behaviors, substance use, adolescents.

Introduction
Adolescence represents a distinct developmental period marked by experimentation and engagement in risky and potentially problematic behaviors, including gambling and substance use problems (Derevensky, 2012; Jessor, 1998). Adolescents often have a perceived sense of invulnerability and as such partake in diverse and high risk-taking behaviors (Derevensky, Gupta, & Winters, 2003). Additionally, adolescence is a developmental period where youth are often given more responsibility and autonomy, thereby increasing their accessibility to potentially problematic activities (e.g., substance use, drinking and driving, gambling, and cigarette use). Finally, adolescents often exhibit higher levels of impulsivity, susceptibility to addiction, and vulnerability to social pressure (Rahman et al., 2012).

Problem gambling during adolescence is a growing concern among mental health professionals and policy

makers. Given the expansion of land-based gambling venues and the growth of online gambling, gambling has become more widely accepted and easily accessible than ever before. Particularly for adolescents, the accessibility of online gambling is of concern given the swiftness with which money can be lost, its ease of access (i.e., the general lack of a large number of online gambling companies to ensure age verifications), and the heightened abilities of adolescents regarding Internet use when compared with adults (Griffiths, & Woods, 2004). Additionally, the prevalence of problem gambling among adolescents has consistently been shown to be significantly higher, ranging from 0.2-12.3%, as compared to adults with prevalence rates ranging from 0.3-2.4% (Calado, Alexandre, & Griffiths, 2017; National Center for Responsible Gaming [NCRG], 2013; Tse, Hong, Wang, & Cunningham-williams, 2012). Problematic gambling has been associated with a host of short- and long-term deleterious consequences for individuals, their families, and the community, including severe psychological, financial, and social challenges (Derevensky, 2007, 2012; Edgerton, Melnyk, & Roberts, 2015). Consequences associated with problem gambling among adolescents are heightened as they also include lower academic performance, isolation, depression, anxiety, and engagement of other high-risk behaviors (Emshoff & Perkins, 2008). Results from Burge, Pietrzak, and Petry (2006) further suggest that individuals who gamble before the age of 15 are more likely to report a number of comorbid disorders, including substance abuse, mental health disorders, and suicide ideation, compared to late-onset gamblers.

Substance use among adolescents is a common occurrence, with 25% of U.S. youth having consumed alcohol by 8th grade and 60% by the end of high school (Johnston, Miech, O'Malley, Bachman, Schulenberg, & Patrick, 2018). Misuse of alcohol and other drugs has been shown to be associated with an increased likelihood of legal problems, financial problems, poor social outcomes, unwanted pregnancy, family conflict, and physical and mental health problems (Loxley et al., 2004). According to the 2017 National Survey on Drug Use and Health, among U.S. adolescents between the ages of 12 and 17, 12.2% were daily cigarette smokers, 9.9% were current alcohol users, 5.3% had engaged in binge alcohol use

in the past month, and 6.5% were current past month users of cannabis (Center for Behavioral Health Statistics and Quality [CBHSQ], 2018). Previous research has similarly shown that substance use during adolescence creates an increased risk for various behavioral and mental health problems (Mcgue, Iacono, Legrand, Malone, & Elkins, 2001) as well as substance use disorders during adulthood (DeWit, Adlaf, Offord, & Ogborne, 2000).

Additionally, in recent years with the onset of what has become referred to as the "opioid crisis" in the United States, opioid misuse among Americans has become a major concern among health professionals and policy makers. In the United States, in 2017, 3.1% of 12 to 17 year olds surveyed reported misuse of opioids. Although these prevalence rates demonstrate a 0.5% decrease from 2016, they are still alarming considering the young ages of those engaging in misuse of the substance (CBHSQ, 2018). Finally, researchers have also begun to consider the use of multiple substances within a defined time-period, referred to as "polysubstance use," as a topic of considerable interest. Polysubstance use has become increasingly common. In 2005, the Youth Risk Behavior Surveillance study reported that between 9th and 12th graders, 13% of students were frequent polysubstance users (Conway et al., 2013). Early polysubstance use has also been associated with a greater likelihood of having substance use problems during adulthood (Stockwell, 2005).

Given that in the United States the engagement in gambling activities and non-prescribed use of most substances discussed are illegal (marijuana/opioids) or prohibited before 18-21 years of age (alcohol/cigarettes/gambling), the prevalence rates of these risky behaviors among adolescents become even more alarming. According to a 2009 survey, when asked their perceptions for ease of access of substances, 14% of adolescents reported that beer was the easiest to access, which was nearly identical to the 16% who reported prescription drugs, while an equal percentage of adolescents chose marijuana and cigarettes as the most easily accessible substance (26% for both), demonstrating that many adolescents report easy convenient access to most substances if desired (QEV Analytics Ltd., 2009).

Previous literature has also shown that gambling disorder and substance use disorders share many of the same clinical, phenomenological, and biological features, suggesting a strong relationship between the two (Wareham et al., 2010). Multiple research studies have also consistently shown high rates of comorbidity between gambling disorder (GD) and substance use disorders. For instance, in a study by Petry and her colleagues (2005) it was found that among lifetime patients with a gambling disorder, almost three-quarters (73.2%) also met the diagnosis for an alcohol use disorder, 38.1% for drug use disorder, and 60.4% for nicotine dependence. Additionally, these disorders have also been highly co-morbid with mood and personality disorders, with 41.3% of individuals facing a lifetime diagnosis of GD also reporting having an anxiety disorder and 60.8% having a personality disorder (Petry, Stinson, & Grant, 2005). Finally, among adolescents, those that report gambling in the past year were twice as likely to engage in illegal drug use as youth who did not gamble (8% v. 15%; Proimos, DuRant, Dwyer, & Goodman, 1998). Due to the social, physical, and mental impact of substance use and gambling disorder, and the increased risk associated with onset of these behaviors during adolescence, it is important to examine the relationship between these two behaviors and understand how engaging in one substance increases the likelihood of having a gambling problem. As such, the objective of the current study is to begin to understand the relationship between the use of various substances, in particular cigarette, alcohol, marijuana, and painkillers, and problem gambling among adolescents. It is hypothesized that individuals who engage in multiple substances will have a higher likelihood of problematic gambling engagement. Specifically, given that, among various types of substances, alcohol has been the most associated with gambling (Desai, Desai, & Potenza, 2007), it is hypothesized that alcohol will be the strongest substance use predictor of problematic gambling behaviors.

Method
The current study employed data from the 2018 Alcohol, Drug Addiction and Mental Health Services (ADAMHS) Board/Wood County Educational Service Center Survey on Alcohol and Other Drug Use among junior high and high school adolescents in Wood County, Ohio. Surveys were administered to all fifth through twelfth grade public school students.

Participants
Of a total of 7,714 students from grades seven through twelve who consented to participate in the survey, 661 were excluded due to inconsistent responding. Specific criteria for exclusion included missing data, reporting using a fake drug, reporting using all drugs at all times, providing responses to items that were inconsistent (i.e., reporting having used a substance during the past month but not during the past year), and reporting participating in all listed gambling activities daily.

Additionally, given the low participation rates of survey completion among youngest and oldest students (i.e. less than 1% were 10, 11, and 19 years old), only data from students ages 12 to 18 years were included for this research. A total of 7,002 students from grades seven through twelve (M_{age} = 14.86 years-old, SD = 1.74) were included in the final analyses (see Table 1 for age and ethnicity).

Table 1.
Participant Demographics

Demographics	N	Percentage
Ages		
12	712	10.2
13	1169	16.7
14	1136	16.2
15	1224	17.5
16	1282	18.3
17	1098	15.7
18	381	5.4
Ethnic Identity		
White	5,655	83.3
Black or African American	187	2.8
Latino	325	4.8
Asian	136	2.0
Pacific Islander	14	0.2
Middle Eastern	30	0.4
Native American	34	0.5
Multicultural	232	3.4
Other	179	2.6

Measures
The following measures from the survey that specifically examined risk of problem gambling and substance use among high school students included:

NORC DSM-IV Screening for Gambling Problems-Loss of Control, Lying and Preoccupation (NODS-CLiP; Toce-Gerstein et al., 2009). The NODS-CLiP is a three-item screen with questions examining loss of control while gambling, lying about one's gambling, and preoccupation with gambling. This measure was used to assess gambling severity and was derived from the NODS, a 17-item measure based on the 10 DSM-IV criteria for pathological/disordered gambling (APA, 2000). The NODS has been widely used for categorizing problem gambling, and the three items included in the NODS-CLiP were determined to be indicative of problem gambling. Each question on this measure requires a dichotomous (yes or no) response. Questions include, *Have there ever been periods lasting 2 weeks or longer when you spent a lot of time thinking about your gambling experiences or planning future gambling ventures or bets?; Have you ever tried to stop, cut down, or control your gambling?; Have you ever lied to family members, friends, or others about how much you gamble or how much money you lost on gambling?* If participants responded yes to one or more questions, they were identified as "at-risk" for a gambling problem. The NODS-CLiP has excellent sensitivity, capturing 94% of NODS problem and pathological gamblers, and a highly satisfactory specificity level (0.96) (Toce-Gerstein et al., 2009).

Substance Use Participation. A set of questions on the use of various substances was administered to collect descriptive information regarding the frequency of cigarette, alcohol, marijuana, and painkiller (e.g., oxytocin) use over the past month, based on a 5-point Likert scale ranging from *Never* (0) to *11+ times* (4). Frequency data for each substance, except for painkillers, was recoded into a dichotomous variable; use of substance 1-2 times or less per month (low/social user) and use of substance 3-5 times or more per month (high-risk/regular user). Given that using painkillers for non-medical reasons is normally less available among adolescents, this variable was recoded more strictly, wherein use of painkillers 1-2 times or more within a month was considered (at-risk/regular use).

Polysubstance Use. In order to understand the relationship between using multiple substances at a given time, a new variable (polysubstance use) was created. As such, engaging in each substance use regularly was coded as 1, and the variables were summed to create a polysubstance use variable. Scores of polysubstance use ranged from 0-4 (i.e., no engagement in substances regularly within the past month to engaging in all four substances [alcohol, cigarettes, marijuana and painkillers] regularly within the past month).

Results

Rates of Substance Use and At-Risk Gambling by Gender

The prevalence rates of substance use and at-risk gambling behavior among students by gender were analyzed. There was missing data on gender for 31 participants. However, the descriptive analyses of those who did report on their gender revealed that the gender distribution for regular use of most substances (i.e., cigarettes, alcohol, and binge drinking) was similar for both males and females. However, females were almost twice as likely to report regular use of painkillers (8% vs. 4.5%), and males were more than twice as likely to be identified as at-risk for gambling problems compared to females (11% vs. 5%) (see Table 2). Additionally, a closer examination of the NODS-CLiP scores revealed that 92% of the sample endorsed no problem gambling symptoms, 7% endorsed one, 1% endorsed two, and 0.3% of the sample endorsed all three of the NODS-CLiP problem gambling symptoms. By gender, the endorsement of gambling symptoms is in line with the at-risk classification. Among males, 9% endorsed one symptom, 1.2% endorsed two, and 0.4% endorsed all three symptoms; among females, 4.3% endorsed one, 0.5% endorsed two, and 0.1% endorsed all three symptoms (almost half as many as males).

Table 2.
Prevalence rates for substance use and problem gambling by gender

Substances	Male Prevalence (N = 3553)		Female Prevalence (N = 3418)	
	At-Risk/Regular User	No Risk	At-Risk/Regular User	No Risk
Cigarettes	2%	98%	2%	98%
Alcohol	5%	95%	5%	95%

Binge drinking	7%	93%	8%	92%
Marijuana	5%	95%	6%	94%
Painkillers	4.5%	95.5%	8%	92%
Problem Gambling	11%	89%	5%	95%

Substance Use and At-Risk Gambling Behavior

In order to understand the relationship between substance use and at-risk gambling behaviors, chi-square analyses were conducted on the six variables of interest (cigarettes, alcohol, binge drinking, marijuana, painkillers, and polysubstance use). The chi-square tests were significant for the relationship between at-risk gambling and alcohol, $\chi^2 = (1, 7002) = 18.51$, $p < 0.001$, with 9% of at-risk gamblers also reporting regularly consuming alcohol. They were also significant for binge drinking, $\chi^2 = (1, 7002) = 17.63$, $p < 0.001$, with 12% of at-risk gamblers also reporting regular episodes of binge drinking; for marijuana use, $\chi^2 = (1, 7002) = 7.38$, $p = .007$, with 7.8% of at-risk gamblers reporting regularly smoking marijuana; and for painkillers, $\chi^2 = (1, 7002) = 7.69$, $p = .006$, with 8.6% of at-risk gamblers reporting regularly taking painkillers. Finally, there was also a significant relationship between at-risk gambling and polysubstance use, $\chi^2 = (4, 7002) = 21.73$, $p < 0.001$. Specifically, approximately 13% of at-risk gamblers used at least one substance regularly per month, 4.5% used two, 2% used three, and 0.3% of at-risk gamblers used all four substances regularly within the past 30 days (see Figure 1).
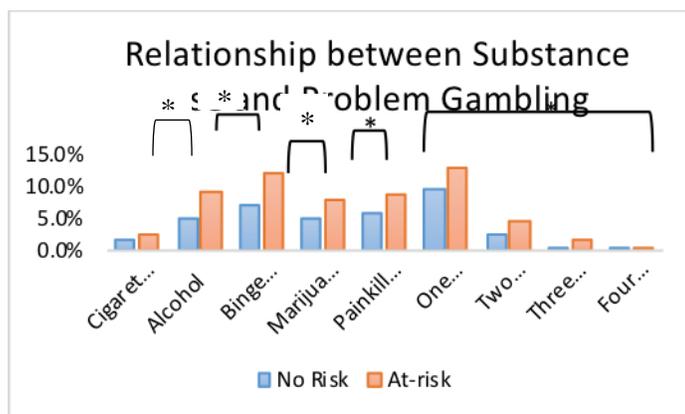
Figure 1. Relationship between substance use and problem gambling; *p < .05

Finally, in order to test for the effects of substance use on at-risk gambling, while also exploring the effects of gender and age, all variables were entered into a hierarchical binary logistic regression with at-risk gambling (score on the NODS-CLiP) as the dependent variable. In order to observe if gender and age influenced student classification as an at-risk gambler, the variables were controlled for and entered first in Block 1, followed by alcohol, cigarettes, marijuana, and painkiller use in Block 2. Given the high level of multicollinearity between binge drinking and alcohol use, and the high multicollinearity between polysubstance use and all the substances, these variables were not included in the logistic regression as independent variables in Block 2. A test of the first model with only gender and age as predictors was significant $\chi^2 = (2, 7002) = 79.65$, $p < 0.001$. The Nagelkerke pseudo R^2 indicated that the model accounted for approximately 3% of the variance in at-risk gambling. A test of the second model with alcohol, cigarettes, marijuana, and painkillers, controlling for gender and age, was also significant $\chi^2 = (4, 7002) = 31.12$, $p < 0.001$. The Nagelkerke pseudo R^2 indicated that the full model accounted for approximately 4% of the total variance, suggesting that substance use added 1% to the variance of at-risk gambling, after controlling for gender and age. Specifically, gender (OR = .45) and age (OR= .90) were negatively associated with problem gambling, indicating that males were significantly more likely than females to report gambling-related problems and younger students were more likely than older students to be identified as at-risk gamblers. Additionally, alcohol (OR = 1.90) and painkiller use (OR = 1.62) were both significantly associated with an increase in the likelihood of being identified as an at-risk gambler (see Table 3 for partial regression coefficients, Wald test, odds ratios, and 95% confidence intervals).

Table 3.
Logistic Regression Analysis Predicting Gambling Frequency

Variables	B	S.E.	Wald	df	Exp(B)	95% CI
Gender	-.80	.09	72.66**	1	.45	[.38; .54]
Age	-.10	.03	14.81**	1	.90	[.86; .95]
Cigarettes	-.03	.31	0.01	1	.97	[.52; 1.79]
Alcohol	.64	.18	12.33**	1	1.90	[1.33; 2.72]
Marijuana	.25	.20	1.67	1	1.29	[.88; 1.89]
Painkillers	.48	.17	8.40*	1	1.62	[1.17; 2.24]

Constant variable was problem gambling, according to the NODS-CLiP; * p < .05, ** p < .001

Discussion

The current study aimed to better understand the relationship and comorbidity levels between substance use and problem gambling among American adolescents. Previous research has consistently demonstrated an increased risk of substance use disorders among problem gamblers, however few have addressed differences in problem gambling across substance types (Håkansson & Ek, 2018). A study by Okunna, Rodriguez-Monguio, Smelson, and Volberg (2016) found that recreational adult gamblers were significantly more likely to drink alcohol, use illicit and prescription drugs, and smoke heavily compared to non-gamblers. Further, adult patients seeking treatment for opioids have been found to be significantly more likely to also have higher rates of problem gambling compared to patients receiving drug or alcohol-related treatment (Håkansson & Ek, 2018). However, these few studies were among adult gambling populations, and even fewer studies have been completed among adolescents (see review by Peters et al., 2015). A study by Liu, Maciejewsky, and Potenza (2009) reported that among a nationally representative sample of 2,417 U.S. adults, a significantly higher proportion of substance-abusing gamblers, as compared to substance non-abusers, began gambling before 18 years of age. Adolescence is a developmental period typically marked by an increase in engagement of risky behaviors, with reported higher rates of problem gambling, tobacco, alcohol, marijuana, and opioid use (Calado et al., 2017; CBHSQ, 2018; Johnston et al., 2018). Understanding the comorbidity levels and relationship of each specific substance with problem gambling will be an important step towards harm minimization.

In the current adolescent sample, females were almost twice as likely to regularly use painkillers, while males were more than twice as likely to be identified as being at-risk for gambling problems. While the gender distribution for all other substances (cigarette use, alcohol use and binge drinking) was similar for both males and females, this does not negate the importance of incidence rates and is in line with previous research that has shown higher rates of non-medical use of painkillers among females (Young, Glover, & Havens, 2012), and an approximate 2-3:1 male predominance of problem gambling (Ferris & Wynne, 2001).

As with previous research demonstrating a significant relationship between gambling problems and substance use (Peters et al., 2015), the current study found a significant difference in levels of regular substance use between non/social gamblers and those displaying gambling-related problems. Specifically, 9% of at-risk gamblers were also regular drinkers, 12% took part in regular binge drinking activities, and 7.8% regularly smoked marijuana. New to the literature, this study also found that 8.6% of adolescent at-risk gamblers also regularly ingested painkillers (e.g., opioids). Finally, given that polysubstance use has been associated with a greater likelihood of substance use disorders and other high-risk behaviors later in adulthood (Stockwell, 2005), it was of interest to find that 7.8% of at-risk gamblers regularly used 2 or more substances per month.

Finally, this study aimed to test for the effects of substance use on the likelihood of being identified with a gambling problem. Results indicated, in line with previous research, that gender and age were significant predictors of problem gambling, with males being more likely than females to be at-risk. Interestingly, within our sample, younger adolescents were more likely than older adolescents to endorse gambling-related problems. Previous research in the U.K. found similar results wherein the youngest children in their sample of adolescents had the highest propensity to be gamblers and were at particular risk of gambling problems (Forrest & McHale, 2012). It is possible that these results are due to the slow development of executive functioning skills and the impulsive decision-making process often seen in adolescents. In fact, a study by Smith, Xiao, and

Bechara (2012) reported that younger children (8 years old) performed better on the Iowa Gambling Task, compared to older children/young adolescents, with performance once again increasing towards late adolescence. Finally, among the various substances examined, alcohol and painkiller use were the only significant predictors of being identified as having gambling problems. More specifically, individuals who regularly consumed alcohol or painkillers were twice as likely to be at-risk for a gambling problem.

Limitations and Future Directions

This research allows for a greater comprehension of the relationship and levels of comorbidity between at-risk problem gambling and specific substance use. However, a number of limitations require being addressed. First, the present study used self-report data and as such may include a certain level of potential biases. In particular, given the sensitive nature of the survey questions (examining illegal activities among adolescents), it is possible that some individuals did not respond truthfully. Although a series of checks and filters were employed to confirm validity and sincerity of the responses, it is impossible to validate each respondent's true engagement. Second, given time constraints on the administration of the survey, the NODS-CLiP was employed rather than the complete NODS measure or other adolescent measures of problem gambling. Other screens may offer a more comprehensive assessment of gambling behaviors, however the NODS-CLiP has shown high specificity and sensitivity in previous research (Toce-Gerstein, Gerstein, & Volberg, 2009). Additionally, given that the data is cross-sectional in nature, it is impossible to assess a causal relationship between the engagement in substances and problem gambling. Finally, although the large sample size allows for greater generalizability, the data was only collected from one county (Wood County), within one state (Ohio). As such, it may not be representative of adolescent behaviors across the United States. Future longitudinal studies should investigate this relationship on a larger scale in order to identify how engagement in each of these activities/substances impacts one another.

Conclusions

Given the morbidity and mortality associated with adolescent addictive disorders, the excessive engagement in substance use and gambling needs to be identified and addressed as soon as possible. Single-variable explanations for risky behaviors among adolescents have been replaced by multivariate and multilevel explanations that implicate the individual, their context, and their interactions (Jessor, 1998). Therefore, given the unique needs of adolescents, treatment options for adolescent addictive disorders should be customized to their distinctive needs. In fact, adult-based treatment approaches often do not work or meet these needs (Truong, Moukaddam, Toledo, & Onigu-Otite, 2017). In order for treatments to be effective during adolescence, clinicians must consider the individual's level of development (biological, social, and psychological), school performance and engagement, family and peer influences, cultural factors, and mental health or physical issues (Truong et al., 2017). As such, it is important that treatment facilities screen for gambling problems along with substance use and understand the comorbidity levels among different addictive behaviors and how they relate to one another, in order to create optimal treatment options for adolescents. Additionally, proactive efforts towards prevention are often deemed an effective solution to addressing behavioral addictions and should be considered a priority. Given the current results, it is crucial that substance use prevention programs directed at adolescents also include gambling issues and prevention measures. Prevention research has seen a movement from single-disorder programs towards initiatives that target general mental health and well-being (Jessor, 1998). Prevention for substance use and gambling issues should include the development of effective coping skills to deal with adversity and adopt improving protective factors among students at-risk for both addictive disorders. Programs that are all-inclusive are likely to be the most effective approaches towards improved mental health.

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