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Gambling disorder-related illegal acts: Regression model of associated factors

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Background and aims: Gambling disorder-related illegal acts (GDRIA) are often crucial events for gamblers and/or their entourage. This study was designed to determine the predictive factors of GDRIA. *Methods:* Participants were 372 gamblers reporting at least three DSM-IV-TR (American Psychiatric Association, 2000) criteria. They were assessed on the basis of sociodemographic characteristics, gambling-related characteristics, their personality profile, and psychiatric comorbidities. A multiple logistic regression was performed to identify the relevant predictors of GDRIA and their relative contribution to the prediction of the presence of GDRIA. *Results:* Multivariate analysis revealed a higher South Oaks Gambling Scale score, comorbid addictive disorders, and a lower level of income as GDRIA predictors. *Discussion and conclusion:* An original finding of this study was that the comorbid addictive disorder effect might be mediated by a disinhibiting effect of stimulant substances on GDRIA. Further studies are necessary to replicate these results, especially in a longitudinal design, and to explore specific therapeutic interventions.

Keywords: gambling disorder, illegal acts, DSM, predictors, addiction

INTRODUCTION

Pathological gambling was renamed *Gambling Disorder* by the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric Association [APA], 2013) and reclassified in the Substance-Related and Addictive Disorders chapter. Pathological and problem gambling (intermediate and sub-clinical forms) affect 0.2%–5.3% of adults worldwide (Hodgins, Stea, & Grant, 2011). This disorder leads to relational, financial, professional, and/or psychological consequences. It can also lead to legal consequences, such as check forgery, embezzlement, theft, larceny, armed robbery, bookmaking, hustling, running con games, fencing stolen goods, loan fraud, tax evasion, burglary, pimping, prostitution, and sale of drugs (Lesieur & Rosenthal, 1991). Gambling-related illegal activities were considered as a diagnostic criterion until the DSM-IV-TR (APA, 2000) and several epidemiological studies demonstrated its almost exclusive relationship with the most severe forms of the disorder (Carragher & McWilliams, 2011; Granero et al., 2014; McBride, Adamson, & Shevlin, 2010; Strong & Kahler, 2007). The prevalence of illegal acts in individuals with gambling disorder ranges from 14% to 30% (Granero et al., 2015). The types

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of illegal acts committed by individuals with gambling disorders seem to be related to the need to obtain money. Therefore, Fraud or theft are the most common (Folino & Abait, 2009).

Gambling disorder-related illegal acts (GDRIA) have a serious clinical and social impact. They may represent crucial moments in a gambler's trajectory, as well as for their family and entourage. In a recent comprehensive study on illegal acts related to pathological gambling, Granero et al. (2014) highlighted that exclusion of the illegal acts criterion from the diagnostic criteria for pathological gambling in the DSM-5 was not a reason to ignore its legal and clinical relevance. The presence of illegal acts is indeed related to more severe psychopathological outcomes and resistance to treatment (Ledgerwood, Weinstock, Morasco, & Petry, 2007). This may lead to specific and more intensive treatment. In a commentary following the extensive work of Ledgerwood et al. (2007), Grant and Potenza (2007) recommended that more research is needed to understand the complex relationship between illegal behavior and pathological gambling, especially into the underlying aspects. Hence, a "therapeutic target" could be to prevent their occurrence and to determine the most highly related factors and/or predictors. This could lead to better identification of the most vulnerable subjects and eventually to the development of specific therapeutic interventions.

This study aims to identify the factors associated with GDRIA among a population of problem gamblers (treatment-seeking and non-treatment-seeking). Various sociodemographic, clinical, and gambling behavioral elements have been linked to GDRIA in literature. They included sociodemographic factors (age, sex, employment, marital status, ethnicity, and financial situation), comorbid disorders (medical, mental and addiction), personality or character traits, gambling severity, and gambling habits. Table 1 illustrates the GDRIA-related factors that we found in literature and the corresponding populations studied and tools used for gambling diagnosis. Severe gambling problems were correlated, almost unanimously, to the occurrence of GDRIA (Granero et al., 2014; Ledgerwood et al., 2007; Meyer & Fabian, 1992; Meyer & Stadler, 1999; Potenza, Steinberg, McLaughlin, Rounsaville, & O'Malley, 2000; Toce-Gerstein, Gerstein, & Volberg, 2003). Researchers reported more severe gambling disorder symptoms (Ledgerwood et al., 2007; Potenza et al., 2000; Toce-Gerstein et al., 2003), even throughout treatment (Ledgerwood et al., 2007), higher total SOGS score, higher total DSM-IV-TR criteria (Granero et al., 2014), high pathological gambling symptom occurrence, and more excessive gambling behavior (Meyer & Fabian, 1992) to be associated with GDRIA. Aside from gambling severity, no clear consensus emerges from this review.

The *main objective* of this study is to verify gambling severity implication in GDRIA emergence among a large cohort of French problem gamblers.

We also explored certain hypotheses, looking for other factors that may characterize problem gamblers.

Hypothesis 1. Several studies looked at the link between gambling problems and antisocial personality disorder (Blaszczynski & Nower, 2002). Carragher and McWilliams (2011) retrieved this association by analyzing the National Epidemiologic Survey on Alcohol and Related Conditions. Thus, we predicted that antisocial personality disorder was associated with the occurrence of gambling-related illegal behavior.

Hypothesis 2. Debt has been reported to be linked to GDRIA (Ledgerwood et al., 2007; Meyer & Fabian, 1992; Meyer & Stadler, 1999; Potenza et al., 2000). Thus, significant financial problems seem to be consistent with the hypothesis that there exists a causal link between escalating problem gambling behavior and offences (Potenza et al., 2000). As gamblers lose money, they have been reported to engage frequently in criminal, particularly non-violent, behavior in order to acquire funds to recoup losses (Potenza et al., 2000). Financial pressures may be related to the decision to engage in illegal behavior (Ledgerwood et al., 2007). Thus, we predicted that a worse financial and social situation is linked to GDRIA.

Hypothesis 3. Comorbid addictive disorders have also been correlated to gambling-related illegal behaviors. Indeed, nicotine (McBride et al., 2010), alcohol, or other substance use disorders (Potenza et al., 2000) were also identified as GDRIA correlates. Focusing on the link between drug misuse and criminality, some researchers (Bennett, Holloway, & Farrington, 2008) conducted a meta-analysis of 30 studies showing that the odds of offending were between 2.8 and 3.8 times greater for drug users than non-drug users.

Thus, we chose to explore two hypotheses to better understand the link between addiction and GDRIA:

- We postulate that a transgressive personality dimension may lead both to illicit substance addiction and GDRIA onset. Thus, we predicted that illicit substance misuse was linked to the emergence of gambling-related illegal behavior.
- We think that a stimulant substance effect potentially facilitates GDRIA emergence by the more or less disinhibitory effect of certain drugs (such an effect could lead gamblers to exert less efficient control over their behavior and ultimately have an impact both on gambling practices and GDRIA). Hence, we predicted that stimulant substance use was associated with GDRIA occurrence.

METHODS

Participants

This study is part of a broader research work, the JEU cohort study. The JEU study consists of a cross-sectional multiaxial evaluation (phase 1) and 5-year follow-up (phase 2) of a case-control cohort of 628 French non-problem and problem gamblers. To meet the main objective of the cohort, which is to explain changes in gambling practices, the number of subjects was estimated at between 500 and 680.

Recruitment took place between April 2009 and September 2011 in five regions of France (Northwest, Southwest, Paris region, Center, and Southeast). Non-problem gamblers and

Table 1. Literature review about gambling disorder-related illegal act-associated variables

References	Population studied	Diagnosis	Sociodemographic	Gambling severity and gambling habits	Comorbidity and personality profile
Granero et al. (2014)	Pathological gamblers seeking treatment	DSM-IV, clinical interview questionnaire	Unemployed Single or widow	SOGS total score Borrowing money and not paying back (SOGS item) Skipping work due to gambling (SOGS item) DSM-IV-TR pathological gambling criteria sum High betting stakes	TCI Novelty Seeking
Carragher and McWilliams (2011)	Nationally representative	DSM-IV, questionnaire, structured diagnostic interview	Black ethnicity		History of mania Specific phobia Antisocial personality disorder
McBride et al. (2010)	Nationally representative	DSM-IV, self-assessment questionnaire	Male Previously married Never married		Limiting long-term illness Current cigarette smoking
Ledgerwood et al. (2007)	Pathological gamblers seeking treatment	DSM-IV, structured clinical interview, questionnaire	Debts	Severe gambling disorder symptoms number	
Toce-Gernstein et al. (2003)	General population gamblers and gambling facilities owners	DSM-IV, structured questionnaire		Severe gambling disorder symptoms number	
Potenza et al. (2000)	Gambling helpline callers	None	Young age Debts	Severe gambling disorder symptoms number Gambling-related suicidal behavior Problems with various forms of gambling	Alcohol or substance-related disorders
Meyer and Stadler (1999)	Treatment and self-help groups pathological gamblers General population and army gamblers	Specific questionnaire	Debts	Addictive gambling behavior	Risk motivation Impulsiveness Emotionality Global mental stress Non-conform social orientation
Meyer and Fabian (1992)	Self-help groups gamblers	DSM-III-R, questionnaire	Debts resulting from neglect of financial obligations	Pathological gambling symptom occurrence Excessive gambling behavior Gambling-induced psychosocial problems High levels of subjective satisfaction in gambling	Aggressiveness

Note. SOGS: South Oaks Gambling Scale; TCI: Temperament and Character Inventory.

problem gamblers without treatment were recruited in various gambling centers (casinos, bars, smoke shops, etc.), and through the press. Problem gamblers seeking treatment were recruited in seven care centers. Female and male gamblers who declared gambling on at least one occasion during the previous year and aged 18–65 years were eligible for the study. Exclusion criteria included severe cognitive impairment or communication difficulties and subjects under guardianship. Problem gamblers seeking treatment were included if they started treatment less than 6 months earlier. The objectives, major characteristics (at baseline), and different methodological aspects of the JEU cohort are described in detail in a specific article (Challet-Bouju et al., 2014).

This work focused on GDRIA in a sub-sample of 372 problem gamblers taken from the JEU cohort study and only using the baseline assessment (phase 1). We chose to study GDRIA only in the problem gambler population given that this event is uncommon and of little interest in gamblers not meeting problem gambling criteria [as an illustration, the JEU cohort includes 1.2% of GDRIA for non-problem gamblers ($n = 3/256$) compared with 21.2% for problem gamblers ($n = 79/372$); unpublished data. We used the Pathological Gambling section of the DSM-IV to assess diagnosis of a gambling problem. Gamblers who met at least three DSM-IV-TR criteria were classified as problem gamblers, covering both gamblers at risk for pathological gambling and gamblers diagnosed with pathological gambling. This was in order to include subclinical forms of pathological gambling (Challet-Bouju et al., 2014).

One of the most important strengths of the JEU cohort is that it included both treatment-seeking and non-treatment-seeking problem gamblers. Among the 372 problem gamblers included in this analysis, 203 were treatment-seeking and 169 were not.

Measures

Participants were assessed through the JEU cohort study procedure (Challet-Bouju et al., 2014). Structured clinical interviews were used to collect information on sociodemographic characteristics, gambling problem diagnosis, gambling habits, psychiatric and addictive comorbidities, and somatic comorbidities (lifetime and past year prevalence). Self-assessment questionnaires were used to evaluate the severity of the gambling problems, gambling-related cognitions, temperament and character dimensions, and screening of attention-deficit hyperactivity disorder.

In this study, we selected a set of variables according to the literature review (see Table 1) and/or their clinical relevance in GDRIA causality:

- *Sociodemographic variables:* Gender, age, marital status, professional activity, and level of income assessed using a short questionnaire.
- *Gambling severity:* South Oaks Gambling Scale (SOGS) (Lejoyeux, 1999; Lesieur & Blume, 1987). The SOGS is a 20-item self-assessment questionnaire used to evaluate the severity of gambling problems.
- *Gambling habits:* A detailed interview was created to explore gambling habits, such as participation in various forms of gambling over the past year, monthly gambling expenditure especially in relation to income, maximum wagering in a single day, favorite type of gambling according to Boutin's classification ["pure chance games," "chance games with pseudo-skills," and "games with chance and skill" (Boutin, 2010)], maximum duration of abstinence, age of initiation in gambling, and age of onset of gambling problems.
- *Psychiatric and addictive comorbidities:* The Mini International Neuropsychiatric Interview – fifth version (MINI) (Lecrubier et al., 1997) is a short structured diagnostic interview used to explore the main axis-I psychiatric disorders in the DSM. It includes an assessment of major anxiety disorders, mood disorders (plus current risk of suicide), addictive disorders, and to a lesser extent psychotic disorders. From the available diagnoses, we analyzed the concomitant occurrence of any addictive disorders and history of traumatic events (post-traumatic stress disorder before vs. after onset of the gambling problem).
- *Personality profile:* Antisocial personality disorder was assessed using the related optional section of the MINI (Lecrubier et al., 1997). We also chose to explore the seven dimensions of personality defined by Cloninger's psychobiological model (Cloninger, Svrakic, & Przybeck, 1993). The short 125-item version of the Temperament and Character Inventory (TCI-125) (Chakroun-Vinciguerra, Faytout, Pelissolo, & Swendsen, 2005; Pélissolo & Lépine, 2000) is a self-assessment questionnaire that evaluates four temperament traits (Novelty Seeking, Harm Avoidance, Reward Dependence, and Persistence) and three character traits (Self-Directedness, Cooperation, and Self-Transcendence).

Statistical analysis

Two groups were set up according to the presence or absence of DSM-IV 8th pathological gambling criterion: "Engaging in illegal activities to fund gambling" ("DSM8+" vs. "DSM8−" subgroups).

A descriptive analysis of the sociodemographic, clinical (psychiatric comorbidities and personality profile), and gambling characteristics was performed first. To examine the contribution of all the variables for predicting the presence of GDRIA (DSM8− vs. DMS8+), we performed a two-step multiple logistic regression. The first step consisted of univariate analyses performed on all the variables of interest, taken one by one. This first step was performed to select the relevant variables to be included in the second step, i.e., variables that were significant at 20% in the univariate analyses. This high threshold of significance enabled us to avoid dropping a variable having interactions with another variable during the first step. The second step consisted of performing a multivariate logistic regression on all the relevant variables selected in the first step. Non-significant variables at 5% were removed one at a time, starting with the least significant variable (backward procedure), to select only the variables that provided significant information in the model. Odds ratios and associated 95% confidence intervals were calculated for the final model to

quantify the strength of the association between the predictive factors selected and the presence of GDRIA. The statistical analysis was carried out with SAS 9.1 and R statistical software (SAS Institute, Inc., Cary, NC, USA).

Ethics

The study procedures were carried out in accordance with the Declaration of Helsinki. An Institutional Review Board, French Research Ethics Committee (CPP), approved the study on January 8, 2009. All subjects were informed about the study and all provided their written informed consent prior to their inclusion in the study.

RESULTS

Descriptive

The DSM8+ and DSM8− groups included 79 and 293 gamblers, respectively, for a prevalence of 21.2% of GDRIA. This prevalence rate is consistent with that found by Granero et al. (2014) (23%). The results of the descriptive analysis are shown in Table 2.

Regression model of GDRIA-associated factors

Univariate analysis identified the following significant variables at 20%: male gender, lower level of income (less than the French minimum wage), age, higher SOGS score, gambling type, chance-based gambling game, any comorbid addictive disorder, antisocial personality disorder, and TCI Novelty Seeking, Harm Avoidance, and Persistence scores.

Multivariate regression analysis confirmed three of these, from the most to the least significant: SOGS score, any comorbid addictive disorder, and level of income (Table 3). Hence, among problem gamblers, those who responded positively to the DSM-IV 8th criterion (gambling-related illegal act) compared with those who answered negatively were more likely to earn less than the French minimum wage, had higher SOGS scores, and displayed more frequent comorbid addictive disorders.

Post-hoc analysis

We tried to define how a comorbid addictive disorder, a variable that emerged from the multivariate analysis as a GDRIA-associated factor, could be involved in illegal activities. Indeed, the link between illegal acts and addiction is

Table 2. Descriptive analysis

	Mean (standard deviation) or percentage	
	DSM8− ($n = 293$)	DSM8+ ($n = 79$)
Sociodemographic variables		
Gender (male)	71.33%	84.81%
Marital status (as a couple)	52.22%	52.56%
Professional activity (working)	65.53%	60.76%
Level of income (<minimum wage)	27.65%	39.24%
Age (years)	43.84 (12.60)	41.01 (11.73)
Gambling severity		
SOGS score	7.71 (3.76)	10.29 (3.36)
Gambling habits variables		
Favorite type of game		
"Pure chance games"	54.14%	35.44%
"Chance games with pseudo-skills"	33.45%	51.90%
"Chance games with elements of skill"	12.41%	12.66%
Maximum duration of abstinence (months)	10.34 (22.19)	8.5 (10.60)
Age of initiation into gambling (years)	20.21 (9.14)	20.05 (8.27)
Age of onset of gambling problems (years)	34.92 (11.82)	33.37 (10.89)
Comorbidity variables		
Addictive disorder (yes)	36.18%	55.70%
Traumatic event		
Pre (preceding gambling problem onset)	75.00%	60.00%
Post (following gambling problem onset)	25.00%	40.00%
Personality variables		
Antisocial personality disorder (yes)	4.10%	11.39%
TCI Novelty Seeking score	56.64 (16.66)	62.16 (16.01)
TCI Harm Avoidance score	45.02 (24.28)	49.32 (24.40)
TCI Self-Directedness score	61.8 (19.60)	58.65 (17.46)
TCI Cooperation score	72.01 (15.06)	69.51 (16.00)
TCI Reward Dependence score	58.73 (17.05)	56.95 (18.42)
TCI Self-Transcendence score	32.82 (23.38)	30.01 (20.00)
TCI Persistence score	55.65 (28.60)	50.81 (27.73)

Note. SOGS: South Oaks Gambling Scale; TCI: Temperament and Character Inventory.

Table 3. Logistic regression model of GDRIA associated factors (multivariate analysis, number of observations = 354)

	Beta	OR	*P* value
Level of income	−0.6818	0.506	.021
Addictive disorder	0.6557	1.927	.0183
SOGS score	0.1954	1.216	<.0001

Note. SOGS: South Oaks Gambling Scale; OR: odds ratios.

Table 4. Descriptive alcohol and substance use results [Mini International Neuropsychiatric Interview – fifth version (MINI) diagnoses]

	Problem gamblers (DSM-IV ≥3 criteria, *N* = 372)	
Addiction object	Dependence	Abuse
Alcohol	54 (14.5%)	62 (16.7%)
Psychostimulants	44 (11.8%)	34 (9.1%)
Cocaine	9 (2.4%)	6 (1.6%)
Opiate	5 (1.3%)	0 (0.0%)
Hallucinogen	4 (1.1%)	6 (1.6%)
Volatile organic compounds	0 (0.0%)	2 (0.5%)
Cannabis	36 (9.7%)	26 (7.0%)
Sedatives, hypnotics, or tranquilizers	6 (1.6%)	2 (0.5%)
Other	0 (0.0%)	0 (0.0%)

usually explained by the need to generate funds to maintain the addictive behavior (Lesieur & Rosenthal, 1991).

Studying each type of substance independently was not possible due to the heterogeneous alcohol and substance distribution (Table 4). Alcohol, psychostimulants, and cannabis were clearly predominant over the other substances. Unfortunately, nicotine use disorders were not assessed in this study.

By exploring the transgressive personality dimension hypothesis (as stated above), we divided problem gamblers with a comorbid addiction ($n = 44$) into two groups: Illicit versus Licit, considering a potential common transgressive pathway for illicit substances. The Licit group included subjects suffering from licit substance use disorders, plus alcohol use disorders. Study participants meeting illicit substance use disorder criteria were included in the Illicit group. Participants responding to both licit and illicit criteria were also included in the Illicit group.

Furthermore, we differentiated two groups to explore the stimulant effect hypothesis: Non-stimulant versus Stimulant, to explore the disinhibitory effect of substances on GDRIA. The Stimulant group included subjects with stimulant substance use disorders. Alcohol use disorder was also included in the Stimulant group due to the stimulant and disinhibitory effects of a moderate alcohol dose (Fillmore, 2012). Table 5 illustrates how we classified each MINI substance as Illicit, Licit, Stimulant, and Non-stimulant. We considered hallucinogens as Non-stimulant, except phencyclidine and angel dust that were considered as Stimulant because of reported hostile or assaultive behavior with high doses (O'Brien, 2006) and their potential stimulant effect (Stahl, 2008). Ketamine was also considered as Stimulant due to its predominant psychostimulant effects at low doses (Wolff & Winstock, 2006).

According to the transgressive personality dimension hypothesis, there were 351 problem gamblers in the Licit group and 21 in the Illicit group. With regard to effects of substances on behavior, 231 problem gamblers were classified in the Non-stimulant group and 141 in the Stimulant group. Post-hoc regression analysis was then conducted using the same variables as those outlined in the Measures subsection. An exception was made for the comorbid addictive disorder variable, replaced in this analysis by Non-stimulant versus Stimulant and Illicit versus Licit variables. We then performed univariate and multivariate analyses using the same above-mentioned methodology (see Statistical analysis subsection). The two variables breaking down comorbid addiction, Illicit and Stimulant variables were significant in the univariate analysis and were thus analyzed in the following step. Multivariate analysis identified the SOGS score variable as the GDRIA factor associated with the highest significance level, followed by the stimulant substance addiction and the level of income variables, as shown in Table 6.

DISCUSSION

Our hypothesis was that specific sociodemographic, gambling, and clinical variables are related to GDRIA. Multivariate analysis confirmed higher SOGS scores, comorbid addictive disorders, and lower levels of income as being GDRIA-associated factors. The comorbid addictive disorder variable remains vague. In order to better understand and characterize this variable, we conducted a post-hoc analysis, breaking addictive disorder down into its illicit and stimulant dimensions. Stimulant substance addiction appears to be linked to GDRIA.

The fact that comorbid addictive disorders may be considered as GDRIA-associated factors is reflected in other studies, in particular in findings concerning nicotine (McBride et al., 2010), alcohol, or substance-related disorders (Potenza et al., 2000). However, the idea of stimulant substance addiction being related to GDRIA is new. To our knowledge, this study is the first to provide such objective evidence. In the light of our results, the link between GDRIA and comorbid addictive disorder would be in favor of a disinhibitory effect of stimulant substances on GDRIA. However, there were no findings to support our second hypothesis of a common transgressive personality. It has been previously demonstrated that alcohol consumption increases the tendency for risk-taking (McMillen & Wells-Parker, 1987). Stimulant substances were also related to the propensity for risk-taking behavior (Bornovalova, Daughters, Hernandez, Richards, & Lejuez, 2005). We also believe that the effect of stimulant substances in GDRIA might be explained by specific effects on behavior control. Fillmore (2012), in a literature review on drug abuse and behavioral disinhibition, produced major results focusing on alcohol, cocaine, and psychostimulant drugs. Impaired ability to inhibit inappropriate responses has become well-documented as an acute reaction to alcohol or stimulant substances. Moreover, in cases of chronic use, repeated

Table 5. Mini International Neuropsychiatric Interview – fifth version (MINI) substance distribution for post-hoc analysis (Licit vs. Illicit; Stimulant vs. Non-stimulant)

MINI substances categories	Name of the substance	Licit versus Illicit	Stimulant versus Non-stimulant[a]
Hallucinogen	Acids	Illicit	Non-stimulant
Diverse	Anabolic substances	Licit	Stimulant
Psychostimulants	Amphetamine	Illicit	Stimulant
Hallucinogen	Angel dust	Illicit	Stimulant
Opiate	Buprenorphine	Licit	Non-stimulant
Cannabinoid	Cannabis	Illicit	Non-stimulant
Hallucinogen	Psilocybin mushrooms	Illicit	Non-stimulant
Cocaine	Coke, cocaine	Illicit	Stimulant
Opiate	Codeine	Licit	Non-stimulant
Volatile organic compounds	Glue	Licit	Non-stimulant
Cocaine	Crack	Illicit	Stimulant
Opiate	Dextropropoxyphene	Licit	Non-stimulant
Hallucinogen	Ecstasy	Illicit	Stimulant
Volatile organic compounds	Gasoline	Licit	Non-stimulant
Volatile organic compounds	Ether	Licit	Non-stimulant
Opiate	Fentanyl	Licit	Non-stimulant
Cocaine	Coca leaf	Illicit	Stimulant
Cannabinoid	Hash, hashish	Illicit	Non-stimulant
Cannabinoid	Cannabis herb	Illicit	Non-stimulant
Opiate	Heroin	Illicit	Non-stimulant
Sedatives, hypnotics, or tranquilizers	Zopiclone	Licit	Non-stimulant
Other	Ketamine	Licit	Stimulant
Sedatives, hypnotics, or tranquilizers	Bromazepam	Licit	Non-stimulant
Hallucinogen	Lysergic acid diethylamide	Illicit	Non-stimulant
Cannabinoid	Marijuana	Illicit	Non-stimulant
Opiate	Meperidine	Licit	Non-stimulant
Hallucinogen	Mescaline	Illicit	Non-stimulant
Opiate	Methadone	Licit	Non-stimulant
Opiate	Morphine	Licit	Non-stimulant
Cocaine	Snow bomb	Illicit	Stimulant
Opiate	Opium	Illicit	Non-stimulant
Hallucinogen	Phencyclidine	Illicit	Stimulant
Psychostimulants	Appetite suppressant	Licit	Stimulant
Volatile organic compounds	Poppers	Licit	Stimulant
Volatile organic compounds	Nitrous oxide	Licit	Non-stimulant
Psychostimulants	Methylphenidate	Licit	Stimulant
Sedatives, hypnotics, or tranquilizers	Clonazepam	Licit	Non-stimulant
Sedatives, hypnotics, or tranquilizers	Oxazepam	Licit	Non-stimulant
Cannabinoid	Cannabis resin (Hash)	Illicit	Non-stimulant
Psychostimulants	Speed	Illicit	Stimulant
Cocaine	Speedball	Illicit	Stimulant
Diverse	Steroids	Licit	Stimulant
Sedatives, hypnotics, or tranquilizers	Zolpidem	Licit	Non-stimulant
Opiate	Buprenorphine (Subutex)	Licit	Non-stimulant
Sedatives, hypnotics, or tranquilizers	Lorazepam	Licit	Non-stimulant
Opiate	Buprenorphine (Temgesic)	Licit	Non-stimulant
Cannabinoid	Tetrahydrocannabinol	Illicit	Non-stimulant
Volatile organic compounds	Toluene	Licit	Non-stimulant
Sedatives, hypnotics, or tranquilizers	Clorazepate	Licit	Non-stimulant
Volatile organic compounds	Trichloroethylene	Licit	Non-stimulant
Sedatives, hypnotics, or tranquilizers	Diazepam	Licit	Non-stimulant
Sedatives, hypnotics, or tranquilizers	Alprazolam	Licit	Non-stimulant
Diverse	Others		

[a]Sedatives, hypnotics, and tranquilizers were considered as "Non-stimulant." Hallucinogens was considered as "Non-stimulant" except phencyclidine and angel dust that were considered as "Stimulant." Ketamine, a psychostimulant substance at low doses, was considered as "Stimulant."

Table 6. Post-hoc logistic regression model of predictive factors for GDRIA (multivariate analysis, number of observations = 354)

	Beta	OR	*P* value
Level of income	−0.7046	0.494	.0171
Stimulant substance-related disorder	0.6598	1.934	.0176
SOGS score	0.1945	1.215	<.0001

Note. SOGS: South Oaks Gambling Scale; OR: odds ratio.

alcohol, or stimulant substance use can induce sustained impulse control deficit (Fillmore, 2012).

We found low levels of income to be a GDRIA predictor. We believe that illegal acts may be committed to cover gambling debts, especially in cases of low levels of income, through a putative vicious circle: debts – illegal acts – consequences of both. We did not identify the low level of income factor in literature, but there were some related elements suggesting poor socioeconomic status. In particular, several characteristics were associated with GDRIA: being unemployed (Granero et al., 2014), being black (Carragher & McWilliams, 2011), being in debt (Blaszczynski & Silove, 1996; Ledgerwood et al., 2007; Meyer & Stadler, 1999; Potenza et al., 2000), and subsequent neglect of financial obligations (Meyer & Fabian, 1992).

Our results for the SOGS scores confirmed those of Granero et al. (2014), who found higher SOGS scores to be related to GDRIA. Gambling problem severity is a typical GDRIA-related factor. Indeed, several studies have previously found a relationship between GDRIA and more severe gambling disorder symptoms (Ledgerwood et al., 2007; Potenza et al., 2000; Toce-Gerstein et al., 2003), even under treatment (Ledgerwood et al., 2007), with higher total DSM-IV-TR criteria scores (Granero et al., 2014), a high frequency of pathological gambling symptoms and more excessive gambling behavior. Some excessive gambling consequences were also related to GDRIA, such as higher gambling-induced psychosocial problems (Meyer & Fabian, 1992) and suicide attempts secondary to gambling (Potenza et al., 2000). Moreover, other gambling features were also linked to GDRIA, such as addictive gambling behavior (Meyer & Stadler, 1999) having problems with various forms of gambling (Potenza et al., 2000) and betting higher stakes (Granero et al., 2014).

This study demonstrates that addictive comorbidity, low levels of income, and gambling severity are implied in GDRIA. The original finding of this study is that the effect of comorbid addictive disorder in GDRIA might be mediated by stimulant substances. Identifying clinical and sociodemographic predictors of GDRIA would provide for better detection of players at risk for such complications and would ensure their overall care. Raising awareness among all professionals likely to come into contact with gamblers to screening and care of these legal gambling issue predictors could prevent the occurrence or recurrence of GDRIA in a tertiary prevention approach. This could influence local policy makers. We especially refer to the French model, which integrates both health and legal aspects, where care and disciplinary measures are complementary. Imposing care for a person accused or convicted of a criminal offense should specifically aim to reduce or avoid the risk of repeating the offense.

These results are limited by several elements. Although the sample included 372 problem gamblers, only 79 reported GDRIA. Such a small sample size exposes our findings to the risk of loss of statistical strength. Second, we can assume that the participants underestimated the presence of criminal behavior, frequently considered as embarrassing events. Our data collection design did not include systematic verification of the presence of illegal acts, and we regret not having explored this dimension in more detail (type of illegal acts, seriousness, etc.). We could have explored the potential correlations between the substance misused and type of illegal act. However, the data collection interview design may have limited this weakness, as it is a method that is more consistent than self-assessment questionnaires. Third, the transversal design of this research did not enable us to confirm the causality of the variables studied. Thus, these results have to be replicated in prospective studies, especially to verify whether the presence of a stimulant substance-related disorder can be linked to subsequent offences. We are counting on the 5-year follow-up part of the JEU cohort study to do this work. Fourth, our data is retrospective and thus exposed to recall bias. Finally, we should mention that breaking down comorbid addiction constructs for post-hoc analysis gave rise to disproportionate population sizes. The findings concerning stimulant groups should thus be interpreted with caution.

However, this study also has a number of strengths rarely seen in gambling studies. First, the overall gambler sample (reporting or not reporting GDRIA) was assessed by experienced psychiatrists and psychologists in clinical interviews – including gambling disorder diagnosis and GDRIA assessment – in addition to self-assessment questionnaires. Another strength of this study lies in the original population including both treatment-seeking and non-treatment-seeking problem gamblers. Problem gamblers who have not yet sought treatment are a very rare population in pathological gambling research, although they form the key transit state between non-problem gambling and treated problem gambling (Challet-Bouju et al., 2014). Finally, another original strength of this study was that it combined several methods of recruitment: within care centers (54.0%), but also at gambling venues (15.3%) and through the press (29.8%). This method gave us access to a broad spectrum of gambling severities and levels of practice.

CONCLUSION

This study showed low income levels, high SOGS scores, and comorbid addictions to be GDRIA-associated factors. Addiction is probably involved in this association through the effect of stimulant substances on GDRIA. Further studies are necessary to explore the effects of addiction-specific therapeutic interventions for reducing GDRIA within the overall management of gambling disorders.

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Authors' contribution: MAG and MR have analyzed the results reported in this paper. Members of the JEU Group made the clinical and psychometric assessments. All authors had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Conflict of interest: MAG, MV, DM, MF, IC-B, and AG declare that they have no conflict of interest. MR received funding directly from gambling industry (Winamax) as part of another research contract – this funding has never had any influence on this work. GC-B, JLV, and MG-B declare that the University Hospital of Nantes has received funding from gambling industry [Française des Jeux (FDJ) and Pari Mutuel Urbain (PMU)] in the form of a sponsorship, which supports the gambling section of the BALANCED Unit (the Reference Centre for Excessive Gambling). Scientific independence toward gambling industry operators is warranted. There were no constraints on publishing. CL declares that the University of Paris Ouest Nanterre La Défense has received funding directly from gambling industry (FDJ and PMU) as part of other research contracts – this funding has never had any influence on this work.

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