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Pathological Gambling, Problem Gambling and Sleep Complaints: An Analysis of the National Comorbidity Survey: Replication (NCS-R)

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Abstract

The purpose of this study is to investigate the relationship between sleep disturbances and gambling behavior. Data from the National Comorbidity Survey—Replication (NCS-R) was used to examine the relationship between three specific sleep complaints (difficulty initiating sleep [DIS], difficulty maintaining sleep [DMS], and early morning awakening [EMA]) and gambling behavior. Bivariate logistic regression models were used to control for potentially confounding psychiatric disorders and age. Almost half of respondents with problem gambling behavior (45.9%) and two thirds (67.7%) of respondents with pathological gambling behavior reported at least one sleep complaint. Compared to respondents with no gambling pathology, respondents with pathological gambling were significantly more likely to report at least one sleep complaint (Adjusted Odds Ratio [AOR] = 3.444, 95% CI = 1.538–7.713), to report all sleep complaints (AOR = 3.449, 95% CI = 1.503–7.914), and to report any individual complaint (DIS: OR = 2.300, 95% CI = 1.069–4.946; DMS: AOR = 4.604, 95% CI = 2.093–10.129; EMA: AOR = 3.968, 95% CI = 1.856–8.481). The relationship between problem gambling and sleep complaints were more modest (any sleep complaint: AOR = 1.794, 95% CI = 1.142–2.818; all three sleep complaints: AOR = 2.144, 95% CI = 1.169–3.931; DIS: AOR = 1.961, 95% CI = 1.204–3.194; DMS: AOR = 1.551, 95% CI = 0.951–2.529; EMA: AOR = 1.796, 95% CI = 1.099–2.935). Given the individual and societal ramifications linked with the presence of sleep problems, this study presents another health-related repercussion associated with gambling pathology rarely discussed in the literature.

Keywords

Gambling; Sleep; National comorbidity survey replication; Epidemiology

Introduction

While a substantial amount of research has explored the adverse physical and mental health effects of disordered gambling (Morasco et al. 2006a, 2006b; Potenza et al. 2002), sleep disturbances in this population have been sparsely explored. Abnormalities in sleep, especially those defined as part of an insomnia syndrome, have a variety of negative influences on human health. The DSM-IV defines insomnia as a syndrome of diminished sleep that can be characterized by any of the four domains of irregularity: difficulty initiating sleep, difficulty maintaining sleep, early morning awakening, and non-restorative

sleep despite sufficient time spent sleeping (APA 2000). Epidemiological studies estimate the prevalence of insomnia to be between 10 and 40% depending on the criteria used (Hossain and Shapiro 2002; Leger and Bayon 2010; Roth 2007). Insomnia is largely recognized as a major public health issue because of its frequency and its large, multifaceted cost to society. Not only does poor sleep have harmful effects on several physiological parameters (Spiegel et al. 1999; Tochikubo et al. 1996), it has also been found to increase the risk for all-cause mortality (Kripke et al. 2002), coronary heart disease, and diabetes mellitus (Ayas et al. 2003). Beyond health-related concerns, individuals suffering from sleep disturbances are at an increased risk for motor vehicle accidents and suicide, experience a decrease in work productivity and quality of life, and are more likely to excessively utilize healthcare services (Hossain and Shapiro 2002; Leger and Bayon 2010; Roth 2007; Wojnar et al. 2009; Wade 2010; Rosekind et al. 2010; Daley et al. 2009).

Interestingly, sleep is assessed in one question in the “Gamblers Anonymous Twenty Questions” (Shaffer et al. 1989), but receives no mention in the DSM-IV description of pathological gambling (APA 2000). Evidence in the gambling literature suggests that some gamblers go days without sleep (Lesieur and Rosenthal 1991), experience extreme stress during phases of continuous losses (Lesieur and Custer 1984; Lesieur and Rosenthal 1991), and encounter problems with sleep during withdrawal (Wray and Dickerson 1981; Lorenz and Yaffee 1986; Rosenthal and Lesieur 1992). Additionally, three cross-sectional gambling studies have included a single question about sleep among a variety of other measures (Hodgins and El Guebaly 2000; Griffiths 2001; Bakken et al. 2009). In contrast to this nominal exploration of sleep in the gambling field, numerous studies suggest that substance-related disorders and sleep dysfunction are bi-directionally associated (Johnson and Breslau 2001; Tynjala et al. 1997): Not only does the abuse of psychoactive drugs affect the quantity and quality of sleep (Lumley et al. 1987; McCann and Ricaurte 2007; Jaehne et al. 2009; Wasielewski and Holloway 2001; Tynjala et al. 1997; Sharma et al. 2010; Schierenbeck et al. 2008; Stein and Friedmann 2005), but poor sleep patterns can predict the development of substance-related disorders (Wong et al. 2004, 2009).

Notably, in a recent sample of current community gamblers, Parhami and colleagues (2012) found a stepwise decrease in sleep quality among recreational, problem, and pathological gamblers, and they found significantly elevated daytime sleepiness in pathological gamblers compared to recreational gamblers. While this was the first study to use objective sleep measures in the gambling population, the sample size ($n = 96$) was inadequate to statistically control for confounding variables, notably comorbid psychiatric conditions.

Individuals with gambling disorders have a high rate of psychiatric comorbidity (Lorains et al. 2011; Petry et al. 2005). In a recent meta-analysis of population surveys, Lorains and colleagues (2011) found that 38, 37, and 58% of disordered gamblers experienced mood disorders, anxiety disorders, and substance-abuse disorders, respectively. Additionally, Kessler et al. (2008) examined the National Comorbidity Study—Replication and found that pathological gamblers were significantly more likely than controls to experience a number of psychiatric comorbidities (e.g., mood disorders, Odds Ratio [OR] = 3.7; anxiety disorders, OR = 3.1; substance-abuse disorders, OR = 5.5). Several studies have also found a consistent link between sleep disturbances and these psychiatric disorders, particularly major depressive disorder, generalized anxiety disorder, bipolar disorder, and substance-related disorders (Breslau et al. 1996; Riemann 2007; Roth et al. 2006). This raises the concern that the problematic sleep patterns observed in disordered gamblers are merely a symptom of comorbid psychiatric illness and not directly associated with gambling pathology itself. To address this issue, this study used data from a nationally representative survey (the National Comorbidity Survey—Replication) to first control for the influence of confounding

psychiatric conditions before examining the relationship between sleep disturbances and gambling behavior.

Given the strong relationship between substance-related disorders and sleep dysfunction, and the finding that disordered gambling shares a great deal of similarity with substance-related disorders (van Holst et al. 2010b; Wareham and Potenza 2010; van Holst et al. 2010a), it is hypothesized that a strong relationship also exists between sleep complaints and gambling pathology.

Methods

Study Design

This study utilized publicly available online data from the National Comorbidity Survey—Replication (NCS-R) (<http://www.icpsr.umich.edu/CPES/data.html>). Over two hundred publications have used this data to publish reports examining prevalence rates and association factors for numerous psychiatric disorders, including specific investigations of problems with sleep (Roth et al. 2006; Wojnar et al. 2009) and others studying pathological gambling (Kessler et al. 2008). Human subjects committees at Harvard Medical School and the University of Michigan approved the NCS-R's procedures and design.

Sample

The NCS-R is a nationally representative, face-to-face, household interview of English-speaking respondents 18 years of age and older. The survey was carried out between February 2001 and April 2003 using a multi-stage clustered area probability sample of the US population (Kessler and Merikangas 2004; Kessler and Üstün 2004). Recruitment consisted of a mailed letter and study fact brochure followed by an in-person interviewer visit to explain the study and obtain informed consent. The response rate was 70.9%, and all respondents received a \$50 incentive for their participation.

This survey consisted of two parts. All respondents ($n = 9,282$) were administered a Part I diagnostic interview, and a subsample ($n = 3,435$) of Part I respondents were also administered a Part II interview that assessed additional disorders and correlates. Part II respondents consisted of the subset of (1) Part I respondents with a DSM-IV diagnosis and (2) an additional probability subsample of those with no such diagnosis. Questions regarding gambling and sleep were administered during the Part II interview. More detailed information about the design and sampling methods of the NCS-R are reported elsewhere (Kessler and Merikangas 2004; Kessler and Üstün 2004).

Variables

Gambling pathology was assessed using the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI) (Kessler and Merikangas 2004; Kessler and Üstün 2004). This is a fully structured, lay-administered interview that generates diagnoses according to the definitions and criteria of the DSM-IV. In order to meet the criteria for gambling pathology, respondents had to answer “yes” to both “gambling 11 times or more in your lifetime” and “gambling at least once every week for 6 months or more in a row.” Respondents who answered “yes” to both of these gateway questions were then asked additional yes/no questions based on the 10 criteria for the DSM-IV definition of pathological gambling. Individuals with positive responses to five or more questions were classified as having pathological gambling behavior, and those with one to four positive responses were categorized as having problem gambling behavior. Based on previously performed procedures (Kessler et al. 2008) and DSM-IV definitions, respondents who also

met criteria for a lifetime CIDI/DSM-IV diagnosis of bipolar I disorder were excluded from a pathological or problem gambling classification.

Sleep complaints were assessed using three yes/no questions, each indicating a classic component of insomnia specified in the DSM-IV (APA 2000). The questions asked whether the respondent had experienced the following symptoms for periods lasting 2 weeks or longer in the past 12 months: difficulty initiating sleep (DIS; “nearly every night it took you 2 hour or longer before you could fall asleep”), difficulty maintaining sleep (DMS; “you woke up nearly every night and took an hour or more to get back to sleep”), and early morning awakening (EMA; “you woke up nearly every morning at least 2 hour earlier than you wanted to”).

Confounding Variables: Age and the Presence of Comorbid Psychiatric Disorders

Age and the presence of psychiatric conditions were recognized as confounding variables, as research has demonstrated a positive relationship between these variables and sleep. The incidence of insomnia is higher in older adults and is associated with many age-related conditions (Ancoli-Israel 2009). A positive relationship also exists between sleep and substance-related disorders, mood disorders, anxiety disorders, and ADHD (Ramsawh et al. 2009; Roth et al. 2006; Sobanski et al. 2008; Peterson and Benca 2008). Age was recorded as a continuous variable, while a binomial variable was created indicating the presence or absence of each category of psychiatric disorder. Psychiatric diagnoses were organized into the following four categories based on classifications in the DSM-IV: mood disorders (bipolar I, bipolar II, bipolar subthreshold, major depressive disorder, dysthymia, hypomania, and mania), substance-related disorders (alcohol abuse, alcohol dependence, drug abuse, drug dependence, and nicotine dependence), anxiety disorders (generalized anxiety disorder, agoraphobia with and without panic disorder, adult separation anxiety, panic attack, panic disorder, PTSD, social phobia, and specific phobias), and ADHD. Psychiatric diagnoses were determined using NCS-R questions that incorporated diagnostic criteria from the CIDI and DSM-IV. These diagnoses showed good concordance rates to blind clinical re-interviews using the Structured Clinical Interview for DSM-IV (SCID) (First et al. 1995).

Analysis

Data used in this study came from respondents who answered all three questions regarding sleep and all relevant gambling questions. First, respondents were categorized into three groups: those with no gambling pathology, those with problem gambling behavior, and those with pathological gambling behavior. Next, distributions were calculated for the number of respondents in each group who reported DIS, DMS, EMA, at least one of the three sleeping problems, or all three sleeping problems. Bivariate relationships between these three groups and the presence of sleep complaints were then assessed using two-sided Chi-square tests.

Bivariate logistic regression models were also used to control for confounding variables (age and presence of mood disorders, substance-related disorders, anxiety disorders, and ADHD). Five separate models were created using the presence of pathological gambling, problem gambling, and non-disordered gambling as the independent variables and the presence of DIS, DMS, EMA, at least one sleep problem, or all three sleep problems as the dependent variables. SPSS 19.0 was used for all analyses.

Results

Sample

The majority (99.6%; $n = 3,421$ out of 3,435) of respondents answered all questions pertaining to sleep and gambling. The prevalence of pathological gambling behavior was 0.9% ($n = 31$), and the prevalence of problem gambling behavior was 2.5% ($n = 85$) (see Table 1). Detailed demographic and gambling characteristics of this sample are described elsewhere (Kessler et al. 2008). More than one third of all respondents (35.5%, $n = 1,213$) reported at least one sleep complaints, which is in line with published epidemiological data (Hossain and Shapiro 2002; Leger and Bayon 2010; Roth 2007; Shaffer and Hall 2002; Petry et al. 2005). Approximately one tenth of the respondents (10.3%, $n = 353$) reported all three sleep complaints (see Table 2).

Gambling Pathology and Sleep Complaints

At least one sleep complaint was reported by 67.7% ($n = 21$) of respondents with pathological gambling behavior, 45.9% ($n = 39$) of respondents with problem gambling behavior, and 34.9% ($n = 1,153$) of respondents with no reported gambling pathology (see Table 2). Furthermore, all three sleep complaints were reported by 32.3% ($n = 10$), 16.5% ($n = 14$), and 10.0% ($n = 329$) of respondents with pathological, problem, and no gambling pathology, respectively. Each individual complaint demonstrated similar distribution (see Table 2). Chi-square tests demonstrated a significant difference ($p < 0.001$) between these three groups.

Relative to respondents who did not report gambling pathology, respondents with pathological gambling were almost four times more likely (OR = 3.920, 95% CI = 1.840–8.351, $p < 0.001$) to report any sleep complaint, and respondents with problem gambling were approximately one and half times more likely (OR = 1.582, 95% CI = 1.027–2.439, $p = 0.038$) (see Table 3). Respondents with pathological gambling (OR = 4.307, 95% CI = 2.011–9.225, $p < 0.001$) and respondents with problem gambling (OR = 1.784, 95% CI = 0.994–3.200, $p = 0.052$) were also more likely to report all three sleep complaints compared to non-disordered gamblers.

Specifically, each sleep complaint independently showed a strong relationship with pathological gambling (DIS: OR = 3.191, 95% CI = 1.565–6.506, $p = 0.001$; DMS: OR = 4.845, 95% CI = 2.342–10.025, $p < 0.001$; EMA: OR = 4.102, 95% CI = 2.018–8.340, $p < 0.001$). The relationship between problem gambling and each individual sleep complaint was only statistically significant for DIS (DIS:AOR = 1.707, 95% CI = 1.068–2.729, $p = 0.025$; DMS: OR = 1.349, 95% CI = 0.844–2.154, $p = 0.211$; EMA: OR = 1.603, 95% CI = 0.997–2.575, $p = 0.051$) (see Table 3).

Adjusted Odds Ratio (AOR) After Controlling for Confounding Variables

After controlling for the influence of confounding variables (the presence of psychiatric comorbidity and age), a significant and positive relationship still existed between pathological gambling and sleep complaints (see Table 3). Compared to respondents with no gambling pathology, respondents with pathological gambling were still significantly more likely to report at least one sleep complaint (AOR = 3.444, 95% CI = 1.538–7.713, $p = 0.003$), report all three sleep complaints (AOR = 3.449, 95% CI = 1.503–7.914, $p = 0.003$), or report any individual complaint (DIS: AOR = 2.300, 95% CI = 1.069–4.946, $p = 0.033$; DMS: AOR = 4.604, 95% CI = 2.093–10.129, $p < 0.001$; EMA: AOR = 3.968, 95% CI = 1.856–8.481, $p < 0.001$). The relationship between problem gambling and sleep complaints was more modest (any sleep complaint: AOR = 1.794, 95% CI = 1.142–2.818, $p < 0.011$; all three sleep complaints: AOR = 2.144, 95% CI = 1.169–3.931, $p = 0.014$; DIS: AOR = 1.961,

95% CI = 1.204–3.194, $p = 0.007$; DMS: AOR = 1.551, 95% CI = 0.951–2.529, $p = 0.079$; EMA: AOR = 1.796, 95% CI = 1.099–2.935, $p = 0.019$). Although the final models have an estimated Nagelkerke R square of 0.10–0.14, the Hosmer–Lemeshow goodness-of-fit test was insignificant ($p > 0.05$) suggesting that the model is a good fit to the data (Table 3).

Discussion

This study examined a large, nationally representative sample and found a strong relationship between gambling pathology and sleep complaints. After controlling for possible confounding variables (age and presence of psychiatric comorbidity), results indicate that pathological gamblers are at increased risk for experiencing difficulty initiating sleep (2.3 times), difficulty maintaining sleep (4.6 times), early morning awakening (4.0 times), any single complaint with sleep (3.4 times), and all three problems with sleep (3.4 times) relative to the control group (see Table 3). The relationship was more modest between individuals with problem gambling behavior and these sleep complaints. By controlling for a broad spectrum of psychiatric illnesses, this study suggests the sleep complaints seen in gamblers are not an effect of diagnosable psychiatric disorders. While previous studies have demonstrated that gamblers often experience sleep complaints during crisis or withdrawal (Lesieur and Custer 1984; Lesieur and Rosenthal 1991; Rosenthal and Lesieur 1992), these findings support the notion that individuals with gambling pathology are more prone to sleep disturbances (Parhami et al. 2012).

While the cause of sleep problems in this population is beyond the scope of this study, there may be psychological explanations. Disordered gamblers commonly experience shame, guilt, depression, helplessness, anxiety, and anger. Even when criteria are not met for a formal psychiatric diagnosis, the negative or dysphoric affect and state of mind of the gambler can have a significant impact on sleep. Preoccupation with gambling, reliving past gambling experiences, planning next gambling sessions, and thinking of ways to get money to gamble (APA 2000) can further contribute to problematic sleep and stress. In addition, extreme amounts of stress are common in pathological gamblers (Goudriaan et al. 2004), and mounting evidence suggests that this stress adversely affects sleep (Van Reeth et al. 2000).

Conversely, since gambling is highly accessible due to the continuous availability of casinos and online gambling, disordered gamblers may gamble not just as a coping mechanism to deal with anxiety and depression (APA 2000) but also as an escape from their sleep problems. This is similar to the way substance abusers, who often acquire sleep problems, are known to use drugs to self-medicate and cope (Bonn-Miller et al. 2010; Brower et al. 2001; Crum et al. 2004; Roane and Taylor 2008).

Regardless of why sleep complaints are more prevalent in disordered gamblers, research has demonstrated that problematic sleep has a significant effect on gambling behavior. Recent studies have found that sleep disturbances impair self-control and decision-making (Hagger 2010; Killgore et al. 2008), increase impulsivity, attenuate responses to losses and increase expectations of gains (Venkatraman et al. 2007), and degrade cognition in executive functioning tasks (Harrison and Horne 2000; Tucker et al. 2010). Along with these findings on impulsivity and impaired decision-making, this study suggests that a bi-directional association may be present whereby poor sleep promotes detrimental gambling behavior, and disordered gambling in turn adversely affects sleep. Such a positive feedback loop would promote the progression of gambling disorders.

Since sleep management is not included in empirically based treatments for gambling disorders (Brewer et al. 2008; Leung and Cottler 2009), and since sleep problems are

associated with diminished quality of life (Kyle et al. 2010) and a number of other adverse outcomes (Hossain and Shapiro 2002; Leger and Bayon 2010; Roth 2007; Wade 2010), screening for and possibly treating sleep problems in such a high-risk population may be of important clinical value. Specifically, disturbances in sleep are accountable for increases in motor vehicle accidents (Smolensky et al. 2011), occupational injury (Salminen et al. 2010), fatigue, daytime sleepiness, cognitive difficulty (Ohayon 2009), and suicide (Wojnar et al. 2009), along with decreased work productivity (Rosekind et al. 2010). Additionally, benefits have been shown for the treatment of problematic sleep in other psychiatric conditions, including substance abuse (Rybarczyk et al. 2009; Stepanski and Rybarczyk 2006; Brower and Perron 2010; Arnedt et al. 2011; Bootzin and Stevens 2005; Bolla et al. 2008; Neubauer 2009).

Three main limitations are present in this study. First, as in other studies involving interview surveys, there likely exists recall bias (Buysse et al. 2008): responses to survey questions may be inaccurate because of participants' inability to objectively remember past events. Future studies could use more objective measurements, such as sleep monitors (e.g., polysomnography) or psychometrically valid and reliable questionnaires. Another limitation was how this data was constrained by the NCS-R questions. Non-restorative sleep or excessive daytime sleepiness, both of which are also criteria for insomnia, may be addressed in future studies. Similar to previous studies, these domains were not examined because they were incompletely surveyed in the NCS-R (Roth et al. 2006; Wojnar et al. 2009). The last limitation of this study is related to the date the survey was conducted, which coincides with the time online gambling began to expand. With the recent increase in accessibility and popularity of online gambling, the association between the presence of sleep complaints and gambling pathology may be stronger than the findings in this study.

Despite these limitations, this study indicates a relationship between gambling pathology and the presence of sleep complaints, and is the first study to use a nationally representative dataset after controlling for various confounders. More importantly, this sample did not concentrate on gambling treatment seekers, who may have withdrawal symptoms or be in crisis, which may affect sleep. These findings will pave a path for further investigation, probe the possible usefulness of sleep management in disordered gamblers, and provide evidence that may one day be used to ascertain whether there is reciprocal comorbidity between problematic sleep and gambling.

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Table 1

Age and prevalence of psychiatric disorders

	Control^a (n = 3,305)	Problem Gambling^b (n = 85)	Pathological Gambling^c (n = 31)	Total (n = 3,421)
Age				
Mean	43.62	44.67	37.87	43.60
Standard deviation	16.921	15.364	13.303	16.861
Presence of psychiatric Disorder, % (n)				
Substance-related disorder	8.5 (250)	15.3 (13)	38.7 (12)	8.9 (305)
Mood disorders	16.4 (542)	7.1 (6)	32.3 (10)	16.3 (558)
Anxiety disorders	35.1 (1161)	31.8 (27)	48.4 (15)	35.2 (1203)
ADHD	3.2 (106)	2.4 (2)	3.2 (1)	3.2 (109)

Percentages indicate the distribution of respondents in each column (control, problem gambling, pathological gambling, and total) that are represented by the category indicated in the far left column

^aControl: respondents who did not meet criteria for problem or pathological gambling (includes non-gamblers)

^bProblem gambling: respondents who met one to four DSM-IV criteria for pathological gambling

^cPathological gambling: respondents who met five to ten DSM-IV criteria for pathological gambling

Table 2

Association between gambling pathology and endorsement of sleep complaints

	At least one sleep complaint	All three sleep complaints	Individual complaints		
			Difficulty initiating sleep ^a	Difficulty maintaining sleep ^b	Early morning awakening ^c
Gambling category					
Control ^d , % (<i>n</i> = 3,305)					
Prevalence, % (n)	34.9 (1,153)	10.0 (329)	20.5 (678)	24.6 (814)	20.6 (682)
OR (CI) ^h	1	1	1	1	1
Problem Gambling ^e , % (<i>n</i> = 85)					
Prevalence, % (n)	45.9 (39)	16.5 (14)	30.6 (26)	30.6 (26)	29.4 (25)
OR (CI) ^h	1.58 (1.027–2.44) *	1.78 (0.99–3.20)	1.71 (1.07–2.73) *	1.35 (0.84–2.15)	1.603 (1.00–2.58)
Pathological Gambling ^f , % (<i>n</i> = 31)					
Prevalence, % (n)	67.7 (21)	32.3 (10)	45.2 (14)	61.3 (19)	51.6 (16)
OR (CI) ^h	3.92 (1.84–8.35) ***	4.31 (2.01–9.23) ***	3.19 (1.57–6.51) ***	4.85 (2.34–10.03) ***	4.102 (2.02–8.34) ***
Total (<i>n</i> = 3,421)					
Prevalence, % (n)	35.5 (1,213)	10.3 (353)	21.0 (718)	25.1 (859)	21.1 (723)
Chi-square ^g	18.63 ***	20.07 ***	16.10 ***	23.34 ***	21.27 ***

Values indicate the percentage of respondents within each gambling category with the following symptoms(s). The reference control category for odds ratios represents respondents who did not meet DSM-IV criteria for problem or pathological gambling

p 0.001;

**
0.001 < p 0.01;

*
0.01 < p 0.05

^aDifficulty initiating sleep: took 2 or more hours to fall asleep for 2 or more weeks in the past year

^bDifficulty maintaining sleep: took an hour or more to get back to sleep for 2 or more weeks in the past year

^cEarly morning awakening: woke up 2 or more hours too early for 2 or more weeks in the past year

^dControl: respondents who did not meet criteria for problem or pathological gambling (includes non-gamblers)

^eProblem gambling: respondents who met one to four DSM-IV criteria for pathological gambling

Pathological gambling: respondents who met five to ten DSM-IV criteria for pathological gambling

χ^2 Chi-square analysis with two degrees of freedom

$OR_{95\%}$ Odds ratio (95% confidence interval)

Table 3
Logistic regression analysis of possible characteristics associated with sleep complaints ($n = 3,421$)

	At least one sleep complaint	All three sleep complaints	Individual complaints		
			Difficulty initiating sleep ^d	Difficulty maintaining sleep ^b	Early morning awakening ^c
Crude odds ratio (95% confidence interval)					
Gambling category					
Problem gambling ^d	1.58 (1.03–2.44) *	1.78 (0.99–3.20)	1.71 (1.07–2.73) *	1.35 (0.84–2.15)	1.603 (1.00–2.58)
Pathological gambling ^e	3.92 (1.84–8.35) ***	4.31 (2.01–9.23) ***	3.19 (1.57–6.51) ***	4.85 (2.34–10.03) ***	4.102 (2.02–8.34) ***
Adjusted for potential confounders, adjusted odds ratio (95% confidence interval)					
Age (continuous variable)	1.01 (1.01–1.02) ***	1.01 (1.00–1.02) **	1.00 (1.00–1.01)	1.02 (1.01–1.02) ***	1.02 (1.01–1.02) ***
Presence of:					
Substance related disorder	1.48 (1.14–1.92) **	1.46 (1.04–2.04) *	1.92 (1.47–2.50) ***	1.34 (1.02–1.76) *	1.11 (0.84–1.48)
Mood disorder	2.62 (2.14–3.21) ***	2.63 (2.02–3.43) ***	2.58 (2.09–3.19) ***	2.87 (2.33–3.53) ***	1.94 (1.56–2.41) ***
Anxiety disorder	2.35 (2.00–2.75) ***	2.56 (1.99–3.28) ***	2.17 (1.81–2.60) ***	2.39 (2.01–2.85) ***	2.34 (1.95–2.81) ***
ADHD	2.05 (1.34–3.15) ***	2.23 (1.39–3.57) ***	1.68 (1.09–2.57) *	1.69 (1.10–2.59) *	2.11 (1.38–3.21) **
Gambling category					
Problem gambling	1.79 (1.14–2.89) *	2.14 (1.17–3.93) *	1.96 (1.20–3.19) **	1.55 (0.95–2.53)	1.80 (1.10–2.94) *
Pathological gambling	3.44 (1.54–7.71) **	3.45 (1.50–7.91) **	2.30 (1.07–4.95) *	4.60 (2.09–10.13) ***	3.97 (1.86–8.48) ***
Hosmer and Lemeshow Test (<i>p value</i>)	0.379	0.319	0.312	0.131	0.513
Nagelkerke R square	0.137	0.122	0.126	0.142	0.100

The reference category for the crude odds ratio represents respondents in the control gambling category (did not meet criteria for problem or pathological gambling). The reference categories in the adjusted odds ratio represent the absence of substance related disorders, mood disorders, anxiety disorders and ADHD

* $p < 0.001$;

**
0.001 < $p < 0.01$;

*
0.01 < $p < 0.05$

^aDifficulty initiating sleep: took 2 or more hours to fall asleep for 2 or more weeks in the past year

^bDifficulty maintaining sleep: took an hour or more to get back to sleep for 2 or more weeks in the past year

^cEarly morning awakening: woke up 2 or more hours too early for 2 or more weeks in the past year
^dProblem gambling: respondents who met one to four DSM-IV criteria for pathological gambling
^ePathological gambling: respondents who met five to ten DSM-IV criteria for pathological gambling