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Gambling disorder: Association between duration of illness, clinical, and neurocognitive variables

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Background and aims: Gambling disorder (GD) may have its onset in a wide range of ages, from adolescents to old adults. In addition, individuals with GD tend to seek treatment at different moments in their lives. As a result of these characteristics (variable age at onset and variable age at treatment seeking), we find subjects with diverse duration of illness (DOI) in clinical practice. DOI is an important but relatively understudied factor in GD. Our objective was to investigate clinical and neurocognitive characteristics associated with different DOI. *Methods:* This study evaluated 448 adults diagnosed with GD. All assessments were completed prior to treatments being commenced. *Results:* Our main results were: (a) there is a negative correlation between DOI and lag between first gambling and onset of GD; (b) lifetime history of alcohol use disorder (AUD) is associated with a longer duration of GD; (c) the presence of a first-degree relative with history of AUD is associated with a more extended course of GD; and (d) there is a negative correlation between DOI and quality of life. *Discussion:* This study suggests that some important variables are associated with different DOI. Increasing treatment-seeking behavior, providing customized psychological interventions, and effectively managing AUD may decrease the high levels of chronicity in GD. Furthermore, research on GD such as phenomenological studies and clinical trials may consider the duration of GD in their methodology. DOI might be an important variable when analyzing treatment outcome and avoiding confounders.

Keywords: gambling disorder, duration of illness, clinical presentation, clinical aspects, psychopathology

INTRODUCTION

Gambling disorder (GD) affects a significant number of people; for example, up to 3.24 million people have developed GD at some point of their lives in the United States alone (United States Census Bureau, 2016). The disorder is associated with several negative consequences, such as high rates of psychiatric comorbidity and suicidality, frequent legal and occupational problems as well as with lower levels of quality of life (Black, Moyer, & Schlosser, 2003; Grant & Kim, 2005; Petry & Kiluk, 2002; Petry, Stinson, & Grant, 2005). GD poses a considerable economic burden, estimated at $5 billion every year in the United States alone (National Gambling Impact Study Commission, United States of America, 1999). GD is a clinically heterogeneous disorder and different subgroups of affected subjects have been examined (Ledgerwood & Petry, 2006; Ledgerwood, Weinstock, Morasco, & Petry, 2007). A deeper understanding of the subtypes of GD may lead to customized, more effective treatments. This is particularly important given that GD tends to demonstrate high chronicity and relapse rates (American Psychiatric Association, 2013; Blanco, Moreyra, Nunes, Saiz-Ruiz, & Ibanez, 2001; Potenza, 2001).

One important but relatively understudied factor in GD is the duration of illness (DOI). For instance, GD may have its onset in a wide range of ages, from adolescents to old adults (American Psychiatric Association, 2013; Burge, Pietrzak, Molina, & Petry, 2004; Kessler et al., 2008; Ladd, Molina, Kerins, & Petry, 2003; Lynch, Maciejewski, & Potenza, 2004; Medeiros et al., 2015; Shaffer, Hall, & Vander Bilt, 1999). In addition, individuals with GD tend to seek treatment at different moments in their lives (Petry, 2002). As a result of these characteristics (variable age at onset and variable age at treatment seeking), we find patients with diverse DOI in clinical practice.

Studies with other addictions (substance-associated and other behavioral addictions) have shown the importance of DOI in the clinical presentation of the disorders. In the case of alcohol and other substance use disorders, studies have suggested that longer duration of alcohol use disorder (AUD), methamphetamine use disorder, and heroin use are correlated with more cognitive deficits. This is particularly true for response inhibition, reaction time, and cognitive flexibility (Laloyaux et al., 2012; Martinovic-Mitrovic et al., 2008; Monterosso, Aron, Cordova, Xu, & London, 2005). Moreover, research in AUD suggested that early onset of problems with alcohol is associated with stronger genetic susceptibility and poorer treatment outcome (Babor et al., 1992; Carpenter & Hasin, 2001; Cloninger, 1987; Schuckit et al., 1995). These two elements (genetic vulnerability and worse prognosis) may lead to longer DOI. With regard to

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behavioral addictions, Mathy and Cooper (2003) found that longer duration of exposure to the Internet was associated with negative outcomes in a non-clinical sample of Internet users. Regarding GD, Tsurumi et al. (2014) found a negative correlation between DOI and insula activation, a neurological area associated with reward anticipation and risk evaluation (Damasio, 1994; Kuhnen & Knutson, 2005; Xue, Lu, Levin, & Bechara, 2010). These findings suggest the need for further clinical and neurocognitive investigations of the influence of DOI in GD. Although DOI seems to be an important variable in understanding GD, no study, to our knowledge, has specifically investigated how this variable might affect the clinical presentation of the disorder.

Our objective was to investigate clinical and neurocognitive characteristics associated with different DOI in a sample of adults with GD. It was anticipated that this study would provide insights regarding how future work might improve treatments for patients. Our main hypotheses were that a longer DOI would be significantly associated with: (a) worse clinical outcomes such as more financial losses, worse severity of GD, and reduced quality of life; (b) a stronger genetic vulnerability clinically evidenced by personal history of AUD and family history of GD and AUD; and (c) worse neurocognitive deficits, especially in response inhibition and cognitive flexibility.

METHODS

Participants

This study evaluated 448 adults diagnosed with GD. In all, 197 (44.0%) individuals were males and 251 individuals (56.0%) were females. The mean and median age of our sample were 47.6 (±11.3) and 49.0 years, respectively. The studied sample consisted of individuals who participated in clinical trials on GD (pharmacotherapy or cognitive behavioral therapy) at the University of Minnesota and at the University of Chicago. The subjects were recruited by media advertisements (public places, Internet, and newspapers). All assessments were completed prior to treatments being commenced.

The inclusion criteria were: (a) age ≥18 years, (b) current GD diagnosis, and (c) able to attend the clinical center for assessment. This research excluded subjects who: (a) needed emergency care or presented unstable medical illness; (b) showed clinically significant abnormalities on physical examination; (c) were unable to complete the study procedures; (d) demonstrated psychotic symptoms; and (e) did not provide written consent to participate in the study.

All studied individuals underwent a semi-structured clinical interview conducted by a board-certified and research-trained psychiatrist. Individuals were financially compensated (gift cards to local stores) for their participation in this study.

Measures

GD diagnosis. The diagnosis of GD was performed using the Structured Clinical Interview for Pathological Gambling. This diagnostic instrument was originally developed and validated using the criteria of the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) (Grant, Steinberg, Kim, Rounsaville, & Potenza, 2004). As the data collected before the release of DSM-5 were electronically saved, the authors retrospectively processed them for a proper adaptation to DSM-5 GD criteria. This approach consisted of removing the criterion "committed illegal acts such as forgery, fraud, theft, or embezzlement to finance gambling regarding illegal acts," which was present in previous manual, DSM-IV. Moreover, we reduced the diagnostic threshold from five to four criteria, consistent with DSM-5. The remaining criteria were unchanged.

During the diagnostic interview, we also evaluated [age at first gambling] and [age at onset of GD]. The trained board-certified psychiatrists conducted all diagnostic interviews.

DOI. DOI was defined as the difference between age at intake and age when full criteria for GD met.

Demographics. Age at intake, gender, marital status, educational status, and ethnicity were obtained from the participants.

Gambling behavior.

– *Age at first gambling and progression from recreational gambling to GD* (lag between first gambling and onset of GD): this variable was calculated as the difference between [age at onset of GD] and [age at first gambling] (collected in the diagnostic interview – see GD Diagnosis subsection).

– *Gambling frequency*: it is assessed by how many days per week the subject gambled.

– *Primary form of gambling*: the participants were asked to specify the main form of gambling based on money spent, frequency, and negative consequences. We grouped the form of betting in strategic (sports betting, cards, dice, stock markets, etc.) and non-strategic methods (slot machines, pull tabs, lottery, video poker, etc.) (Grant, Odlaug, Chamberlain, et al., 2012).

– *Monetary losses*: we assessed money lost due to gambling in the last year (in American dollars) and income in the last year (in American dollars). The coefficient of money lost/income provided the percentage of income lost in gambling (last year).

– *Severity of GD*: we evaluated GD severity using the Gambling Symptom Assessment Scale (G-SAS) and the Yale–Brown Obsessive-Compulsive Scale modified for Pathological Gambling (PG-YBOCS). The G-SAS is a valid and reliable 12-item scale that investigates gambling symptoms in the past week (Kim, Grant, Potenza, Blanco, & Hollander, 2009). The PG-YBOCS is a 10-item questionnaire that has demonstrated high validity ($r = .895$) and reliability (Cronbach's $\alpha = .970$) (Pallanti, DeCaria, Grant, Urpe, & Hollander, 2005). The PG-YBOCS provides an overall score as well as scores in two subscales: (a) urge subscale and (b) behavior subscale.

Psychiatric symptoms/antecedents and quality of life.

– *Lifetime prevalence of co-occurring psychiatric disorders*: the subjects were assessed for co-occurring psychiatric disorders by two validated semi-structured interviews: the Mini-International Neuropsychiatric Interview (M.I.N.I.) and the Minnesota Impulsive Disorders Interview (M.I.D.I.). The M.I.N.I. evaluates the

lifetime existence of main co-occurring psychiatric disorder comorbidities (Sheehan et al., 1998), whereas the M.I.D.I. assesses impulsive/compulsive behaviors (Odlaug & Grant, 2010).

– *Current depressive and anxiety symptoms*: the Hamilton Anxiety Rating Scale (HAM-A) is a valid and reliable 14-item questionnaire that evaluates the severity of anxiety symptoms in the past week (Beck & Steer, 1991; Hamilton, 1969; Maier, Buller, Philipp, & Heuser, 1988; Snaith, Baugh, Clayden, Husain, & Sipple, 1982).

– *Previous treatment for GD*: the subjects were asked (self-report measure) if they had sought previous treatment specifically for GD. Individual outpatient treatment, group outpatient treatment, and inpatient treatment were considered formalized treatments.

– *Family history of GD and AUD*: the family history of AUD was evaluated as a self-report measure from the subject. They were asked if they had a first-degree relative with GD or AUD.

– *Quality of life*: it is investigated by the Quality of Life Inventory (QOLI), which is a 17-item questionnaire that assesses the subjects' overall quality of life (Frisch et al., 1992).

Neurocognitive measures. the participants undertook two selected tests from the computerized Cambridge Neuropsychological Test Automated Battery (CANTABeclipse, version 3, Cambridge Cognition Ltd., Cambridge, UK; Cambridge Cognition, 2015).

– *Response inhibition*: it is evaluated by the stop-signal task. This assessment measures the participant's ability to suppress/inhibit motor responses. The subjects react to an arrow stimulus, by pressing either a left or right key depending on the position of the arrow. When an auditory stimulus occurs, the individual attempts to inhibit their motor response for the particular trial (Morein-Zamir & Sahakian, 2010). The measurement of the response inhibition is the stop-signal reaction time, a score that evaluates the time taken for the participant's brain to suppress a response that would normally be performed.

– *Cognitive flexibility*: it is evaluated by the intra-/extra-dimensional set shifting test. This task assessed rule learning, reversal, and changing of attentional focus. The trial provides visual stimuli (white lines and colorful shapes) and feedback to the subjects in a way that they can learn an underlying "rule" regarding which stimulus is correct, based on trial and error. The underlining rule that controls what is "correct" and "incorrect" shifts several times and evaluates the individual's capacity to respond with cognitive flexibility (Cambridge Cognition, 2015). The overall performance is assessed by adjusted total number of errors.

Statistical analysis

First, we conducted a one-sample Kolmogorov–Smirnov test to evaluate the distribution of the continuous variables. As all continuous variables showed a non-parametric dispersal, we evaluated the association between DOI and the clinical/neurocognitive variables using Spearman's rank correlation coefficient and Mann–Whitney *U* test, respectively, for continuous and categorical variables. To investigate which variables ultimately affected DOI, we performed multiple linear regressions. In this procedure, we introduced the clinical variables with level of significance (sig.) <.01. Additional controlled analyses assessing DOI and continuous variables were conducted using partial correlation coefficients.

Ethics

This research was approved by the Institutional Review Boards of the University of Chicago and University of Minnesota. The research procedures were described to the participants prior to providing consent. The investigators provided time for the subjects to ask questions. All individuals provided written informed consent for participation. The study procedures followed the rules of the World Medical Association Declaration of Helsinki, which describe ethical principles for medical research involving human subjects (World Medical Association, 2002).

RESULTS

The mean and median DOI in our sample were 10.2 (±7.7) and 8.0 years, respectively. This variable showed a right-skewed distribution (see Figure 1).

In terms of severity, the participants demonstrated a mean G-SAS total score of 34.6 (±12.5), therefore in the severe range (from 31 to 40 points) (Kim et al., 2009). Table 1 describes the main demographic and clinical variables in our sample.

Regarding gambling behavior, we found a statistically significant negative correlation between DOI and lag between first gambling and onset of GD. A longer DOI was not associated with higher severity scores in G-SAS or PG-YBOCS. Table 2 displays the association between DOI and gambling behavior variables.

With respect to psychiatric antecedents and quality of life, a longer DOI was significantly associated with personal history of AUD and the presence of a first-degree relative with history of AUD. In addition, DOI presented a

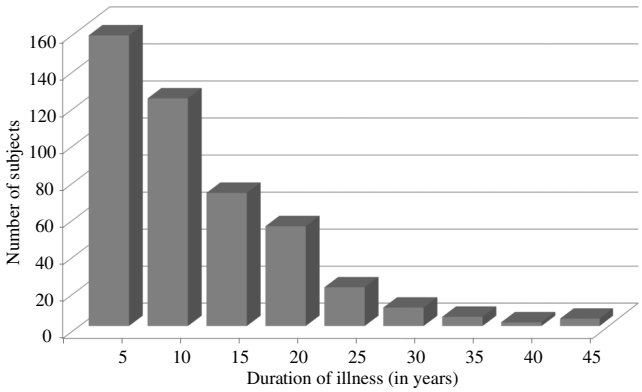

Figure 1. Distribution of duration of illness[a] in treatment-seeking subjects with gambling disorder ($n = 448$). [a]Duration of illness was defined as the difference between [current age] and [age at onset of gambling disorder]

Table 1. Description of demographics and main clinical variables in treatment-seeking adults with gambling disorder ($n = 448$)

Variables	Mean (SD[a])/median or % (n)
Demographics	
Age	47.6 (±11.3)/49.0
Gender	
Male	44.0 (197)
Female	56.0 (251)
Marital status	
With partner	36.7 (173)
Without partner	63.3 (275)
Educational level	
Less than college	36.7 (164)
College or more	63.3 (283)
Ethnicity	
Caucasian	89.2 (397)
Non-Caucasian	10.8 (48)
Clinical variables	
Duration of illness[b]	10.2 (±7.7)/8.0
Age at first gambling	28.1 (±13.2)/25.0
Age at onset of gambling disorder	37.4 (±12.2)/37.0
Frequency of gambling (times a week) [N[c] = 365]	6.6 (±9.4)/2.5
G-SAS[d] total score [$N = 382$]	34.6 (±12.5)/33.0
PG-YBOCS[e] total score [$N = 290$]	20.8 (±5.4)/20.0
Previous formalized treatment[f] for gambling disorder [$N = 365$]	18.6 (68)
Previous gamblers anonymous treatment [$N = 365$]	39.7 (145)
Lifetime prevalence of any affective disorder	27.2 (122)
Lifetime prevalence of any anxiety disorder	12.3 (55)
Lifetime prevalence of alcohol use disorder	23.2 (104)
Lifetime prevalence of substance use disorder	11.7 (52)

Note. %: relative values; n: absolute values.
[a]Standard deviation. [b]Duration of illness was defined as the difference between [age at intake] and [age at onset of gambling disorder]. [c]Number of valid subjects for the variable. If N is not displayed, the total sample ($n = 448$) was evaluated for the variable. [d]The Gambling Symptom Assessment Scale (Kim et al., 2009). [e]Yale–Brown Obsessive-Compulsive Scale modified for Pathological Gambling (Pallanti et al., 2005). [f]Formalized treatment: individual outpatient treatment and/or group outpatient treatment and/or inpatient treatment.

Table 2. Association between gambling behavior and duration of illness[a] (DOI) in treatment-seeking adults with gambling disorder ($n = 448$)

Gambling behavior variables	Correlation coefficient[b] or mean DOI (SD[c])	p value
Lag between first gambling and onset of gambling disorder	−0.094	**.049**
Gambling frequency (times a week) [N[d] = 365]	0.030	.563
Primary form of gambling (strategic/non-strategic)	10.8 (±8.1)/9.9 (±7.0)	.524
Percentage of income lost in gambling (last year)	−0.096	.088
G-SAS[e] total score [$N = 382$]	−0.082	.108
PG-YBOCS[f] total score [$N = 290$]	0.057	.332
PG-YBOCS urge subscale [$N = 290$]	−0.019	.745
PG-YBOCS gambling behavior subscale [$N = 290$]	0.112	.056

Note. p values with statistically significant differences ($p < .05$) are highlighted in bold.
[a]Duration of illness was defined as the difference between [age at intake] and [age at onset of gambling disorder]. [b]Spearman's rank correlation coefficient. [c]Standard deviation. [d]Number of valid subjects for the variable. If N is not displayed, the total sample ($n = 448$) was evaluated for the variable. [e]The Gambling Symptom Assessment Scale (Kim et al., 2009). [f]Yale–Brown Obsessive-Compulsive Scale modified for Pathological Gambling (Pallanti et al., 2005).

Table 3. Association between duration of illness[a] (DOI), psychiatric antecedents, quality of life, and neurocognitive variables in treatment-seeking subjects with gambling disorder ($n = 448$)

Variables	Mean DOI (SD[b]) or correlation coefficient[c]	p value
Psychiatric antecedents and quality of life		
Lifetime prevalence of any affective disorder (yes/no)	10.2 (±7.5)/10.3 (±7.8)	.820[d]
Depressive symptoms (Hamilton Depression Rating Scale)	−0.063	.182
Lifetime prevalence of any anxiety disorder (yes/no)	8.0 (±5.7)/10.5 (±7.9)	.059[d]
Anxiety symptoms (Hamilton Anxiety Rating Scale)	−0.050	.327
Lifetime prevalence of alcohol use disorder (yes/no)	11.9 (±8.4)/9.7 (±7.4)	**.037**[d]
Lifetime prevalence of substance use disorder (yes/no)	10.5 (±7.6)/10.2 (±7.7)	.497[d]
Lifetime prevalence of any impulse control disorder (yes/no)	10.4 (±7.9)/10.2 (±7.7)	.942[d]
Current smoking (yes/no)	10.9 (±8.5)/9.5 (±6.7)	.161
Previous formalized treatment[e] for GD (yes/no) [N[f] = 365]	9.6 (±8.1)/10.1 (±7.9)	.665
Previous gamblers anonymous treatment [$N = 365$]	10.3 (±8.6)/9.8 (±7.5)	.657
First-degree relative with history of GD (yes/no)	10.9 (±7.9)/9.8 (±7.6)	.057
First-degree relative with history of AUD (yes/no)	11.2 (±8.0)/8.9 (±7.1)	**.001**
Quality of life (QOLI[g]) [$N = 134$]	−0.170	**.049**
Neurocognitive variables[h]		
Response inhibition (delay at the stop-signal task) [$N = 77$]	0.100	.388
Cognitive flexibility (intra-/extra-dimensional set shifting test) [$N = 77$]	−0.019	.873

Note. p values with statistically significant differences ($p < .05$) are highlighted in bold.
[a]Duration of illness was defined as the difference between [age at intake] and [age at onset of gambling disorder]. [b]Standard deviation. [c]Spearman's rank correlation coefficient. [d]p values adjusted for age. [e]Formalized treatment: individual outpatient treatment and/or group outpatient treatment and/or inpatient treatment. [f]Number of valid subjects for the variable. If N is not displayed, the total sample ($n = 448$) was evaluated for the variable. [g]Quality of Life Inventory (Frisch et al., 1992). [h]The following measures were used: [delay at the stop-signal task] = stop-signal reaction time (ms); [intra-/extra-dimensional set shifting test] = total errors (adjusted).

negative correlation with quality of life. These results are displayed in Table 3.

Finally, we conducted multiple linear regressions where we introduced the clinical variables with level of sig. <.05 in the univariate analysis. The variables inserted in this model were: [lag between first gambling and onset of GD], [lifetime prevalence of AUD], [first-degree relative with history of AUD], and [quality of life (QOLI)]. The model did not reach statistical significance. Final model = [QOLI] ($B = -.077$; 95% confidence interval for B = lower limit: −.165, upper limit: .010; constant: $B = 13.069$; sig. < .001); model summary: $R = .154$; $R^2 = .024$; degrees of freedom = 4; sig. = .084. Strategy used = backward. Therefore, the multivariate approach was not more informative than the conclusions withdrawn from the univariate analysis.

DISCUSSION

This research evaluated the association between DOI, clinical, and neurocognitive variables in a sample of 448 adult subjects with GD. This is, to our knowledge, the first study to investigate specifically DOI in GD. We assessed gambling behavior, psychiatric antecedents, quality of life, and neurocognitive variables. Our main results were: (a) there is a negative correlation between DOI and lag between first gambling and onset of GD; (b) lifetime history of AUD is associated with a longer duration of GD; (c) the presence of a first-degree relative with history of AUD is associated with a more extended course of GD; and (d) there is a negative correlation between DOI and quality of life.

DOI, GD severity, and financial losses

Contrary to our initial hypothesis, no associations were seen between DOI and GD severity in this study. Neither we were able to find significant correlations between DOI and financial losses (evaluated by percentage of income lost last year). It is important to notice that, although a longer DOI was not significantly associated with greater financial losses in the past year, more extended DOI tends to be correlated with higher lifetime losses. This is a result of recurrent losses and expenses in bets throughout the years. The money spent in gambling could be invested in healthier, self-fulfilling, and productive ways. Chronic monetary losses may also explain in part why subjects with long-duration GD report a lower quality of life (see more in DOI and Quality of Life subsection).

The absence of a cross-sectional correlation between DOI and GD severity in treatment-seeking/clinical trial samples may be due to a possible selection bias (i.e., individuals with chronic GD may be less prone to seek treatment or participate in clinical trials). Future studies assessing the association between duration of GD and severity of symptoms in non-clinical samples are needed.

DOI and lag between first gambling and GD

This study found a negative correlation between DOI and lag between first gambling and onset of GD. Previous studies have suggested that women tend to have a faster progression from recreational gambling to GD when compared with men (Grant, Odlaug, & Mooney, 2012; Ibáñez, Blanco, Moreryra, & Sáiz-Ruiz, 2003; Tavares

et al., 2003). Therefore, gender differences in DOI may cause this discrepancy. However, this study did not find statistically significant differences between men and women in terms of DOI nor lag between first gambling and GD [mean DOI: men = 11.1 (±8.8) years, women = 9.6 (±6.7) years, sig. = .250; mean lag between first gambling and GD: men = 10.1 (±10.6) years, women = 8.8 (±9.7) years, sig. = .309). In this context, it is unlikely that the differences observed in the progression to GD in the current research is a consequence of gender-associated issues.

A faster progression from recreational gambling to GD appears to be associated with higher severity. For example, we found a negative correlation between lag from first gambling to GD and severity of gambling behavior in accordance with PG-YBOCS (Spearman's rank correlation coefficient = −0.155; sig. = .009) and G-SAS (Spearman's rank correlation coefficient = −0.245; sig. < .001). Furthermore, lag from first gambling to GD was positively correlated with QOLI (Spearman's rank correlation coefficient = 0.301; sig. = .001).

These findings are consistent with what Blaszczynski and Nower (2002) describe as the "impulsive gambler." Impulsive gamblers show more severe gambling levels, more impact in non-gambling-related areas, earlier onset, and unresponsiveness to treatment. Therefore, they are less likely to recover and more prone to present longer DOI. In the clinical setting, patients with longer DOI and faster progression from recreational gambling to GD may benefit from long-term customized psychotherapeutic interventions focused on impulse control (Blaszczynski & Nower, 2002).

Personal history of AUD and family history of AUD and GD

The subjects with lifetime AUD showed a significantly longer DOI when compared with those without the history of AUD. The family history of AUD was also correlated with a more extended DOI. In addition, the participants with family history of GD showed a trend to present longer DOI.

The association between longer DOI and AUD may possibly represent two underlying processes. The first element appears to be a common genetic vulnerability between GD and AUD. Shaffer et al. (1999) suggested that AUD was associated with an increased risk of developing GD. Accordingly, Slutske et al. (2000) investigated twins and found that there is a common genetic susceptibility for GD and AUD. Recent research has shown that GD and AUD addictions share significant similarities, such as continuous behavior despite relevant negative consequences, development of tolerance/withdrawal symptoms, presence of urges/craving, neurocognitive findings, and a chronic course (Bechara, 2001; Blanco et al., 2001; Potenza, 2001, 2008).

The second possible factor is a behavioral interaction between AUD and gambling. Alcohol use is associated with greater impulsivity (Dougherty, Marsh-Richard, Hatzis, Nouvion, & Mathias, 2008) and risky behaviors, such as risky sex, irresponsible driving, and gambling (Cooper, 2002; McCarthy, Niculete, Treloar, Morris, & Bartholow, 2012). Therefore, subjects who use alcohol may also be prone to gamble or bet more due to behavioral disinhibition when intoxicated. As a result, co-occurring AUD may facilitate relapse and lead to a more chronic course. In this context, assessing and managing AUD is an important step in the treatment of GD.

Proper treatment of AUD may reduce the DOI and avoid further negative consequences.

DOI and quality of life

As expected, this study observed a negative correlation between DOI and quality of life. GD is correlated with a wide range of negative consequences, such as legal, relational, financial, and occupational problems (Grant & Kim, 2005; Petry & Kiluk, 2002; Petry et al., 2005). As a result, individuals with chronic GD tend to suffer adverse impacts for a longer period and this in turn may ultimately affect the quality of life.

This is worrisome since disordered gamblers overall (regardless of DOI) tend to have a lower quality of life when compared with the general population (Black et al., 2003). In our sample, the mean [33.2 (±13.8)] and median (34.0) QOLI were in the *very low* range (QOLI scores of 37 or less) (Frisch, 2009). In this context, the chronic disordered gamblers tend to present an even lower quality of life.

Regarding treatment-seeking behavior, only 18.6% of the subjects in this study had sought formalized treatment specifically for GD. This percentage is consistent with the previous literature which suggests that the vast majority of individuals with gambling problems do not seek treatment (Slutske, 2006). Embarrassment and negation of the problem seem to be important explanatory factors (Suurvali, Cordingley, Hodgins, & Cunningham, 2009). Therefore, appropriate training of health professionals regarding GD, motivational interviewing, and stigma may increase the treatment-seeking behavior. As psychological and pharmacological interventions may provide significant benefits (Dell'Osso, Allen, & Hollander, 2005; Pallesen, Mitsem, Kvale, Johnsen, & Molde, 2005), strategies to increase adequate care of disordered gamblers may improve their quality of life.

Limitations and future studies

This study has significant strengths such as: (a) the investigation of an important and understudied clinical variable in the treatment of disordered gambling (DOI); (b) the use of a large sample ($n = 483$); and (c) a comprehensive evaluation including gold-standard measures on psychiatric symptoms, co-occurring disorders, overall functioning, and neurocognitive variables. However, this study presents some limitations. First, this is a cross-sectional research, and although it provides measures of association, causal conclusions cannot be inferred. It is important to replicate and further understand our findings in other study designs such as longitudinal studies. Second, this study used subjects who participated in clinical trials. Therefore, caution is needed when generalizing our findings to other patient populations. Third, some of the data in this research (such as [age of first gambling], [age at onset of GD], and [money lost last year]) were retrospectively evaluated. Consequently, it is possible that these assessments had some degree of recall bias. Despite the limitations, this study presents an innovative approach to GD and provides an important insight on a

clinically relevant and understudied topic. Longitudinal research approaching clearer causal associations and the biological changes associated with different DOI is needed. It will be particularly interesting to investigate the possible biological changes associated with different DOI. It is important not only to further study treatment-seeking samples but also to expand research on DOI to non-treatment-seeking samples.

CONCLUSIONS

This study suggests that some important variables are associated with different DOI. DOI was negatively correlated with a lag from recreational gambling to GD (in years). In addition, the subjects with lifetime history of AUD and family history of AUD demonstrated a longer DOI. Finally, there was a negative correlation between DOI and quality of life. Increasing treatment-seeking behavior, providing customized psychological interventions, and effectively managing AUD may decrease the high levels of chronicity in GD. Furthermore, research on GD such as phenomenological studies and clinical trials may consider the duration of GD in their methodology. DOI might be an important variable when analyzing treatment outcome and avoiding confounders.

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Authors' contribution: We confirm that all persons designated as authors were qualified for authorship. Each author participated sufficiently in the work to take public responsibility for the content. The corresponding author affirms that he had access to all data from the study, both what is reported and what is unreported, and also that he had complete freedom to direct its analysis and its reporting, without influence from the sponsors. The corresponding author also affirms that there was no editorial direction or censorship from the sponsors.

GCM conducted the literature searches, the statistical analysis, and wrote the first draft of the manuscript. SAR and SRC made edits and amends to the first draft of the manuscript. JEG designed the study, wrote the protocol, supervised the literature searches and statistical analysis, and reviewed the final version of the paper. All authors contributed to and have approved the final version of the manuscript.

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