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Relationship of Gambling With Tobacco, Alcohol, and Illicit Drug Use Among Adolescents in the USA: Review of the Literature 2000–2014

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Background and Objectives: Adolescence is a time during which not only gambling, but also tobacco, alcohol, and illicit drug use, usually begin. The purpose of this paper is to provide an updated review of the literature on gambling and its associations with tobacco, alcohol, and illicit drug use among US youth.
Methods: An electronic literature search of PubMed and PsycInfo was conducted for studies since 2000 using the keywords "smoking," "tobacco," "nicotine," "cigarette," "gambling," "adolescence," "adolescent," "alcohol," and "substance use." Ten articles with unique adolescent samples were located. Because the articles varied in regard to definitions of gambling, tobacco, alcohol, and drug use, we provide a qualitative review of included studies.
Results: Gambling prevalence rates ranged from 44.3% to 68% in national telephone-based surveys, from 24.4% to 86% among students in school-based surveys, and from 22.5% to 47.4% in surveys of convenience samples. Significant associations were reported between gambling and tobacco use (4/7 articles), gambling and alcohol use (7/8 articles), and gambling and illicit drug use (7/8 articles).
Conclusions: The wide range in rates of gambling and problem gambling may be due in part to differences among the studies in participant samples, sampling techniques, assessment time frames, and definitions of gambling. Despite methodological differences, most studies showed significant associations of gambling with tobacco, alcohol, and other illicit drug use.
Scientific Significance: As accessibility to gambling increases, more research is needed to inform prevention efforts and identify youth at-risk for gambling and other high-risk behaviors. (Am J Addict 2015;24:206–216)

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INTRODUCTION

Gambling is increasingly accessible in the US as lottery games and casinos expand geographically[1,2] and internet gambling becomes accessible throughout the world.[3] As accessibility to gambling increases, there is a concern that the number of youth with gambling problems will rise[4] despite the illegal nature of commercial gambling of those under 18 years of age in much of the US.[5] Because early onset of gambling is associated with later severity of gambling-related problems,[6,7] prevention, identification, and treatment of gambling problems in youth is of public health importance.[8,9]

A 15-year-old meta-analysis of gambling prevalence studies estimated that 77–83% of adolescents had gambled in the past year and 5.77% had problem gambling.[10] A more recent US population-based survey reported that 68% of adolescents had gambled in the past year and 2.1% had problem gambling.[11] Adolescence is a time in which not only gambling, but also tobacco, alcohol, and illegal drug use, usually begin. In 2012, 8.6% of US youth ages 12–17 used tobacco, 12.9% drank alcohol, 7.2% binge drank (ie, consumed five or more drinks on the same occasion), and 9.5% used an illicit drug, in the past month.[12] Thus, preventing tobacco, alcohol, and drug use during adolescence is critical.[13] In addition, the relationship between tobacco, alcohol, illicit drug use and gambling among youth needs examination.

Recently, numerous studies have been conducted on the relationship of gambling to tobacco, alcohol, and illicit drug use, demonstrating an increased appreciation for the potential comorbidity of gambling with other risky behaviors. However, findings on the relationships of gambling to tobacco, alcohol, and illicit drug use have not yet been synthesized. Increased knowledge about the prevalence and correlates of gambling among youth may help to both monitor trends associated with the expansion of gambling and inform efforts to prevent gambling and risk behaviors associated with gambling. The purpose of this paper is to provide an updated review of the literature on gambling and its associations with tobacco, alcohol, and illicit drug use among youth in the US.

METHODS

Inclusion criteria for this review were peer-reviewed articles in English that examined the prevalence of adolescent gambling, alcohol, and/or illicit drug use of individuals 12–18 years of age who resided in the US. We focused exclusively on US studies to reduce heterogeneity between studies included in the review and to reduce potential geographic variation in gambling-related domains such as gambling-related attitudes and availabilities of different forms of gambling. We included studies whose participants exceed 18 years of age if the maximum age was 21 and most of the participants were 18 years old or below. In order to keep this review contemporary, only articles that were published after 2000 were included. Exclusion criteria were studies concerning populations of specific psychiatric disorders (eg, early-onset schizophrenia)[14] and those studies that included primarily participants older than adolescent age (eg, college-age students, young adults).

An electronic literature search of PubMed and PsycInfo for studies within relevant parameters using the search terms "adolescent/adolescence" and "gambling" entered together and in combination with the terms "alcohol," "substance use," "cigarette," "tobacco," "nicotine," "smoking" yielded 358 articles. Three of the authors (ENP, CN, and RPS) collaboratively reviewed the titles, abstracts and, as necessary, the entirety of each article to select studies that potentially met inclusion criteria. Three hundred forty-seven publications that clearly did not meet inclusion criteria were excluded (ie, populations outside the US, older populations, lack of substance use analysis). The full text articles of the remaining publications were obtained and evaluated to determine whether the studies examined both gambling and its association with tobacco, alcohol, and/or illicit drug use within the selected population. The references in the included articles were examined for additional potential papers of interest, which yielded one additional publication.

A total of 22 articles examining gambling and tobacco, alcohol, and/or illicit drug use in adolescent samples were located. Because some of these articles included the same sample in different publications, we used only the most relevant article (ie, the article that examined tobacco, alcohol, or drug use as correlates of gambling). Thus, a total of 10 articles examining unique adolescent samples are included in this review.

The characteristics of the included articles are summarized below based on: (1) sample size, age range, and geographic location; (2) gambling, alcohol, tobacco, and illicit drug use screening instruments employed; (3) definition of gambling; (4) prevalence of gambling in each sample; and (5) the association of gambling with tobacco, alcohol, and/or illicit drug use. Because the included articles varied as to definitions of gambling, tobacco, alcohol, and illicit drug use, statistical meta-analysis of the association of gambling with tobacco, alcohol, and illicit drug use was not possible; thus, we provide a qualitative review of included studies based on the five characteristics listed above.

RESULTS

A summary of the 10 papers included in this review is provided below and abstracted in Table 1. Results on the prevalence of gambling and its association with tobacco, alcohol, and illicit drug use are provided below and in Table 2. We present results according to data collection methods (i.e., telephone-based surveys, school-based surveys, and surveys of convenience samples).

Telephone-Based Surveys

Duhig et al. (2007)

A nation-wide, computer-assisted, self-administered telephone survey among 534 adolescents ages 16 and 17-year-old was conducted by Duhig and colleagues.[15] A clear breakdown of gender distribution for the overall sample was not provided. The survey assessed past year gambling (yes/no), defined as any betting or game-playing that involved money, and whether participants met one or more Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition (DSM-IV)[16] criteria for gambling use disorder using the NORC DSM Screen for Gambling Problems (NODS).[17] In addition, participants were asked about their frequency (weekly or more), quantity (largest win or loss $>$\$100), and patterns (usually with someone else) of past year gambling. Tobacco use was not assessed but alcohol use was assessed by the number of days drinking alcohol in the past year ($>$12 days = "low frequency" and $\geq$12 days = "high frequency" alcohol use). Twenty one percent of the sample endorsed high frequency alcohol use and 79.0% endorsed low frequency alcohol use. Any drug use was screened by asking whether participants used drugs (not including tobacco or alcohol) for non-medical purposes on $\geq$5 days/year. Individuals who screened positive for drug use were assessed for DSM-IV criteria of substance use disorder for marijuana, cocaine, methamphetamine, or benzodiazepines. A total of 44.3% of the sample reported having gambled in the past year. Within the group of participants who used alcohol at a low frequency,

TABLE 1. Description of included studies

First author (year)	Sample	Sample size	Age range (years)	Self-report measures				
				Gambling	Problem gambling	Tobacco	Alcohol	Illicit drug use
Telephone-based surveys								
Duhig (2007)	Nation-wide telephone survey	534	16–17[k]	Any in the past 12 months[a]	One or more DSM-IV lifetime criteria (NORC DSM Screen for Gambling Problems); frequency, quantity, patterns	Not assessed	Past 12 month frequency	DSM-IV criteria[l]
Barnes (2009)	Nationwide telephone survey	2,274	14-21[k]	At least once in the past 12 months[b]	≥3 problems in the past year on items from combined surveys(SOGS-RA[p], DSM-IV-MR-J, Diagnostic Interview Schedule, Version IV)	Past 12-month use; Use of 10+ cigarettes, cigars, etc. per day; ≥3 DSM-IV tobacco dependence symptoms in the past year	Past year average consumption; heavy drinking (5+ drinks in 1 day on 12+ days); misuse (3+ DSM-IV problems)	Past 12 month frequency of marijuana use; heavy marijuana use; DSM-IV marijuana problems
School-Based Surveys								
Stinchfield (2000)	Minnesota high school classrooms	78,582	14-20[k]	Past 12 month frequency[c] (Minnesota Student Survey)	Past 12 months: "… have you ever felt bad about the amount you bet, or about what happens when you bet money?; "… have you ever felt that you would like to stop betting money but didn't think you could?"	Past 12 month chewing tobacco use	Past 12 month alcohol use	Past 12 month marijuana use
Westphal (2000)	Louisiana classrooms	11,736	12–18[k]	Lifetime and past 12 months[d]	SOGS-RA	Lifetime use	Lifetime and monthly alcohol use	Lifetime and monthly illicit drug use
Yip (2011)	Connecticut classrooms	2,484	14–18[k]	Past 12 month frequency[e]	DSM-IV criteria(Massachusetts Gambling Screen)	Lifetime frequency	Lifetime use and past 30-day frequency	Lifetime use
Chaumeton (2011)	Oregon 8th grade classrooms	15,865	M = 13.7 SD = 0.5	Past 3 month betting $1 or more[f](adapted from Youth Risk Behavior Survey)	Not assessed	Past 30 day use	Past 30 day use and frequency	Past 30 day use
Chiu (2012)	Chinese-American students in California classrooms	192	13–19 M = 15.9 SD = 1.5	Lifetime and past year frequency (SOGS-RA)[g]	SOGS-RA	Past 12-month use	Past 12-month use	Past 12-month use[m]

(*Continued*)

TABLE 1. Continued

First author (year)	Sample	Sample size	Age range (years)	Self-report measures: Gambling	Problem gambling	Tobacco	Alcohol	Illicit drug use
Lee (2014)	Maryland high school classrooms	25,456	Range not reported M = 16.0, SD = 1.3	Any lifetime[h]	"Have you ever felt the need to bet more and more?" and "Have you ever had to lie to people important to you about how much you gambled?" (Lie/Bet Questionnaire)	Past month use	Past month use	Past month use[n]
Surveys of Convenience Samples								
Martins (2008)	Participants in a prevention trial in Baltimore, Maryland classrooms	452	17 M = 17.1	Past 12 month gambling[i]	SOGS-RA	Lifetime and past year use	Lifetime and past year use	Lifetime and past year use[o]
Goldstein (2009)	Michigan emergency department	1,128	14–18 M = 16, SD = 1.47	Past 12 months betting $1 or more[j](Ontario Student Drug Use Survey)	Not assessed	Past 12 month cigarette use	Past 12 month use $\geq$ 2 times; CRAFFT	Past 12 month marijuana use

[a]Gambling defined as any betting or game-playing that involved money.

[b]Gambling defined as participating in office pools, raffles, or charitable small-stakes gambling; playing the lottery; purchasing pull tabs; gambling on the Internet; casino gambling; gambling on sports events; in card games; betting while playing sports games of skill; betting on sports events; and buying sports cards for inserts.

[c]Gambling defined as playing cards for money, betting money on games of personal skill (eg, pool) or on sports, buying lottery tickets or scratch-offs, or casino gambling.

[d]Gambling defined as playing: scratch-off, bingo, lotto, video poker, slot or keno machines, cards for money; betting on horse/dog races, casino gambling, betting on sports teams, games of personal skill (pool, golf, bowling), dice, flipping coins for money, Pogs; placing a bet with a bookie; or buying or selling "Intent or Chase" cards.

[e]Gambling defined as betting on strategic games (eg, playing cards not in a casino, placing a bet with a bookie, betting on video or arcade games, betting on dice outside of a casino, betting on pool or other games of skill), non-strategic gambling (eg, buying or receiving instant lottery or scratch tickets, playing bingo at church, synagogue, or other public place) and machine gambling (playing slot, machines, or other gambling machines).

[f]Gambling defined as betting on bingo, lottery, card games, Internet, or sports.

[g]Gambling defined as playing cards for money, purchasing raffle tickets, betting money on games of skill (eg, pool, golf or arcade games), betting money on sports teams with friends or relatives, flipping coins for money, gambling on the internet, betting money on sports teams with a bookie, and playing bingo for money.

[h]Gambling defined as playing the lottery, card/dice games, placing horse/sport bets, going to a casino, playing slot/poker machines, and online gambling.

[i]Gambling defined as betting on strategic games (eg, games of personal skill, sports, card games, horse or dog races, dice games, coins) or non-strategic games (eg, bingo, slot and poker machines, lottery, pull tabs, scratch-offs)

[j]Gambling defined as buying lottery tickets; betting money on card games, bingo or other games, sports, horse races, dog fighting; gambling machines at casino; or over the Internet.

[k]Mean and standard deviation not reported.

[l]Substances assessed include marijuana, benzodiazepines, methamphetamine, and cocaine. Opiate and stimulant medications were not assessed.

[m]Substances assessed include marijuana and cocaine.

[n]Substances assessed include marijuana and non-medical prescription drugs.

[o]Substances assessed include marijuana, cocaine, crack, heroin, hallucinogens, ecstasy, and inhalants.

[p]South Oaks Gambling Screen—Revised Adolescent.

TABLE 2. Association of gambling with tobacco, alcohol, and illicit drug use

First author (year)	Gambling rates	Significant association		
		Gambling and tobacco use	Gambling and illicit drug use	Gambling and Alcohol use
Telephone-based surveys				
Duhig (2007)	Gamblers: 44.3%	not reported	AOR = 2.57, $p < .05$[a]	not reported
Barnes (2009)	Gamblers: 68% Problem gamblers: 10%[m]	$p < .001$[b]	$p < .001$[b]	$p < .001$[b]
School-Based Surveys				
Stinchfield (2000)	Gamblers: 49.0%	$sr^2 = .01$, $p < .001$[c]	not reported	$sr^2 = .04$, $p < .001$[d]
Westphal (2000)	Gamblers: 86% At-risk gamblers: 10.1%[m] Pathological gamblers: 5.8%[m]	?[e]	?[e]	?[e]
Yip (2011)	Gamblers: 81.7% At-risk gamblers: 17.4%[n] Problem/pathological gamblers: 10.4%[n]	NG v. LRG for occasional v. never cigarette smoking: OR = .54, $p < .001$ and for regular vs. never cigarette smoking: OR = .52, $p = .001$[f] ARG v. LRG for occasional v. never cigarette smoking: OR = 1.51, $p = .003$[f] PPG v. LRG for occasional v. never cigarette smoking: OR = 2.0, $p < .001$ and for regular v. never cigarette smoking OR = 4.21, $p < .001$[f] PPG v. ARG for occasional v. never cigarette smoking: OR = 1.77, $p = .002$ and for regular v. never cigarette smoking: OR = 3.83, $p < .001$[f]	NG v. LRG: OR = .56, $p < .001$[f] PPG v. LRG: OR = 3.31, $p < .001$ and OR = 5.81, $p < .001$[f] PPG v. ARG: OR = 3.12, $p < .001$ and OR=5.68, $p < .001$[f]	NG v. LRG: OR = .59, $p = .023$[f] PPG v. LRG: OR = 2.22, $p < .001$[f] PPG v. ARG: OR = 2.03, $p = .011$ and OR = 4.54, $p < .001$[f]
Chaumeton (2011)	Gamblers: 24.4%	C = .56, $p < .001$[g]	C = .50, $p < .001$[g]	C = .14, $p < .001$[g]
Chiu (2012)	Gamblers: 62% At-risk gamblers: 12.0%[m] Problem gamblers: 10.9%[m]	†[h]	$sr^2 = .04$, $p < .05$[h]	†[h]
Lee (2014)	Gamblers: 32.8% Problem gamblers: 10.0%[o]	*Ns*[i]	AOR = 1.42, $p < .001$ and AOR = 1.86, $p < .001$[i]	AOR = 2.12, $p < .001$[i]
Surveys of Convenience Samples				
Martins (2008)	Gamblers: 47.4% At-risk gamblers: 5.3%[m] Problem gamblers: 2.9%[m]	not reported[j]	not reported[j]	AOR = 2.9, $p = .002$[k]
Goldstein (2009)	Gamblers: 22.5%	Past year gambling: *ns* Gambling frequency: *ns* Largest amount gambled: *ns*	Past year gambling: AOR = 2.15, $p < .001$[l] Gambling frequency: AOR = 2.03, $p < .001$[l] Largest amount gambled: AOR = 2.10, $p < .001$[l]	Past year gambling: AOR = 1.87, $p < .01$[l] Gambling frequency: AOR = 1.71. $p < .01$[l] Largest amount gambled: AOR = 1.68, $p < .01$[l]

sr2, semipartial r^2; OR, odds ratio; AOR, adjusted odds ratio; C, contingency coefficient; ns, nonsignificant.

[a]Within the alcohol abstainer/low frequency alcohol user group, gamblers reported more drug use than their non-gambling counterparts. There were no significant findings in the moderate/heavy alcohol user group between gamblers and non-gamblers in regard to drug use. Within the sub-sample of gamblers, gamblers with moderate/heavy frequency alcohol use were seven times more likely to report frequent gambling than the abstainer/low frequency alcohol use gamblers (AOR = .19, $p < .01$).

[b]The article stated that "heavy gambling and gambling problems were significantly associated with heavy drinking, smoking, and marijuana use (all chi-square and correlations were $p < .001$)." No other information was provided that would allow for calculation of an effect size.

[c]Tobacco use in this regression model was specific to chewing tobacco use only. Its sr^2 was reported when it entered the equation on step 5 (following: antisocial behavior scale ratings, gender, feeling bad about gambling, and alcohol use; and before: age and wanting to stop gambling). A p value was not reported in the article, and was computed based on data available in the article.

[d]sr^2 for alcohol was reported when it entered the equation on step 4 (following: antisocial behavior scale ratings, gender, and feeling bad about gambling; and before: chewing tobacco use, age, and wanting to

stop gambling). A p value was not reported in the article, and was computed based on data available in the article.

[e]This article reported that "lifetime prevalence of marijuana and tobacco use, past-year prevalence of alcohol and other drug use, and alcohol use monthly or more frequently accounted for 12.2 percent of the variance between [SOGS] level 1 gamblers and level 2 and 3 [SOGS]gamblers." However, it was not possible to determine on which of these individual variables the three groups differed.

[f]NG, non-gambling group; LRG, low-risk gambling group; ARG, at-risk gambling group; PPG, problem/pathological gambling group. In comparison to LRG, NG were less likely to report occasional or regular cigarette smoking (OR = 0.54, $p < .0001$; OR = 0.52, $p = 0.001$), any lifetime marijuana use (OR = 0.56, $p < .0001$), any lifetime alcohol use (OR = 0.24, $p < .0001$), current moderate or heavy alcohol use (OR = 0.59, $p = 0.023$; OR = 0.32, $p = 0.003$), and lifetime other drug use (OR = 0.50, $p = 0.011$). ARG were more likely than LRG to report occasional cigarette smoking (OR = 1.51, $p = 0.003$). PPG were more likely than LRG to report occasional and regular cigarette smoking (OR = 2.00, $p = 0.000$; OR = 4.21, $p < .0001$), any lifetime marijuana use (OR = 3.31, $p < .0001$), moderate or heavy current alcohol use (OR = 2.22, $p = 0.005$; OR = 5.03, $p < .0001$), and other drug use (OR = 5.81, $p < .0001$). In comparison to ARG, PPG were more likely to report occasional and regular cigarette smoking (OR = 1.77, $p = .002$; OR = 3.83; $p < .0001$), lifetime marijuana use (OR = 3.12, $p < .0001$), moderate and heavy current alcohol use (OR = 2.03, $p = 0.011$; OR = 4.54, $p < .0001$), and other drug use (OR = 5.68; $p < .0001$).

[g]C was calculated from available data. Both male and female active gamblers were significantly more likely to use tobacco, alcohol, and illicit drugs in the past 30 days (all $ps < .001$).

[h]Gambling was significantly associated with any past year substance use [as defined by cigarettes, alcohol, marijuana, or cocaine (all $p < .05$)].

[i]Lifetime gambling was associated with past month marijuana use and non-medical use of prescription drugs, and past month alcohol use. Past month cigarette use was not significantly associated with lifetime gambling. However, the past month use of cigarette, marijuana, and non-medical use of prescription drugs were associated with gambling problems among lifetime gamblers.

[j]Among gamblers, female were more likely than males to use tobacco in the past year (42.4% vs. 30.1%). Gambling was associated with past-year alcohol in both genders, however no specific data regarding this association was reported.

[k]Past-year alcohol use was associated with gambling in both genders, although no specific data were reported in the paper.

[l]Past year alcohol and marijuana use, but not tobacco use, were significantly associated with past-year gambling, higher frequency and higher amounts of money gambling.

[m]At-risk gamblers were defined as those with a SOGS score of 2 or 3. Those who received a SOGS score of 4 or more were classified as problem/pathological gamblers.

[n]Past year gamblers who endorsed one or two DSM-IV criteria items were considered at-risk gamblers. Those who endorsed three or more criteria items were classified as problem/pathological gamblers.

[o]Gamblers were dichotomously classified into two categories: problem gamblers or no-problem gamblers.

[†]Cigarette use and alcohol use were categorized as "substance use" for this analysis. Individual results for cigarette use or alcohol use were not reported.

there was a significant association between gambling and illicit drug use. This relationship was not in the group of adolescents who used alcohol at high frequency. The authors explained this lack of association in the high to moderate frequency alcohol use group with prior data linking increased alcohol consumption with adverse mental health problems such as drug use and abuse/dependence.[18–22] Consequently, the association between gambling and drug use was weakened. High frequency alcohol users were seven times more likely than the abstaining and low alcohol frequency groups to report frequent gambling (ie, weekly; $p < .01$).

Barnes et al. (2009)

Barnes et al.[23] examined a nationally-representative sample of US youth who participated in a telephone-based gambling survey. The household survey was conducted from 2005 through 2007 and surveyed 2,274 youth 14–21 years of age. Just over half (50.5%) of the sample were male. Past-year gambling behavior was assessed for frequency of multiple types of gambling: participating in office pools, raffles, or charitable small-stakes gambling; playing the lottery; purchasing pulltabs; gambling on the Internet; betting on any gambling activity at a casino, a riverboat, or a cruise ship; in card games; betting while bowling or playing other games of skills; betting on sports events; and buying sports cards (ie, to make money on insert cards). Respondents were asked if they had gambled money on any of these 15 activities in their lives. For every activity that was affirmatively endorsed, respondents were asked if they had gambled on those activities in the past 12 months. If respondents had gambled in the past 12 months, they were asked the frequency: "every day"; "at least once a week (if so, how many days a week)"; "at least once a month (if so, how many days a month)"; or "at least once in the past 12 months (if so, how many days in the past 12 months)". Respondents who endorsed any of these activities more than five times in the past year were assessed for gambling problem behaviors with three interviews: the South Oaks Gambling Screen—Revised Adolescents (SOGS-RA),[24] which has 12 items measuring frequency of gambling behavior and its associated problems in the past year and has scores ranging from 0–1 (no problem; Level 1), 2–3 (at risk for problem gambling; Level 2), to four or greater (at risk for pathological gambling; Level 3); the Fisher DSM-IV-MR-J for adolescents;[25] and the Diagnostic Interview Schedule-IV (DIS-IV).[26] Tobacco use was assessed through self-reported past 12-month use and daily use and DSM-IV tobacco dependence criteria. Marijuana use was assessed via self-reported lifetime and heavy use, and alcohol use was assessed via quantity/frequency questions over the past year and DSM-IV[16] criteria using the DIS-IV interview.[26] A dichotomous measure of gambling problems was defined as three or more gambling problems in the past year, derived from the total number of symptoms endorsed from the three gambling assessments. Over two-thirds (68%) of the youth reported to have gambled in the past year, with 10% (16% males and 3% females) reporting three or more gambling problems. African

American youth had higher rates of heavy gambling (24%) compared with white (15%) and Hispanic (21%) youth but lower rates of heavy drinking, cigarette, and marijuana smoking. Overall, rates of gambling and number of gambling problems were significantly associated with heavy drinking, tobacco use, and marijuana use, as well as problems related to tobacco, alcohol, and marijuana use.

School-Based Surveys

Stinchfield (2000)

A large self-administered survey was conducted in Minnesota among 78,582 high school students 14–20 years of age by Stinchfield.[27] Just over half of the sample (50.9%) were male. Past 12-month gambling behavior was assessed by a series of five items assessing the frequency of playing cards for money, betting on games of skill or on sports, playing the lottery, or casino gambling. For each of the five items, students were asked, "During the last 12 months, how often have you done these activities?" Each activity had five response choices: Not at all; Less than once a month; About once a month; About once a week; and Daily. Problems associated with gambling in the past year were assessed with questions regarding feeling bad about betting and loss of control of gambling. Chewing tobacco, alcohol, and marijuana use were assessed in the past 12 months; it was unclear if cigarette smoking was also assessed. A total of 49% of the sample reported gambling in the past year, with boys and older students reporting having gambled more than girls and younger participants, respectively. A multiple regression analysis indicated that alcohol and chewing tobacco use were correlated with the frequency of gambling (along with anti-social behavior, age, male gender, feeling bad about gambling, and wanting to stop gambling). Tobacco use uniquely explained 1%, and alcohol use 4%, of the variance in gambling frequency.

Westphal et al. (2000)

Westphal et al.[28] conducted a self-administered school-based survey among a random sample of 11,736 Louisiana students, grades 6 through 12 (12–18 years of age) regarding their gambling and substance use. Just over half the sample (53.4%) were female. Gambling behaviors were assessed using the SOGS-RA.[24] Gambling activities included playing a scratch-off, playing bingo for money, playing the lotto, playing video poker, playing slot or keno machines, betting on horse/dog races, gambling at a land-based casino, gambling at a riverboat casino, playing cards for money, betting on sports teams, betting on games of personal skill (pool, golf, bowling), playing dice games (craps, over/under), flipping coins for money, betting on sports pools, playing Pogs for money, placing a bet with a bookie, and buying or selling "Intent or Chase" cards. Lifetime alcohol, tobacco, and illicit drug use were assessed via questionnaire, as well as monthly alcohol and drug use. Eighty-six percent of the sample reported gambling in the past year, with the majority of participants (70.1% of the total sample) reporting gambling without problems. Individuals at risk for problem gambling and at risk for pathological gambling constituted between 10.1% and 5.8% of the sample, respectively. Fourteen percent of the sample had never gambled. Males and minority youth were more likely to have gambling problems than females and Caucasians, respectively. Lifetime prevalence of marijuana and tobacco use, past-year prevalence of alcohol and other drug use, and alcohol use monthly or more frequently accounted for 12.2 percent of the variance between SOGS level 1 gamblers and SOGS level 2 and 3 gamblers. However, it was not possible to determine on which of these individual variables the three groups differed.

Yip et al. (2011)

Yip and colleagues[29] conducted a multi-site survey among 2,484 students 14–18 years of age in Connecticut High Schools. The sex distribution was not clearly indicated. The confidential and anonymous paper-based survey on risk behavior was conducted at each school on one day in 2006–2007. Past-year gambling behavior and DSM-IV Gambling Disorder criteria were assessed with the Massachusetts Gambling Screen (MAGS). [30] Gambling was grouped into three categories: strategic gambling (eg, playing cards not in a casino, placing a bet with a bookie, betting on video or arcade games, betting on dice outside of a casino, betting on pool or other games of skill), non-strategic gambling (eg, buying or receiving instant lottery or scratch tickets, playing bingo at church, synagogue, or other public place), and machine gambling (playing slot machines, poker machines, or other gambling machines). Lifetime cigarette, alcohol, and illicit drug use were assessed with items derived from the Youth Risk Behavior Survey (YRBS).[31] Cigarette use was assessed with a single item that asked, "have you ever smoked a cigarette?" with responses coded to "Never," "Occasionally," and "Regularly." Lifetime alcohol and illicit drug use were assessed with survey items ("Have you ever smoked marijuana/ had a sip of alcohol/ used designer or other drugs, such as ecstasy, GHB, Special K, or cocaine?"). Current alcohol use was also assessed with a single question, "During the past 30 days, on how many days did you have at least one whole drink of alcohol?" Past-year gambling was reported by 81.7% of the sample, 53.9% of the total sample were low-risk gamblers (no DSM criteria met); 17.4% were at-risk gamblers (1 or 2 DSM criteria met); and 10.4% were problem/pathological gamblers (three or more DSM criteria). Consistent with other studies,[23,28,32] males were more likely than females to be in all three gambling groups and non-Caucasians were more likely to be in the problem/pathological gambling group than were Caucasians, respectively. Relative to non-gambling, low-risk, at-risk, and problem/pathological gambling were associated with higher likelihood of regular cigarette smoking, current moderate/heavy drinking and lifetime marijuana and other drug use.

Chaumeton et al. (2011)

Chaumeton and colleagues[5] conducted a school-based survey among 15,865 eighth-graders in Oregon. Less than half

(47.9%) were male. Gambling behavior was assessed by a single question "In total, how much money have you bet in any form (bingo, lottery, card games, internet, sports, with friends) in the past 3 months?" Potential responses were in the following dollar categories: $0, $0–10, $11–50, $51–100, $101–200, $201–$500 and over $500. Tobacco, alcohol, and illicit drug use were assessed using the Oregon Healthy Teens survey (OHT), which adapted questions from the YRBS[33] and were defined as the number of days in the past 30 days in which participants consumed at least one alcohol drink, used tobacco, and used an illegal substance. Nearly a quarter of respondents (24.4%) reported gambling in the past 3 months. Bivariate analysis found significant associations between gambling and alcohol, tobacco, and illicit drug use among both males and females. A logistic regression analysis that adjusted for potentially confounding risk factors found that females who did not use tobacco (and who had good personal safety habits and personal health beliefs, spent less than 2 h of screen time on school nights, were not involved in antisocial behavior, were not injured in the mouth while playing sports, and who spoke English at home) were more likely to have not gambled whereas males who reported recent drinking (as well as frequent physical activity, and having had a mouth injury during sports in the past 12 months) were more likely to have gambled in the past 3 months.

Chiu and Woo (2012)

Chiu and Woo[34] examined 192 Chinese-American High School students ages 13–19 in a relatively small school-based survey in San Francisco, CA. Just over half (50.5%) of the respondents were male. Gambling activities reported include playing cards for money, purchasing raffle tickets, betting money on games of skill (eg, pool, golf or arcade games), betting money on sports teams with friends or relatives, flipping coins for money, gambling on the internet, betting money on sports teams with a bookie, and playing bingo for money. Gambling in the past 12 months was assessed with the SOGS-RA,[24] and only a single assessment item combined any cigarette, alcohol, marijuana, or cocaine use in the past 12 months. Gambling in the past 12 months was reported by 62% of the sample, with an additional 10.9% reporting problematic gambling and 12.0% reporting at-risk problematic gambling. There was a significant association between problem gambling and general substance use ($p < .05$).

Lee et al. (2014)

Lee and colleagues[35] conducted a school-based survey among 25,456 students in 58 high schools in Maryland. Lifetime gambling behavior was assessed with one item on lifetime involvement in several types of gambling activities (ie, lottery, card/dice games, horse/sport bets, casino, slot/poker machines, online gambling, other gambling). Lifetime gambling-related problems were assessed with the Lie/Bet Questionnaire.[36] Substance use was assessed through YRBS[37] questions on past-month use of alcohol, cigarettes, marijuana, and non-medical use of prescription drugs. Lifetime gambling was reported by 32.8% of the weighted sample, and lifetime gambling-related problems were endorsed by 31.0% of lifetime gamblers. The likelihood of lifetime gambling was increased for students who endorsed past-month use of alcohol, marijuana, and non-medical prescription drugs. Additionally, the likelihood of lifetime gambling-related problems was increased for students who reported past-month use of cigarettes, marijuana, and non-medical prescription drugs.

Surveys of Convenience Samples

Martins et al. (2008)

Martins and colleagues[32] conducted a secondary data analysis of a longitudinal prospective study of youth in Baltimore, MD who had participated in a prevention trial targeting academic achievement and aggression in first grade. The secondary analysis examined the African American subsample of 452 youth who were interviewed for follow-up at 17 years of age in 2004. Fifty-four percent of this sample were male. Past year gambling behavior was assessed with the SOGS-RA.[24] Examples of gambling activities that were assessed include strategic games (eg, betting on games of personal skill, sports, cards games, horse or dog races, dice games, coins) and non-strategic games (eg, bingo, slot and poker machines, lottery, pull tabs, and scratch-offs). Lifetime and past-year alcohol, tobacco, and illicit drug use were assessed with items from the Monitoring the Future Survey.[38] Nearly half of the sample (47.4%) reported past-year gambling. In contrast to Westphal et al.[28] who also administered the SOGS and observed a problem gambling rate of 15.9%, 13.1% of males and 2.4% of females within the overall sample were problem gamblers, respectively. Male compared to female gamblers had higher SOGS-RA scores indicating higher number of gambling problems. Gambling was associated with past-year alcohol use in both sexes, but the study did not report the association of gambling with tobacco or illicit drug use. Female gamblers were more likely than male gamblers to be past-year tobacco users (42.4% vs. 30.1% respectively). However, there were no gender differences among gamblers in lifetime or past-year use of illicit drugs.

Goldstein et al. (2009)

Goldstein and colleagues[39] conducted a computerized self-administered survey among 1,128 urban youth 14–18 years of age admitted to a Michigan emergency room. Less than half (45.9%) were male. Gambling behavior in the past 12 months, as well as its frequency (from once to $\geq$12 times) and the most money wagered (from $1 to $\geq$ $200), were assessed with three items from the Ontario Student Drug Use Survey.[40] Gambling was defined as buying lottery tickets or betting money on playing cards, bingo or other games, sports, horse races, dog fighting, gambling machines at the casino, or over the Internet. Any tobacco use, alcohol use two or three times, and any marijuana use in the past 12 months were assessed with items from the Monitoring the Future Study.[38] In addition, the CRAFFT[41] was used to assess alcohol abuse. The authors

revised the items on the CRAFFT to make the measure alcohol-specific and removed any reference to drug use. Past-year gambling was reported by 22.5% of participants, with 24.5% of the gamblers reported waging at least 10 times and 13% reported spending more than $100 on a bet. Men and African Americans were more likely to have gambled. In logistic regression analyses, past-year gambling, higher rate of gambling, and spending greater amounts of money were significantly associated with past-year alcohol and marijuana use, but not tobacco use.

DISCUSSION

This paper summarizes 10 peer-reviewed articles published between 2000 and 2014 that reported on the prevalence of gambling and the association of gambling with alcohol, tobacco, and illicit drug use among adolescents in the US. Gambling prevalence rates ranged from 44.3% to 68% in national telephone-based surveys, from 24.4% to 86% in school-based surveys, and from 22.5% to 47.4% in surveys of convenience samples. Significant associations were reported between gambling and tobacco use (4/7 articles), gambling and alcohol use (7/8 articles), and gambling and illicit drug use (7/8 articles). The overall significant relationships of gambling to tobacco, alcohol, and illicit drug use among US adolescents mirror findings in US adults.[42] When compared to gambling prevalence rates found in the only US population-based youth survey of gambling of which we are aware,[11] gambling prevalence rates for the national telephone-based surveys were similar but were lower for the surveys of convenience samples. The wide range in gambling prevalence rates found in the school-based surveys (24.4–86%) makes comparison to the rates found in Welte et al. (2008)[11] difficult. The wide range in reported gambling rates and differences in prevalence rates found in the included studies versus Welte et al. (2008)[11] may be due in part to methodological differences among the studies. The sample recruitment approaches varied considerably across studies from classroom surveys,28,52[30] to nationwide telephone surveys[30] and emergency room surveys.[40] Time frames for assessment differed among the studies as well. The study with one of the lowest prevalence rates of gambling assessed only the past 3-month period[5] in contrast to all the other studies that assessed gambling over the past 12-month period. In addition to different time frames for measuring recent gambling, another methodological difference among studies was the definition of gambling itself (eg, betting with friends or playing cards at home in contrast to casino or online gambling). Finally, different measures of gambling were utilized including the SOGS, DSM-IV criteria, and other questionnaires. The possible contribution of methodological differences to varied results across these US studies is consistent with the conclusion derived from a review of international studies on gambling prevalence,[4] which pointed out similar challenges comparing gambling studies across countries. In addition to methodological differences, external factors, such as regional differences in the base rate of gambling and proximity to gambling casinos, could influence the wide range in gambling prevalence rates.

Across studies, there was also a relatively wide range of rates of problem and pathological gambling. Studies using the SOGS-RA measure of gambling problems found that 5.3%,[32] 10.1%,[28] and 12.8%[34] were at-risk problem gamblers, and 2.9%,[32] 5.3%,[28] and 10.9%[34] were considered at-risk pathological gamblers. Two of the three studies that assessed the DSM-IV categorization of problem gambling found a prevalence of at risk youth (meeting one or two DSM-IV criteria) of 10.1%[28] and 17.4%,[29] plus a prevalence of DSM-IV criteria for pathological gambling of 5.8%[28] and 10.4%[29]. The third study[15] reported only whether participants met at least one DSM-IV criteria (not whether they met criteria for dependence). In this third study, 19% of high frequency drinkers and 15% of low frequency drinkers met at least one criterion. Given that adolescence is a time of increased risk for onset of addiction[43] and early onset of gambling is associated with increased likelihood of concurrent substance use disorders among adult gamblers,[44] the relatively high prevalence of gambling behaviors of concern.

Gambling was associated with tobacco, alcohol, and illicit drug use in the majority of the studies reviewed. Consistent associations between gambling and tobacco, alcohol, and illicit drug use were observed even though the studies employed a variety of methods to assess tobacco, alcohol, and illicit drug use. Assessment methods included self-reported lifetime use, questions from the Monitoring the Future Study,[38,45] and the CRAFFT.[41] The associations of gambling with tobacco, alcohol, and illicit drug use support the clustering of high-risk behaviors[46] and indicate that future gambling-related interventions for adolescents may need to target multiple high-risk behaviors. Such interventions could provide psychoeducation of the interactions of high-risk behaviors, promote increased participation in prosocial activities that do not involve gambling or substance use, and minimize favorable attitudes towards high-risk behaviors. Interventions could address multiple high-risk behaviors in either a simultaneous or sequential fashion.

Adolescence is a time of increased risk for onset of substance use disorder[43] and early onset of gambling is associated with increased likelihood of concurrent substance use disorders among adult gamblers.[44] Thus, the relatively high prevalence of gambling behaviors, and the consistent associations of gambling with tobacco, alcohol, and illicit drug use, are of concern. However, some longitudinal research on gambling has shown that, within individuals, problem gambling from adolescence throughout adulthood may be more transitory and episodic than chronic and enduring.[47–49] If the developmental course of problem gambling appears to be one in which some adolescents "mature out" of problem gambling or recover from problem gambling on their own, then future research may benefit from identifying characteristics (eg, sociodemographic, personality) of adolescents that predict continued problem gambling into adulthood.

Identification of such characteristics would inform prevention interventions that could be targeted to adolescents who would be most likely to have problem gambling throughout their lives.

Stinchfield[50] has called for more research on developmentally appropriate gambling measures for youth. Until such a measure is developed, one option is to use interviews based on DSM-5[51] criteria as a way of standardizing classifications of gambling problems. Uniformity and methodological consensus in gambling will allow for the examination of temporal and geographic trends and variation in gambling patterns, and will also allow for measurement of the effect of preventive interventions. Future research should use a consistent measure of substance use such as items from the Monitoring the Future Study in order to permit cross study comparisons. Given the changes in the local environment in gambling availability as well as the expansion of internet and mobile gambling, repeated surveying to monitor changes in prevalence over time will be important. The theory of adolescent risk behavior posits that there is a positive correlation among a variety of adolescent risk behaviors including substance use, gambling, lack of seat belt wearing, unsafe sex, and delinquency.[46] More longitudinal research is needed to clarify the natural history of gambling among youth as well as its relationship with other risk behaviors.

Strengths of this literature review are its inclusion of recent studies, allowing for a current understanding of the prevalence and severity of gambling among adolescents in the US, and its synthesis of findings from studies with varying methodologies. Although statistical meta-analysis was not possible due to the varying study methodologies, our qualitative review is an important first step towards identifying trends in the prevalence and correlates of gambling. Limitations of this literature review are the relatively small number of included studies, the cross-sectional nature of the associations evaluated, and the lack of information on the degree or extent of the associations of gambling with tobacco, alcohol, and illicit drug use. Given the widespread prevalence of gambling among youth, the relatively high prevalence rate of gambling problems and their association with other substance use disorders, more research is needed to inform prevention efforts and to identify youth at-risk for problem gambling.

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Declarations of Interest

The authors report no financial conflicts of interest. The authors alone are responsible for the content and writing of this paper.

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