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Patterns of gambling and substance use initiation in African American and White adolescents and young adults

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Abstract

The focus of the current investigation is to examine the temporal relationship of gambling onset and alcohol, tobacco and cannabis initiation in adolescents and young adults (*M* age= 20.3 years), by examining the prevalence and pattern of onset for each substance and gambling pairing and the associated risk between gambling and each substance use. Data were drawn from the multi-wave Missouri Family Study (*n*=1349) of African American (AA; *n*=450) and White families (*n*=317) enriched for risk for alcohol use disorder and includes those who were assessed for gambling behaviors and problems: African American: 360 males; 390 females and White: 287 males; 312 females. Findings indicated racial differences in the overall prevalence of gambling behaviors and substance use as well patterns of initiation– particularly within gambling/alcohol and gambling/tobacco for males. Survival models revealed some similarities as well as differences across race and gender groups in associations of gambling with initiation of substances, and of substances with initiation of gambling. Alcohol use (AA males only) and cannabis use (AA males and White females) elevated the hazards of initiating gambling. In contrast, gambling significantly elevated the hazards of initiation alcohol across 3 of 4 groups, and of cannabis use in AA males only. The results highlight some overlapping as well as distinct risk factors for both gambling and substance use initiation in this cohort enriched for vulnerability to AUD. These findings have implications for integrating gambling prevention into existing substance use prevention and intervention efforts – particularly but not exclusively for young African American males.

Keywords

Gambling; Alcohol; Tobacco; Cannabis; Race/Ethnicity; Etiology; Adolescent and Young Adults

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Introduction

Gambling among adolescents and emerging adults is a growing public health concern (Lussier, Derevensky, Gupta, & Vitaro, 2014). As the accessibility of gambling continues to rise, there are concerns that adolescent gambling will follow the same trend (Chaumeton, Ramowski, & Nystrom, 2011). In fact, adolescents born more recently are initiating gambling earlier than in the past (Leah S. Richmond-Rakerd, Slutske, & Piasecki, 2013). Previous research has linked greater access to and opportunities for gambling with an increase in prevalence of gambling and the development of gambling problems in youth (Calado, Alexandre, & Griffiths, 2017). Although gambling is an illegal activity for adolescents and some emerging adults, it is highly prevalent (Simmons, Whelan, Meyers, & Wickwire, 2016). For example, in an analysis of two combined U.S. youth and adult surveys of past-year gambling involvement (Welte, Barnes, Tidwell, & Hoffman, 2011) found that 60% of individuals age 14–15 and 72% of those age 20–21 gambled in the past year. Gambling behaviors increase throughout the teenage years, and reach a peak during young adulthood, and begin to decrease in one's late twenties (Welte et al., 2011). Furthermore, adolescents who gamble are vulnerable for problematic behaviors in adulthood (Abdi, Ruiter, & Adal, 2015) as early onset gambling has been associated with not only increased severity of gambling problems later in life (Burge, Pietrzak, & Petry, 2006; Kessler et al., 2008) but also, illicit alcohol, drug and other substance use, as well as other problem behaviors (Barnes, Welte, Hoffman, & Tidwell, 2009; Petry, Stinson, & Grant, 2005). Although results have been mixed, a recent study of Australian Twins found the relationship of gambling to substance use to be non-causal (Slutske et al., 2014). Therefore, understanding the interconnectedness of gambling behaviors and substance use involvement in this young population is paramount to combat the development of gambling and substance use problems later in life.

Reviews on the topic stress the importance of paying attention to racial difference when examining the etiology of adolescent gambling (Blinn-Pike, Worthy, & Jonkman, 2010). Overall, there is limited research on gambling involvement among African Americans in the United States (Barnes, Welte, & Tidwell, 2017). Prior studies have found race differences in gambling involvement between African Americans and other race/ethnic groups (Alegria et al., 2009). In fact, using a nationally representative adolescent sample, Barnes et al. (2009) documented higher rates (24%) of heavy gambling among African American youth compared to White youth (15%). African American youth also reported higher rates of past year gambling than their non-African American counterparts (Goldstein, Walton, Cunningham, Resko, & Duan, 2009). Similarly, such disparities are also found for rates of daily gambling in that nearly 10 % of African American youth gambled daily compared to 4% of White youth (Stinchfield, 2000). In addition to race, there are significant gender differences in that African American males of all ages have the highest rates of youth gambling compared to White males (Barry, Stefanovics, Desai, & Potenza, 2011; Simmons et al., 2016) putting them at particularly high risk of gambling-related consequences (Blanco, Hasin, Petry, Stinson, & Grant, 2006). In addition, gender differences have been reported pertaining to the environmental factors that influence age of onset of drinking and gambling behaviors (Richmond-Rakerd, Slutske, Heath, & Martin, 2014) indicating distinct

etiology across gender. These racial and gender differences underscore the importance of considering these demographic characteristics carefully when examining the etiology of gambling (Barnes et al., 2009).

In light of racial and gender differences, gambling must be considered in relation to other risky behaviors such as substance use, as many risky behaviors co-occur. Gambling behaviors have been reported at a higher frequency among youth who also report using alcohol or cannabis use, and further, heavy gambling and gambling problems were significantly associated with heavy drinking, smoking, and marijuana use (Barnes et al., 2009). Because shared risk is evident in gambling and substance use, it is essential to consider the temporal ordering of the behaviors to capture the association and directionality of initiation between these risky behaviors. Earlier research by Jacobs (2000) on long term trends in gambling in youth, average age of gambling initiation was observed to begin earlier than use of alcohol or drugs. These findings highlight both the potential risk pathways of gambling behaviors on the development of substance use, and substance use on predicting gambling behaviors. While only a few studies have examined the temporal relationship between substance and gambling initiation, little is known about possible characteristics of adolescents and young adults, including their substance involvement that predicts early gambling, including the impact of race on this relationship. Additional risk factors to consider for both gambling and substance involvement include age, other psychopathology, social environment, socioeconomic status, and familial – including genetic background. Previous research has reported that early age of gambling initiation is a risk factor for other risky behaviors as well as gambling problems (Gallimberti et al., 2016). Anxiety and mood disorders are also known to be correlated with problem gambling (Blaszczynski, 2010) but few have examined the impact of gambling initiation. As adolescent gamblers move quickly from social to problem gambling (Blinn-Pike et al., 2010) little is known pertaining to the associated risk of anxiety and depression symptomatology for gambling initiation.

Overall, studies on the temporal association between gambling behaviors and substance use are sparse with few exploring gender and racial differences. While gender differences have been found among young African American gamblers (Martins, Storr, Ialongo, & Chilcoat, 2008) we found no published study examining the risk associated with gambling for substance initiation and substance use for gambling initiation concurrently. Furthermore, most studies do not account for the influence of related psychopathology (e.g. anxiety, depression, or conduct disorder). As major short- and long-term psychological and behavioral factors are associated with early onset gambling, it is important to account for their impact. As such, the aim of the current investigation is to describe and examine the temporal relationship of alcohol, cannabis, and tobacco initiation in relation to onset of gambling in African American and White males and females. In order to investigate the associated risk between gambling and substance use, we report the prevalence of gambling behaviors and pattern of onset for each substance and gambling pairing and examine the hazard associated with specific substance use for gambling initiation and with gambling for substance use initiation using survival models in African American and White adolescents and young adults.

Methods

The data analytic sample includes African American (55.6%) and White (44.4%) participants drawn from the multi-wave Missouri Family Study (MOFAM; $n = 1349$), an epidemiologically ascertained sample that was enriched with families at high risk for alcohol use, where the mean offspring age at most recent interview is 20.3 (SD 3.9; Range 12–38). Specifics of the MOFAM procedures and ascertainment have been described in detail previously (Sadler et al., 2017) but for the reader's convenience salient details are briefly presented. In the MOFAM study, Missouri state birth records between 2003 and 2009, were used to identify families with a child aged 13, 15, 17 or 19 years and with at least one additional full sibling. Brief screening interviews with mothers were conducted to identify families of males at high risk for having AUD that was subsequently confirmed by a full interview with the mother. High risk families were defined by mother's report at screening of excessive drinking in the father and of paternal AUD at her full interview. Low risk families were those where mothers did not report a history of excessive drinking in the fathers nor did they meet AUD criteria at mother's full interview. Families where the screening risk assignment was not confirmed by mother's full interview (high risk families where fathers did not meet AUD, and low risk where fathers met AUD criteria) were considered misclassified and coded separately. An additional group of families at very high risk were defined by matching males with 2 or more DUI citations on state driving records to offspring birth records. Final familial risk level was used in the analyses to account for ascertainment strategy with the following prevalence: low risk (31.37%), false positive (6.45%), high risk (21.35%), false negative (4.60%), and very high risk (36.03%). Biological mothers provided permission to recruit offspring for interviews; offspring who themselves consented to participate were interviewed.

In total, 450 African American families and 317 White families were enrolled in the study over 6 years. Three of the intake years had 3 waves of data, collected at two-year intervals; the remainder had 1 to 2 waves. Offspring were assessed via telephone by an interview that was adapted from the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA) a reliable and valid instrument (Bucholz et al., 1994; Hesselbrock, Easton, Bucholz, Schuckit, & Hesselbrock, 1999) which assessed *DSM-IV* [American Psychiatric Association (APA), 2000)] lifetime criteria of alcohol and other drug use disorders, depression, conduct disorder, and other psychopathology, other psychosocial domains, as well, age of onset of substance use was obtained. This interview has been used extensively in a series of twin-family studies conducted by investigators in the Missouri Alcohol Research Center. (e.g. Jacob et al., 2003; Knopik et al., 2005; Werner et al., 2016)

Gambling Behaviors

To examine gambling behaviors, we used the Gambling Assessment Module (GAM-IV-S©; (Cunningham-Williams et al., 2005) to assess participation in gambling behaviors and age of gambling onset in the current study. The GAM-IV-S has been found to have excellent internal consistency among gamblers ($a = 0.86$; $n = 532$). In addition, the computerized version of the GAM-IV has been shown to have good to excellent test-retest reliability and concordance with semi-structured clinical interviews of disordered gambling (Sacco,

Cunningham-Williams, Ostmann, & Spitznagel, 2008). The GAM-IV assesses whether participants had "ever gambled or bet more than 5 times in your lifetime" and notes that these experiences include "gambling, betting, and playing games for money or for something else of value at a casino, on the computer, at the track, on the street, at home, or any other place." We also determined if participants had ever played or bet on ten types gambling activities, including slots, lottery, video poker, card games, casino games, dice/craps, bingo, races, sports, or other types of activities. Gambling initiation was defined as the age first gambled, and where age of onset was reported at more than one assessment wave, we used the age reported at the first endorsement of gambling. For those who endorsed ever gambling at more than one assessment, Cronbach alpha for age of first gambling behavior was 0.84, indicating acceptable test-retest reliability across waves of assessment.

Substance Use Initiation

As noted above, the interview obtained ages of onset of use of alcohol, tobacco, and cannabis. We defined the initiation of alcohol, tobacco, and cannabis as the first time the participant ever tried/used each of these substances, and recorded the age of onset as the age the participant first reported using each of these substances. As with gambling behaviors, when ages of onset were reported across multiple assessment waves, we used the onset age reported at the first endorsement of the behavior. For those who endorsed ever using substances at more than one assessment, Cronbach alpha for age of first alcohol initiation was 0.83, first tobacco initiation was 0.82, and first cannabis initiation was 0.89, indicating good test-retest reliability across waves of data.

Covariates

As noted above, the SSAGA covered a wide range of non-substance psychopathology based on lifetime *DSM-IV* (APA, 2000) criteria. We operationalized *Major depressive disorder* (MDD) as meeting *DSM-IV* (APA, 2000) lifetime criteria for 5 or more major depressive symptoms during the same 2-week period with age of onset defined as the age when full criteria were first met. We defined *conduct problems* as endorsing three or more conduct disorder symptoms all occurring before the age of 15, and for those meeting criteria, the age at which 3 or more behaviors first occurred. We operationalized *General Anxiety Disorder* (GAD) as meeting *DSM-IV* (APA, 2000) diagnostic criteria for three more anxiety symptoms in adults, and at least one symptom in adolescents. Additionally, a period of excessive worry for a period lasting of six months or more as required for both adults and children. We defined age of onset as the age first reported experiencing a GAD symptom. Consistent with our approach for coding onsets of gambling and substance use, we used the onset reported at the first assessment where the definition was met. For those who endorsed major depressive or generalized anxiety disorder symptoms at more than one assessment, Cronbach alpha for age of onset of GAD was 0.71 and MDD was 0.84, indicating acceptable test-retest reliability across waves of assessment.

Familial level covariates included family risk status (described above) and socioeconomic status. Mother's reports of familial household income and parental education were both included in models as a proxy for socio-economic status. Variables representing mother's and father's education levels were created representing whether each parent had completed

high school (including GED), did not graduate from high school, or had education beyond high school, the latter serving as the reference variable). We used the mother's report of her own and the father's educational levels.

Data Analysis

We conducted all analyses using Stata, version 14 (StataCorp, 2015) and performed analyses of descriptive statistics and prevalence rates of demographic characteristics, gambling, substance use, and covariates overall and within gender by race/ethnicity. To correct for multiple comparisons, we used a Bonferroni corrected significant value ($p = 0.003$) for the significance threshold of these prevalence rates. In addition, we accounted for familial clustering by identifying the primary sampling unit using the Stata *svyset psu()* command. To examine the order of initiation for each substance (alcohol, tobacco, and cannabis) with gambling onset, we grouped participants into one of six categories for each pairing based on reported age of initiation of each substance and/or gambling use: (1) gambling before substance use, (2) initiation of substance use and gambling at same age, (3) substance use before gambling, (4) gambling only, (5) substance use only, or (6) no substance use or gambling. Mean ages at first substance use and first gambling were calculated by category and by race/ethnicity for males and females. We also conducted within-gender, between race chi-squared analyses to test for racial differences in order of initiation.

To examine the temporal relationship between initiation of substance use and of gambling behavior, we conducted Cox Proportional Hazards regression analyses to examine the risk associated with alcohol, tobacco, and cannabis use for gambling initiation and the risk of gambling initiation for the initiation of alcohol, tobacco, and cannabis. To examine violations of collinearity, we tested correlations between alcohol, tobacco, and cannabis initiation and no violations were found ($r = 0.25$–0.73).

In all survival models, we adjusted for age at most recent interview, family risk level, parental educational attainment, and annual familial household income. Prior to the main analyses, we tested for interaction effects of race with substance initiation to predict gambling initiation. When predicting gambling initiation, significant interactions were present in males for race and each substance: alcohol ($F = 45.66$, $p < 0.001$), tobacco ($F = 30.62$, $p < 0.001$), and cannabis ($F = 46.63$, $p < 0.001$). We observed that in females, there were significant interactions between race and cannabis ($F = 26.12$, $p = 0.001$). Given evidence of interactions and to avoid compromising the statistical validity of our findings, for survival analyses, we stratified by race, as pooled analyses are not valid when there is substantial separation of the distribution between contrast groups as was the case in our data (see Imbens & Rubin, 2015). Marked imbalances of socio-economic status, as assessed by annual household income and parental educational attainment, between African American and White participants were evident. Stratified analyses allowed for separate, generalizable statements about risk-mechanisms for African American and White participants. Given the stratification by race in survival analyses, we made no direct comparisons of models. Instead, we focused the results and discussion on race-specific findings.

Models also accounted for psychopathology including GAD, MDD, and conduct disorder. Substance use variables, gambling status, MDD, GAD, and conduct problems were modeled as time-varying covariates coded as negative in each year prior to the age at first occurrence and positive for that year and each subsequent year. Thus, the time-varying covariates were counted as a risk factor only if they occurred prior to, or at the same age, as the particular outcome. The Huber-White robust standard errors adjusted for familial clustering in the confidence intervals. Cox Proportional Hazard regression analyses account for the possibility that participants who have not yet experienced the event of interest (e.g. initiation of gambling) may do so in the future. Under this approach, we used data up until the time of censoring (most recent interview) in the calculation of hazard ratios. We tested violations of the Cox Proportional Hazard assumption that risk remains constant over time using the Grambsch and Therneau test of the Schoenfeld residuals (Grambsch & Therneau, 1994) as operationalized in Stata and, if present, we corrected them with age-specific interactions, and conducted post-hoc tests to ensure that the hazard estimates for the age-specific risk periods were significantly different.

Results

Racial differences in prevalence, order of initiation, age at first involvement

In Table 1, descriptive statistics are presented along with the prevalence rates of demographic characteristics, gambling, substance use, and covariates by race. After correcting for multiple comparisons (using $p < 0.003$ as the significance level), African American males were slightly, but not significantly, more likely than White males to ever gamble [48.3% vs 40.1%; $X^2 = 4.41$, $p = 0.044$], yet their rates of betting on craps [29.3% vs 9.1%; $X^2 = 40.21$, $p < 0.001$] and sports [32.3% vs 17.4%; $X^2 = 18.52$, $p < 0.001$] were significantly higher compared with White males (Table 1). African American males were significantly less likely to have ever used alcohol [69.2% vs 80.8%; $X^2 = 11.40$, $p < 0.001$] and tobacco [67.2% vs. 79.4%; $X^2 = 12.00$, $p < 0.001$]. No difference in rates of cannabis use between African American and White males were observed [55.6% vs. 51.6%; $X^2 = 1.02$, $p = 0.372$]. African American and White males also differed significantly on annual household income, with a higher proportion of African American males in the low income group compared to their White counterparts (52.5% vs. 24.7%, $X^2 = 67.53$, $p < 0.001$). Significant differences between African American and White females were also found in annual household income, with a higher proportion of African American females in the low income group compared to their White counterparts (54.9% vs. 24.7%, $X^2 = 68.70$, $p < 0.001$) and other gambling activities (4.6% vs 0.6%, $X^2 = 9.89$, $p = 0.002$). Examples of other gambling activities endorsed include video games, animal fights, drag racing, own games of chance, and target shooting. We did not observe differences in other psychopathology between Black and White participants for either males or females.

When examining the prevalence and order of initiation of gambling and of each specific substance (Table 2), significant order of initiation differences were found between African American males and White males for alcohol-gambling ($X^2 = 30.97$, $p < 0.001$) and tobacco-gambling ($X^2 = 24.93$, $p < 0.001$). For African American males compared to White males, gambling was more likely to have preceded use of alcohol or tobacco, or to have occurred

without alcohol or tobacco use, while in White males alcohol use was more likely to have preceded gambling, or for alcohol or tobacco use to have occurred without gambling. We did not observe any significant differences between African American and White males for cannabis before gambling or gambling only. For females, significant order of initiation differences were found between African American and White females for alcohol-gambling (X^2=19.38, p=0.003). Compared to White females, African American females were more likely to have engaged in gambling before or at the same age as alcohol use, and less likely to have initiated only alcohol use. There were no significant differences in order of initiation for tobacco-gambling and cannabis-gambling in females.

Substance Use Associations with Gambling Initiation

In Table 3, results are shown for the Cox Proportional Hazard regression analyses, as conducted separately for African Americans and Whites, estimating the association of substance use initiation (alcohol, tobacco, and cannabis) on the initiation of gambling. There were no violations of the proportional hazard assumption for main predictor variables in the models for time to first gambling. In the model for males, cannabis and alcohol initiation significantly increased the hazard for gambling initiation in African American males (HR=1.75, 95% CI: 1.19–2.56 for cannabis, HR 1.79, 95% CI: 1.22–2.62 for alcohol) but not in White males, while conduct disorder significantly increased the hazard in White males (HR=2.15, 95% CI: 1.25–3.68) but not in African American males (HR=1.42, 95% CI: 0.95–2.13). In females, cannabis initiation increased the hazard of gambling markedly in White, but not African American females (HR=4.60, 95% CI: 1.72–12.31 - White; HR=1.41, 95% CI: 0.80–2.48 – African American). However, conduct disorder predicted gambling in African American females, but not White females (HR=2.54, 95% CI: 1.27–5.07- African American; HR=0.80, 95% CI: 0.20–3.19-White). For full models including HR for all variables, please see Supplement Table 1.

Gambling Initiation Associated with Substance Use Initiation

In Table 4, results are displayed for of the Cox Proportional Hazard regression analyses estimating the association of gambling on initiation of each specific substance. In the model for initiation of alcohol use, in White males, gambling was associated with the highest hazard for alcohol initiation prior to age 15 (HR=2.48, 95% CI: 1.22–5.02) but not thereafter. Gambling was also associated with an increased hazard of alcohol initiation in African American males (HR=1.71, 95% CI: 1.30–2.23) across the entire risk period. In White and African American males, conduct disorder also conferred an increase hazard for early alcohol initiation prior to the age of 15 (HR=3.45, 95% CI: 1.86–6.38 – African American; HR=2.15, 95% CI: 1.38–3.34 - White) but not thereafter. For females, gambling was associated with increased hazard for alcohol initiation for African American females only (HR=1.61, 95% CI: 1.14–2.28) and this estimate did not differ across the risk period. However, conduct disorder was linked to an increased hazard for alcohol initiation before age 17 in African American Females (HR=2.38, 95% CI: 1.45–3.90) and in White females (HR=2.66, 95% CI: 1.64–4.30) across the entire risk period. Neither Major Depression nor Generalized Anxiety were associated with increased risk of gambling initiation in any group.

For tobacco, gambling was not associated with starting to use tobacco in any group. Conduct disorder was associated with increased risk of early tobacco initiation (before age 15) in African American males (HR=2.20, 95% CI: 1.39–3.49) and White males (HR=3.00, 95% CI: 1.84–4.88). Generalized Anxiety was also associated with increased hazard for tobacco initiation in African American males (HR= 4.08, 95% CI: 1.60–10.24) but not in White males. In African American females, MDD was associated with increased risk of tobacco initiation (HR=2.00, 95% CI: 1.36–2.92). Conduct disorder was associated with an increased hazard for tobacco initiation before age 15 in White females (HR=3.09, 95% CI: 1.74–5.51) and in African American females (HR=1.79, 95% CI: 1.13–2.85) across the entire risk period.

With respect to cannabis initiation, gambling increased the hazard for cannabis initiation in African American males (HR= 1.90, 95% CI: 1.38–2.62) but not in any other group. Conduct disorder was associated with early cannabis initiation before age 15 in African American males (HR=3.18, 95% CI: 1.87–5.42) and before age 17 in White males (HR=3.37, 95% CI: 2.14–5.30). Conduct disorder increased the hazard of cannabis initiation in both White (HR=4.82, 95% CI: 2.36 – 9.85) and African American females (HR=2.64, 95% CI: 1.57–4.42) across the complete risk period. For African American females, MDD was associated with early cannabis initiation (before age 15; HR=2.68, 95% CI: 1.12–6.41) and GAD was associated with an increased hazard for cannabis initiation (HR=2.29, 95% CI: 1.11–4.72) across the risk period. For the models with HR estimates for all variables please see Supplement Tables 2–4. As with primary independent variables, any violations of the Cox Proportional Hazard assumption were corrected with age-specific interactions.

Discussion

The findings from this study underscore the importance of examining racial differences in gambling participation separately for males and females and the order of initiation of gambling and use of substances. This is essential in determining the patterns of risk associated with these behaviors in heterogeneous populations of adolescents and young adults. African American males had higher rates of gambling participation in this study, especially for certain types of gambling and betting, a finding that is consistent with epidemiological investigations of gambling (Barnes et al., 2009). Similarly, the lower risk of alcohol and tobacco use for young African Americans compared to their White counterparts is supported in the literature (Barnes et al., 2009). However, while the present study found no significant racial differences for cannabis use, when differences were found in other samples, the risk for African Americans have been lower than for White young adults (McCabe et al., 2007) . Discrepant findings in the current study could be due to the high-risk nature of the current population. These findings of differential risk by race for gambling and substance use and initiation of use highlights the need for future examination of the cultural context within which gambling and substance use behaviors develop and persist into young adulthood (Caler, Vargas Garcia, & Nower, 2017).

The models in males supported increased risk for gambling attributable to alcohol and cannabis initiation for African American males and conduct disorder for White males. For females, the opposite findings were observed in that increased hazard for gambling was

observed for cannabis initiation for White females and for conduct disorder for African American females. Furthermore, we found that gambling consistently and significantly elevated the HR for alcohol initiation across race for males, and for African American females (with estimates in the same direction, albeit not significantly so, for White females). In contrast, gambling had little association with initiation of tobacco, and was significantly associated with cannabis initiation only in African American males. These distinctions are important particularly when considering the "gateway hypothesis" of risky behaviors (Kandel, 1975). That is, gambling may serve as a gateway behavior, for alcohol use for most, and for cannabis use in some populations. Further, substance use, particularly cannabis use, may be the point of entry for gambling initiation, at least for some groups like African American males in our sample. Previous findings have suggested that gambling and other risk-taking behaviors may resemble gateway drug properties (Singer, Scott-Railton, & Vezina, 2012). Even when accounting for co-occurring psychopathology and other socio-economic risk factors, significant associations were revealed between substance and gambling initiation in African American males and White females, supporting a unique relationship between these risky behaviors. Results supported both gambling and substance initiation as risk factors particularly in African American males where alcohol and cannabis use increased hazard for gambling initiation and gambling increased risk for cannabis and alcohol initiation. That said, to our knowledge, no study to date has directly addressed these potentially relationships and etiological distinctions by race, and therefore further research into this hypothesis is warranted.

In the current study, regardless of race, conduct disorder was associated with increased risk of alcohol, tobacco and cannabis initiation for nearly all groups and for gambling initiation with the exception of White females. This finding is consistent with research indicating conduct problems as a robust predictor of gambling and substance initiation in youth even after accounting for other psychosocial risk factors (Temcheff, Dery, St-Pierre, Laventure, & Lemelin, 2016). Congruent with the tenets of Problem Behavior Theory (Jessor & Jessor, 1977) and more recent Structure of Psychopathology (Wright et al., 2013), it is common to engage in multiple risky behaviors and endorse conduct problems (Barnes, Welte, Tidwell, & Hoffman, 2013; Casey et al., 2011; Welte, Barnes, Tidwell, & Hoffman, 2008). Interestingly, GAD was associated with a high hazard for tobacco initiation in African American males and for cannabis initiation in African American females. This is in contrast to a recent study finding no relationship between anxiety and substance use in African American adolescent girls (McCauley Ohannessian, 2014). However, discrepant findings could be due to the slightly older sample in the current study allowing for consideration of risk across a longer time period. The current study also identified MDD as a hazard for cannabis and tobacco initiation in African American females. As such, future research would benefit by examining the relationship between depressive symptoms and substance use in African American females.

The findings from this study provide additional evidence for increased risk of adolescent gambling linked to early substance use and early conduct disorder across gender and race groups, and of cannabis and alcohol use as associated in particular with beginning to gamble in African American males Youth from disadvantaged neighborhoods may be even more vulnerable to gambling, as neighborhood disadvantage has been linked to greater

opportunities to gamble and at earlier ages, and therefore heightening risks for not only problem gambling (Barnes et al., 2013; Martins, Storr, Lee, & Ialongo, 2013), but also for the co-occurrence of conduct disorder and substance use (Karriker-Jaffe, 2011). Both directions of transmissions (e.g. substance use to gambling and gambling to substance use) have major implications including risks of co-occurrence of multiple addictive behaviors. Greater efforts towards interventions among youth focused on not only substance use but highlighting the risks of gambling for early substance initiation should be considered. Specifically, particular clinical attention to include early screening and treatment for cannabis misuse and conduct disorder and their relationships to gambling as well as culturally appropriate and gender-specific interventions are warranted as our findings indicate that patterns differ for males and females by race.

Limitations

These findings should be considered in the context of several key limitations. First, methodological limitations include the possibility of recall bias for ages of gambling and substance initiation. Still, we note this is a young sample; therefore, recall bias may be less potent. We also employed a Midwestern cohort and one that was enriched for risk for AUD that might not be generalizable to populations that are less geographically restricted or at lower risk for substance use vulnerability. We also acknowledge large socio-ecological disparities between the White and Black participants in our study sample and attempted to address this limitation by stratifying analyses by race and gender and accounting for socioeconomic characteristics within each group. Although outside of the current study's scope, future research should examine the impact of socioeconomic disparities and additional race-specific stressors (i.e., racial discrimination) as a potential contributor to these outcomes. That said, current findings point to the importance of considering race and other behavioral factors when describing the etiology of gambling and substance initiation.

Future directions

In light of the current findings, future research should continue to examine racial differences, but extend to cultural contextual characteristics involved in gambling and substance use given the racial differences observed among the young males and females in this sample. Furthermore, an examination of the order of initiation of potentially addictive behaviors and the impact of that pattern on pathological behaviors and addictive disorders is warranted. Additional longitudinal examination of these factors in males and females as well as culturally diverse populations should be considered. Lastly, prevention strategies should be designed and implemented to be both targeted in approach and universal in execution to meet the needs of heterogeneous populations and be broad enough to be applied to meet the specific needs of at- risk populations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Descriptive Statistics and Prevalence by Race

	Total	White Males	African American Males	White Females	African American Females
	$N = 1349$	$n = 287$	$n = 360$	$n = 312$	$n = 390$
	M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
Age at most recent interview	20.3 (3.9)	20.2 (3.8)	20.3 (4.2)	20.3 (3.7)	20.3 (3.8)
	n(%)	*n(%)*	*n(%)*	*n(%)*	*n(%)*
Ever Gambled	402 (29.8)	115 (40.1)	174 (48.3)	68 (17.4)	45 (14.4)
Mean age onset of gambling	17.4	17.1	16.2	18.4	17.2
Gambling activities					
Slots	175 (13.0)	51 (17.8)	50 (13.9)	32 (10.3)	42 (10.8)
Lottery	278 (20.6)	91 (31.7)	93 (25.9)	41 (13.1)	53 (13.6)
Video poker	104 (7.7)	33 (11.5)	43 (12.0)	10 (3.2)	18 (4.6)
Betting cards	219 (16.3)	80 (27.9)	88 (24.5)	19 (6.0)	32 (8.2)
Casino	79 (5.9)	31 (10.8)	25 (7.0)	8 (2.6)	15 (3.9)
Craps [a]	150 (11.1)	26 (9.1)	105 (29.3)	5 (1.6)	14 (3.6)
Bingo	100 (7.4)	17 (5.9)	41 (11.4)	12 (3.9)	30 (7.7)
Betting races	30 (2.2)	15 (5.2)	8 (2.2)	5 (1.6)	2 (0.5)
Betting sports [a]	192 (14.2)	50 (17.4)	116 (32.3)	7 (2.2)	19 (4.9)
Betting stocks	10 (0.7)	5 (1.7)	4 (1.1)	0 (0.0)	1 (0.3)
Other [b]	96 (7.1)	20 (7.0)	56 (15.6)	2 (0.6)	18 (4.6)
Substance Use					
Alcohol Use [a]	1001 (74.2)	232 (80.8)	249 (69.2)	246 (78.9)	274 (70.3)
Tobacco Use [a]	906 (67.2)	228 (79.4)	242 (67.2)	208 (66.7)	228 (58.5)
Cannabis Use	673 (49.9)	148 (51.6)	200 (55.6)	140 (44.9)	185 (47.4)
Psychopathology					
MDD	234 (17.4)	31 (10.9)	42 (11.7)	73 (23.6)	88 (22.7)
Conduct disorder	147 (10.9)	37 (12.9)	57 (15.8)	20 (6.4)	33 (8.5)
GAD	97 (7.2)	16 (5.6)	20 (5.6)	31 (9.9)	30 (7.7)
Annual Housed Income [a, b]					
< $30,000	551 (40.9)	71 (24.7)	189 (52.5)	77 (24.7)	214 (54.9)
$30,000 - $74,999	265 (19.6)	56 (19.5)	78 (21.7)	66 (21.2)	65 (16.7)
$75,000	533 (39.1)	160 (55.7)	93 (25.8)	169 (54.2)	111 (28.5)

Note:

[a] Significant differences between African American and White males at $p < 0.003$;

b Significant differences between African American and White females at $p < 0.003$ (Bonferroni correction for 34 comparisons); Examples of other gambling activities endorsed include video games, animal fights, drag racing, own games of chance, and target shooting.

Table 2.

Racial difference in the prevalence and order of initiation of gambling and substance use

	Gambling First % (Age Onset)	Same Age % (Age Onset)	Substance First % (Age Onset)	Substance Use Only % (Age Onset)	Gambling Only % (Age Onset)	None %	X^2	p
Alcohol								
African American males (n=360)	14.7 (16.9)	6.4 (15.4)	18.1 (15.0)	30.0 (16.5)	9.2 (15.1)	21.7	30.97	<.001
White males (n=287)	8.4 (16.6)	4.2 (15.6)	24.7 (14.9)	43.6 (15.3)	2.8 (14.4)	16.4		
African American females (n=390)	5.1 (17.4)	3.3 (18.1)	6.9 (16.4)	54.9 (16.7)	2.1 (14.7)	27.7	19.38	0.003
White females (n=312)	2.9 (17.0)	0.6 (19.5)	10.3 (15.0)	65.1 (15.7)	0.6 (11.0)	20.5		
Tobacco								
African American males (n=360)	9.4 (15.9)	3.9 (14.9)	22.5 (13.1)	31.4 (14.0)	12.5 (15.8)	20.3	24.93	<.001
White males (n=287)	4.9 (17.6)	3.5 (15.8)	26.8 (13.1)	44.3 (14.1)	4.9 (15.8)	15.7		
African American females (n=390)	2.8 (16.8)	0.8 (16.7)	8.7 (13.9)	46.2 (14.8)	5.1 (17.2)	36.4	10.90	0.062
White females (n=312)	1.3 (15.3)	0.6 (18.0)	10.6 (12.4)	54.2 (14.4)	1.9 (17.3)	31.4		
Cannabis								
African American males (n=360)	10 (15.6)	5.3 (14.9)	18.6 (13.9)	21.7 (15.5)	14.4 (16.2)	30.0	12.69	0.041
White males (n=287)	4.2 (17.1)	2.8 (16.5)	17.1 (17.8)	27.5 (15.6)	16.0 (16.6)	32.4		
African American females (n=390)	2.3 (15.9)	0.8 (16.3)	8.0 (15.1)	36.4 (15.8)	6.4 (17.4)	46.2	6.13	0.318
White females (n=312)	1.3 (16.0)	0.3 (21.0)	9.3 (15.6)	34.0 (15.7)	3.5 (17.1)	51.6		

Table 3.

Results of Cox proportional hazards regression analyses for the association of substance use with gambling initiation

	White Males	African American Males	White Females	African American Females
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Alcohol Use	1.52 (0.78–2.95)	**1.79 (1.22–2.62)**	0.87 (0.23–3.36)	1.55 (0.76–3.15)
Nicotine Use	1.34 (0.69–2.59)	0.82 (0.55–1.23)	1.03 (0.30–3.54)	0.94 (0.54–1.64)
Cannabis Use	0.94 (0.58–1.50)	**1.75 (1.19–2.56)**	**4.60 (1.72–12.31)**	1.41 (0.80–2.48)
MDD	1.00 (0.56–1.77)	1.20 (0.74–1.96)	0.99 (0.50–1.95)	1.17 (0.57–2.40)
GAD	0.67 (0.22–1.99)	1.12 (0.41–3.06)	2.29 (0.75–6.93)	0.53 (0.07–4.24)
Conduct Disorder	**2.15 (1.25–3.68)**	1.42 (0.95–2.13)	0.80 (0.20–3.19)	**2.54 (1.27–5.07)**

Note: All models account for family risk level, age at most recent interview, mother's and father's educational attainment, and familial household income. All variables reported in the table are coded as time-varying; MDD = Major Depressive Disorder, GAD = Generalized Anxiety Disorder.

Table 4.

Results of Cox proportional hazards regression analyses of the association of gambling with time to initiation of alcohol, tobacco, and cannabis use

Gambling associated with Alcohol initiation	White Males	African American Males	White Females	African American Females
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Gambling (<15)	**2.48 (1.22–5.02)**	**1.70 (1.30–2.23)**	1.72 (0.98–3.03)	**1.61 (1.13–2.29)**
Gambling (15)	1.07 (0.73–1.56)			
MDD	0.84 (0.50–1.41)	1.06 (0.67–1.67)	0.96 (0.64–1.43)	1.13 (0.78–1.64)
GAD	0.58 (0.24–1.43)	1.51 (0.88–2.60)	1.11 (0.62–1.99)	0.89 (0.47–1.69)
Conduct Disorder (<16)	**2.15 (1.38–3.34)**	**3.45 (1.86–6.38)**	**2.66 (1.64–4.30)**	-
Conduct Disorder (16)	0.62 (0.21–1.79)	1.17 (0.79–1.74)		-
Conduct Disorder (<17)	-	-	-	**2.38 (1.45–3.90)**
Conduct Disorder (17)	-	-	-	0.65 (0.32–1.34)

Gambling associated with Tobacco initiation	White Males	African American Males	White Females	African American Females
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Gambling	1.07 (0.69–1.65)	1.33 (0.95–1.88)	1.77 (0.74–4.21)	1.35 (0.84–2.17)
MDD	0.85 (0.41–1.76)	0.96 (0.61–1.49)	1.31 (0.79–2.18)	**2.00 (1.36–2.92)**
GAD	0.80 (0.45–1.41)	**4.08 (1.60–10.42)**	1.22 (0.69–2.17)	1.24 (0.41–3.76)
Conduct Disorder (<15)	**3.00 (1.84–4.88)**	**2.20 (1.39–3.49)**	**3.09 (1.74–5.51)**	**1.79 (1.13–2.85)**
Conduct Disorder (15)	0.43 (0.16–1.18)	0.78 (0.39–1.57)	0.48 (0.05–4.89)	

Gambling associated with Cannabis initiation	White Males	African American Males	White Females	African American Females
	HR (95% CI)	HR (95% CI)	HR (95% CI)	HR (95% CI)
Gambling	0.81 (0.48–1.36)	**1.90 (1.38–2.62)**	1.40 (0.44–4.47)	1.43 (0.79–2.59)
MDD (<15)	1.15 (0.72–1.85)	0.88 (0.51–1.49)	1.40 (0.86–2.29)	**2.68 (1.12–6.41)**
MDD (15)				0.85 (0.49–1.48)
GAD	0.82 (0.21–3.13)	1.48 (0.70–3.15)	1.15 (0.57–2.31)	**2.29 (1.11–4.72)**
Conduct disorder (<15)	-	**3.18 (1.87–5.42)**	**4.82 (2.36–9.85)**	**2.64 (1.57–4.42)**
Conduct disorder (15)	-	1.29 (0.77–2.17)		
Conduct Disorder (<17)	**3.37 (2.14–5.30)**	-	-	-
Conduct Disorder (17)	0.57 (0.11–3.05)	-	-	-

Note: All models account for family risk level, age at most recent interview, mother's and father's educational attainment, and familial household income. All variables reported in the table were coded as time-varying; MDD = Major Depressive Disorder, GAD = Generalized Anxiety Disorder.