Gambling disorder seeking treatment patients and tobacco use in relation to clinical profiles

Susana Jiménez-Murcia[a,b,c], Mónica Giménez[b,d] Roser Granero[a,e], Cristina Masuet-Aumantell[c,f], Josep M. Ramón[c,f], Fernando Agüero[c,f], Sergio Morchón-Ramos[f], Laura Moragas[b], Isabel Baenas [a,b], Amparo del Pino-Gutiérrez[a,b,g], Ester Codina[b], Eduardo Valenciano-Mendoza[b], Bernat Mora-Maltas[b], Susana Valero-Solís[b], Mikel Extandi[b], Elías Guillen-Guzmán[h], José M. Menchón[b,c,d], Fernando Fernández-Aranda[a,b,c]

[a]*CIBER Fisiopatología Obesidad y Nutrición (CIBERObn), Instituto de Salud Carlos III. Madrid, Spain*

[b]*Department of Psychiatry, University Hospital of Bellvitge-IDIBELL, Barcelona, Spain*

[c]*Department of Clinical Sciences, School of Medicine and Health Sciences, University of Barcelona, Barcelona, Spain*

[d]*CIBER Salud Mental (CIBERSam), Instituto de Salud Carlos III. Madrid, Spain*

[e]*Department of Psychobiology and Methodology, Autonomous University of Barcelona, Barcelona, Spain*

[f]*Department of Preventive Medicine, University Hospital of Bellvitge-IDIBELL, Barcelona, Spain*

[g]*Department of Public Health, Mental Health and Perinatal Nursing, School of Nursing, University of Barcelona, Barcelona, Spain.*

[h]*Department of Child and Adolescent Psychiatry and Psychology, Institute of Neurosciences, Hospital Clinic Barcelona, Spain.*

Abstract

Objectives: Tobacco smoking and gambling disorder (GD) often co-occur. However, few studies have assessed the extent to which cigarette smoking may serve to classify and/or better define GD behaviour profiles.

Methods: Among a large sample of n=3,652 consecutive treatment-seeking patients with GD (91% men). Smokers were compared to non-smokers across different sociodemographic, clinical, psychopathological and personality variables. The effect sizes for the means and the proportion differences between the groups were estimated. An evaluation of the smoking changes over the last 15 years was also performed.

Results: From the total sample, 62.4% of gamblers reported tobacco use. A decreasing linear trend in tobacco use was observed within the studied period, women having a more irregular pattern. The use of tobacco was linked to the use of alcohol and other illegal drugs. Gamblers who smoke, as compared to those who don't, presented lower education levels, lower social position indexes and active employment. They were younger, with an earlier age of onset, shorter duration of the gambling behavior, higher GD severity, more psychological symptoms, higher scores in novelty seeking and lower scores in reward dependence, self-directedness and self-transcendence.

Conclusions: Gamblers seeking treatment who smoke display particular social, clinical, psychological, temperamental and character features different from non-smoking gamblers, suggesting that the presence or absence of comorbid smoking condition in GD should always be considered when developing an optimal treatment, as gamblers who smoke might need treatment strategies different from non-smoking gamblers.

1. Introduction

There is a clear link between gambling disorder (GD) and addictive-related substance abuse (Jazaeri & Habil, 2012; Wareham & Potenza, 2010) even in youth (Buja et al., 2017). People who develop gambling disorder earlier in life also tend to have problems with substance abuse (American Psychiatric Association, 2013). Among these substances, gambling has been especially associated with the use of alcohol and tobacco even when gambling behavior does not reach risk-related levels (Buja et al., 2017).

Smoking is an important global public health concern (Committee on the Public Health Implications of Raising the Minimum Age for Purchasing Tobacco Products, 2015; West, 2017). The World Health Organization (WHO) estimates that, globally, smoking causes enormous harm annually (WHO, 2013; Ekpu & Brown, 2015). Smokers have been identified as contributing a disproportionate level of revenue in gambling (Harper, 2003). Studies found that the likelihood of co-occurrence for smoking and GD is high (Mcgrath & Barrett, 2009), partly explained as a cross-cue reactivity (Wulfert, Harris, & Broussard, 2016). However, little is known about the association of smoking status and gambling clinical profiles in patients seeking treatment.

Smoking and GD appear to share neurobiological and hereditary influences related to similar dopaminergic action (Mcgrath & Barrett, 2009). A recent preclinical study revealed that nicotine presence interacts with reward conditions to increase cue-triggered behavior and enhance motivation for rewards, providing possible insight into the comorbid relationship between GD and tobacco use (Russell and Robinson, 2019). In this sense, a presynaptic dopaminergic dysfunction has been reported in striatal regions of GD subjects (Pettorruso, Martinotti, Cocciolillo, De Risio, Cinquino, Di Nicola et al., 2019). Mcgrath and Barrett (2009) reported that GD may be influenced and reinforced by nicotine consumption, through an increase in the dopamine neurotransmission under the effect of nicotine in brain regions (mesocorticolimbic system) related to reinforcement, reward, but also to attention that contributes to concentration during gambling. In this vein, Barrett et al. (2015) demonstrated that nicotine-containing tobacco increased average wager and acutely increased the propensity to gamble.

There is a previous study based on a sample of 317 treatment-seeking gamblers that links cigarette smoking with increased GD severity and psychiatric symptoms (anxiety mainly) (Petry & Oncken, 2002). A posterior study in 465 treatment-seeking gamblers reported that gamblers with daily smoking had more severe obsessive and compulsive behaviors but were less likely to have mood disorders (Grant, Kim, Odlaug, & Potenza, 2008). More recently, a study carried out with a sample of 385 treatment-seeking gamblers enrolled in a gambling treatment reported that tobacco

users (63% of their sample) presented significantly more severe gambling and mental health symptoms (Odlaug, Stinchfield, Golberstein, & Grant, 2013). These authors also described that daily tobacco use, however, was not significantly associated with the number of days gambled. These results warrant further investigation of smoking in a large sample of gamblers offering a comprehensive characterization of the possible clinical profile differences of smokers and non-smoker gamblers looking for treatment, in order to evaluate if smoking differences may account for specific profiles that may help guiding GD management. It has been reported that despite the fact that tobacco is associated with greater gambling severity, gambling smokers had similar rates of a treatment completion and outcomes as non-smokers (Odlaug, Stinchfield, Golberstein, & Grant, 2013; Ronzitti, Lutri, Meleck, Smith, & Bowden-Jones, 2015). These results show that despite the association between higher GD severity and higher smoking use, treatments could achieve similar effectiveness in smokers and non-smoker gamblers. A greater understanding of the relationship between gambling and smoking may lead to the design of more individualized treatments for gamblers who smoke.

The aims of the current study were to examine in depth in a large sample of 3,652 treatment-seeking adult patients with GD (1) sociodemographic, clinical, psychopathological and personality profile of smokers and non-smoker gamblers, and (2) to provide characterization of the evolution of smoking behaviour in GD over an extended period during the last 15 years. Our study expands on data from previous studies of smoking in seeking treatment gamblers (Grant, Kim, Odlaug, & Potenza, 2008; Odlaug, Stinchfield, Golberstein, & Grant, 2013; Petry & Oncken, 2002) providing for the first time a description of the psychopathological and personality aspects involved in patients with GD who smoke. Also the large sample size (new times larger than previously studied samples), and the fifteen years' time span assessment provides an added value. With this, we may be able to provide keys that may help the development of specific treatments and strategies for GD in smokers versus non-smoker patients, as well as specific treatments and strategies for smokers in disordered gambling according to their severity.

2. Methods

2.1. Sample selection

This study included treatment-seeking patients with GD. The sample comprised n=3,652 patients consecutively recruited at the gambling unit of the Bellvitge University Hospital over a

period of 15 years (between 2005 and 2019). All patients reported disordered gambling, and had cognitive capability to complete the self-report measures of the study. Only patients who met clinical criteria for GD as their primary health concern were included in the study.

This work was carried out in accordance with the Declaration of Helsinki of 1975 (revised in 1983), and was approved by the Ethics Committee of Bellvitge University Hospital. Written informed consent was obtained from all study participants.

2.2. Procedure

Patients were assessed by trained and licensed psychologists and psychiatrists with more than 15 years of experience assessing and treating GD patients. Further information regarding gambling behavior was also gathered via a semi-structured face-to-face interview. Sociodemographic and additional clinical information was taken, and patients individually completed the questionnaires required for this study (requiring approximately two hours) before initiating outpatient treatment.

2.3. Measures

Diagnostic Questionnaire for Pathological Gambling according to Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria (Stinchfield, 2003). This is a self-report used to assess the presence of GD. It is based on 19 items developed for measuring the diagnostic criteria defined in the DSM-5 classification (American Psychiatric Association, 2013). The Spanish adaptation of the scale was used (Jiménez-Murcia, Stinchfield, Alvarez-Moya et al., 2009) and the total number of DSM-5 criteria for GD as a measure of the gambling severity was obtained (internal consistency in the current sample for the DSM-5 total GD criteria was good, Cronbach alpha α=0.728).

Symptom Checklist-Revised (SCL-90-R) (Derogatis, 1975). This is a 90-item test assessing diverse psychological and psychopathological symptoms, based on nine primary symptom dimensions (somatization, obsession-compulsion, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, and psychoticism). With this test, three global indices were obtained: (1) a global severity index (GSI, aimed to measure global psychological distress), (2) a positive symptom distress index (PSDI, to evaluate the intensity of symptoms), and (3) a positive symptom total (PST, to account for the number of self-reported symptoms). The validated scale in a Spanish population was used here (Derogatis, 2002). The nine primary symptoms present good internal consistency in the current sample ($\alpha \geq 0.780$ in all cases). The GSI, PSDI and PST particularly present an excellent internal consistency (α=0.980 in all cases).

Temperament and Character Inventory-Revised (TCI-R) (Cloninger, Przybeck, Svrakic, & Wetzel, 1994). This questionnaire contains 240 items to measure personality traits. A total of 7 personality dimensions (4 temperament-related and 3 character-related) were obtained: novelty seeking, harm avoidance, reward dependence and persistence, self-directedness, cooperativeness and self-transcendence. The Spanish version of TCI-R was used for the present study (Gutiérrez-Zotes, Bayón, Montserrat et al., 2004). Internal consistency in this sample ranged between α=0.750 (novelty seeking) and α=0.866 (persistence).

Other clinical and sociodemographic variables. Other measures of the study were registered with the semi-structured self-reported interview. It covered different sociodemographic characteristics (i.e. marital and employment status, education), as well as clinical and gambling-related variables (i.e. gambling preferences, age of onset and duration of gambling activities). The social position index was obtained thorough the Hollingshead's algorithm (Hollingshead, 2011) obtaining a global measurement of social position based on three items (profession, employment status and education). This index allows obtaining five levels (high, medium-high, medium, medium-low and low). During the initial clinical interview (anamnesis) questions were asked about the use of tobacco, coffee, alcohol and other drugs. With regard to smoking use, this study analyzed the daily consumption of cigarettes through a binary classification of the sample within the group smokers versus non-smokers (it was not considered any differentiation based on the tobacco type). In non-smoker patients the period from which they had not smoked was registered.

3. Statistical analyses

Stata16 for Windows was used for the statistical analyses (Stata-Corp, 2019). The comparison of categorical variables between the groups was done with chi-square test (χ^2), while T-test for independent samples was used for the comparison of quantitative measures.

The estimation of the effect sizes for the means differences and the proportions differences were based on the standardized Cohen's-*d* coefficient, considering poor-low effect size for $|d|>0.20$, moderate-medium for $|d|>0.5$ and large-high for $|d|>0.80$ (Kelley & Preacher, 2012)

The Finner-correction method, defined as a familywise error rate stepwise procedure which offers a more powerful test than the classical Bonferroni correction, was used to control the potential increase in Type-I error due to the multiple statistical comparisons (Finner, 1993).

4. Results

4.1. Characteristics of the sample

The first block of Table 1 displays the frequency distribution for the sociodemographic and the gambling profile measures in the study. Most participants were men (91.1%), single (40.7%) or married (45.8%), with low education levels (57.9% with primary or lower grades), social indexes into the mean-low and low levels (83.4%) and employed (57.4%). Mean chronological age was 42.0 years-old (standard deviation [SD]=13.4). Regarding gambling profile, mean age of onset was 29.4 years-old (SD=11) and mean duration of gambling 6.6 years (SD=7.2). Regarding preferred forms of gambling, most participants reported only non-strategic gambling (70.4%), while only strategic was reported for 10.6% and both (non-strategic plus strategic) was reported for 19.0% of the sample.

Table 1 Descriptive for the sample (*n*=3,652)

Sociodemographics		*n*	*%*
Sex	Women	324	8.9%
	Men	3328	91.1%
Marital status	Single	1486	40.7%
	Married – partner	1673	45.8%
	Divorced – separated	493	13.5%
Education	Primary or less	2113	57.9%
	Secondary	1309	35.8%
	University	230	6.3%
Social index	High	55	1.5%
	Mean-high	164	4.5%
	Mean	389	10.7%
	Mean-low	1179	32.3%
	Low	1865	51.1%
Employment status	Unemployed	1554	42.6%
	Employed	2098	57.4%
Chronological age		*Mean*	*SD*
Age (years-old)		42.03	13.37

Gambling profile	*Mean*	*SD*
Onset of GD (years-old)	29.34	10.97
Duration of GD (years)	6.58	7.17
Gambling preference	*n*	*%*
Non-strategic	2571	70.4%
Strategic	388	10.6%
Both	693	19.0%
Tobacco use	*n*	*%*
No	1373	37.6%
Yes	2279	62.4%

Note. SD: standard deviation.

4.2. Tobacco correlates

The number of patients who reported daily tobacco use was n=2,279 [prevalence=62.4%; 95% confidence interval (95%CI): 60.8% to 64.0%]. First panel of Figure 1 displays the line-plot with the prevalence of the smoking during the period of recruitment of the data in the study. A negative linear trend emerged (Wald=29.71, *df*=1, $p<0.001$): the proportion of patients who reported tobacco use decreased from 73.2% during 2005 to 49.3% in 2019. A descriptive interpretation of the

line-plots obtained separately for men and women also suggest a linear trend for both sexes (second panel of Figure 1), but women showed a more irregular pattern compared to men.

The prevalence of smoking was higher for men compared to women (63.1% *versus* 55.2%), divorced or separated patients (66.7% *versus* 63.7% for single and 60.1% for married), primary or lower education level (65.4% *versus* 60.9% for secondary level and 43.9% for university level), lower social position indexes (high or mean-high index reported a point prevalence equal to 54.8% compared to 62.1% among low index) and active employment (64.6% *versus* 59.4% for unemployed patients) (Table 2).

Figure 1 Prevalence of tobacco use during the years of the data recruitment

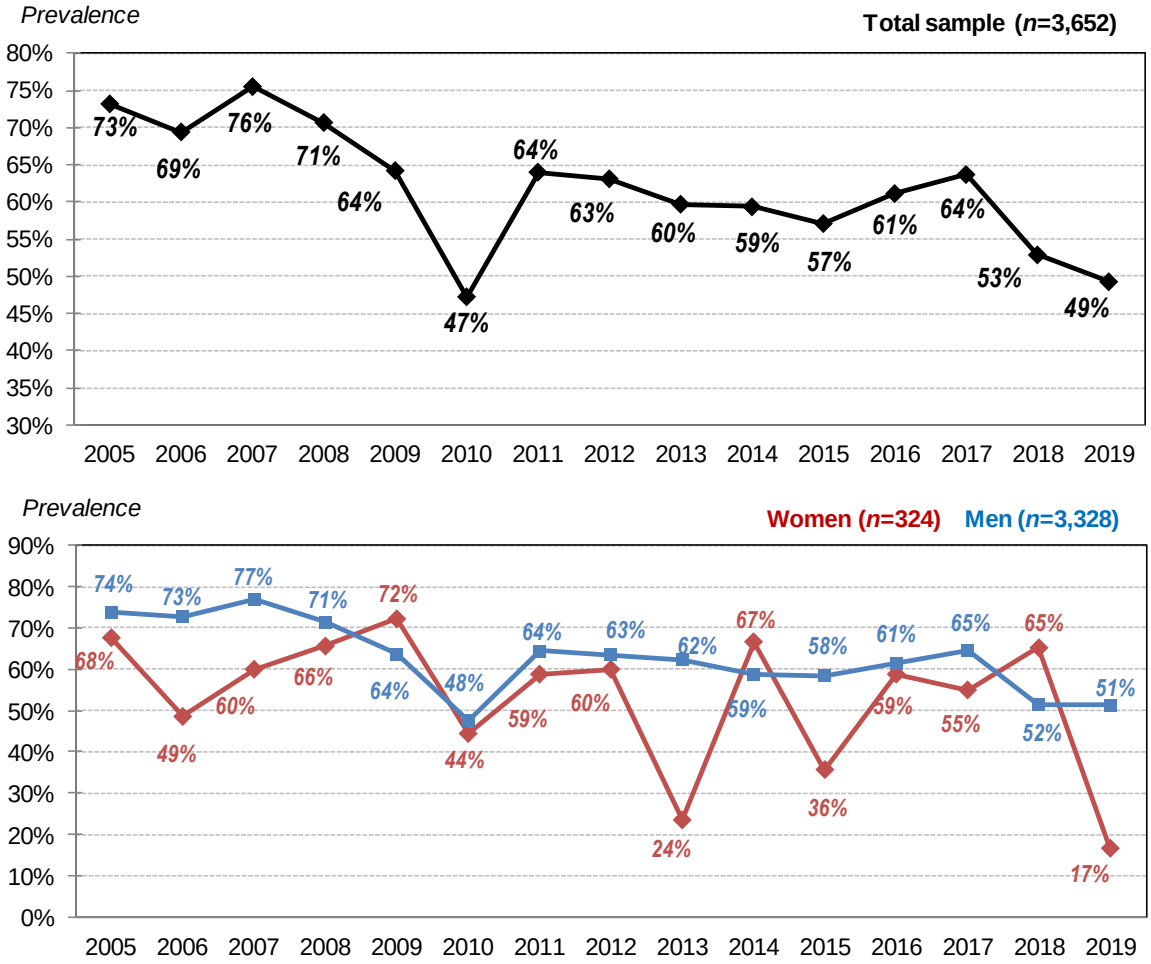

Table 2 Prevalence estimates of tobacco use and association with sociodemographics

		Tobacco = No (*n*=1,373)		Tobacco = Yes (*n*=2,279)			
		n	%	*n*	%	*p*	|*d*|
Sex	Women	145	44.8%	179	55.2%	**0.005***	0.21
	Men	1228	36.9%	2100	63.1%		
Marital status	Single	540	36.3%	946	63.7%	**0.011***	**0.55†**
	Married – partner	669	40.0%	1004	60.0%		0.40
	Divorced – separated	164	33.3%	329	66.7%		**0.68†**
Education	Primary or less	732	34.6%	1381	65.4%	**<0.001***	**0.62†**
	Secondary	512	39.1%	797	60.9%		0.44
	University	129	56.1%	101	43.9%		0.24
Social index	High or mean-high	99	45.2%	120	54.8%	**0.024***	0.19
	Mean	154	39.6%	235	60.4%		0.42
	Mean-low	413	35.0%	766	65.0%		**0.61†**
	Low	707	37.9%	1158	62.1%		0.49
Employment status	Unemployed	631	40.6%	923	59.4%	**<0.001***	0.38
	Employed	742	35.4%	1356	64.6%		

Note. *Bold: significant comparison (0.05 level).

†Bold: effect size into the mild-moderate (|*d*|>0.50) to high-large range (|*d*|>0.80).

The patients within the tobacco use group also were younger on average, reported younger age of onset, shorter duration of gambling, higher severity of the GD (worse symptom level and more cumulate debts due to the gambling activity), non-strategic gambling preference, slot machines, higher number of psychological symptoms (SCL-90R PST), higher scores in novelty seeking and lower scores in reward dependence, self-directedness and self-transcendence (Table 3).

The use of tobacco was also related to the use of alcohol (p<0.001; OR=1.74, 95%CI: 1.43 to 2.11) and other illegal drugs (p<0.001; OR=4.26, 95%CI: 3.18 to 5.71). The estimates of the adjusted OR through multiple logistic regression achieved similar OR values for the use of alcohol (p=0.001; OR=1.42, 95%CI: 1.16 to 1.73) and other drugs (p<0.001; OR=3.90, 95%CI: 2.90 to 5.25).

Table 3 Comparison between patients with and without tobacco use for clinical variables

	Tobacco = No *(n=1,373)*		Tobacco = Yes *(n=2,279)*			
Age, onset and duration of GD	*Mean*	*SD*	*Mean*	*SD*	*p*	|*d*|
Age (years-old)	44.74	15.12	40.39	11.90	**<0.001***	0.32
Onset of GD (years-old)	31.92	11.54	27.78	10.31	**<0.001***	0.38
Duration of GD (years)	6.97	8.37	6.34	6.32	**0.010***	0.09
Severity of the GD	*Mean*	*SD*	*Mean*	*SD*	*p*	|*d*|
DSM-5 total criteria	7.11	1.53	7.24	1.51	**0.011***	0.09
Bets (max-episode; euros)	1059	2676	1080	2517	0.811	0.01
Bets (mean-episode; euros)	103	247	106	227	0.727	0.01
Debts due to GD; n - %	639	46.5%	1,215	53.3%	**<0.001***	0.14
Gambling preference	*n*	*%*	*n*	*%*	*p*	|*d*|
Gambling subtype-group						
Non-strategic	841	61.3%	1730	75.9%	**<0.001***	0.32
Strategic	229	16.7%	159	7.0%		0.31
Both	303	22.1%	390	17.1%		0.13
Gambling activities (prevalence)						
Slot machines	878	63.9%	1976	86.7%	**<0.001***	**0.54†**
Bingo	167	12.2%	259	11.4%	0.467	0.02
Lotteries	303	22.1%	470	20.6%	0.300	0.04
Casino	176	12.8%	216	9.5%	**<0.001***	0.11
Gaming rooms	54	3.9%	57	2.5%	**0.015***	0.08
Cards	79	5.8%	136	6.0%	0.790	0.01
Bets on horses	59	4.3%	66	2.9%	**0.024***	0.08
Bets on sports	172	12.5%	153	6.7%	**<0.001***	0.20
Psychopathology (SCL-90R)	*Mean*	*SD*	*Mean*	*SD*	*p*	|*d*|
Somatic	0.99	0.80	1.00	0.81	0.582	0.02
Obsessive-compulsive	1.18	0.80	1.19	0.81	0.616	0.02
Interpersonal sensitivity	1.03	0.80	1.11	0.83	**0.006***	0.09
Depressive	1.53	0.87	1.59	0.89	0.058	0.06
Anxiety	1.05	0.79	1.08	0.80	0.258	0.04
Hostility	0.95	0.81	0.97	0.84	0.464	0.03
Phobic anxiety	0.49	0.67	0.53	0.68	0.110	0.05
Paranoid ideation	0.94	0.77	0.99	0.78	0.082	0.06
Psychosis ideation	0.92	0.74	0.97	0.76	**0.047***	0.07
GSI	1.09	0.68	1.12	0.70	0.143	0.05
PST	46.58	21.04	48.27	21.13	**0.019***	0.08
PSDI	1.93	0.58	1.92	0.58	0.638	0.02
Personality (TCI-R)	*Mean*	*SD*	*Mean*	*SD*	*p*	|*d*|
Novelty seeking	108.08	12.71	111.35	12.77	**<0.001***	0.26
Harm avoidance	101.11	15.44	101.56	16.35	0.404	0.03
Reward dependence	98.83	13.24	97.74	13.89	**0.019***	0.08
Persistence	107.59	18.50	108.68	18.69	0.085	0.06
Self-directedness	127.31	18.99	125.23	19.62	**0.002***	0.11
Cooperative	129.70	15.11	129.61	15.34	0.862	0.01
Self-transcendence	65.02	14.41	63.05	13.90	**<0.001***	0.14
Other substances use	*n*	*%*	*n*	*%*	*p*	|*d*|
Alcohol	162	11.8%	430	18.9%	**<0.001***	0.20
Other drugs	55	4.0%	344	15.1%	**<0.001***	0.40

Note. Obtained for the subsample of patients with accumulated debts due to gambling. SD: standard deviation.

*Bold: significant comparison (0.05 level). †Bold: effect size into the mild-moderate (|*d*|>0.50) to high-large range (|*d*|>0.80).

5. Discussion

To the best of our knowledge, this is the first study in a very large sample of GD seeking treatment individuals, evaluating the relationship between smoking and the profile of GD under different points of view, and the evolution of tobacco use over the last 15 years. The prevalence of gamblers who reported daily tobacco use was higher than the non-smoker gamblers, with different factors related to the presence of tobacco use.

Our sample is the largest within the literature evaluating smoking in GD patients. Current smoking prevalence in disordered gambling (62%) coincides with previous literature reporting a smoking prevalence around 63-66% (Odlaug, Stinchfield, Golberstein, & Grant, 2013; Petry & Oncken, 2002) and appears higher than other study samples reporting a prevalence around 45-46% (Grant, Kim, Odlaug, & Potenza, 2008; Ronzitti, Lutri, Meleck, Smith, & Bowden-Jones, 2015). Differences in the samples' makeup may account for these discrepancies, as i.e. in the case of the Grant study the sample was based on 46% of men. In line with this, we found that the prevalence of smoking was higher for men, not married, lower education levels, lower social position indexes and active employment. In general, differences in sex with regards to smoking have been clearly postulated (Pampel, 2006; West, 2017), with women smoking less than men (Gowing, Ali, Allsop et al., 2015). The prevalence of smoking during the period assessed here, despite being still higher, decreased from 2005 to 2019 by 24% across the sample, with women showing a more irregular pattern. This decline is in concordance with global trends according to which smoking rates have been declining in almost all countries in recent years (Ritchie & Roser, 2013).

Smoking patients with low educational levels and low socioeconomic status showed a greater preference for non-strategic gambling (i.e. slot machines), compared to non-smoking gamblers. At this point we cannot forget the role played by impulsivity in influencing the choice of specific gambling activities. Thus, some impulsive aspects (i.e., negative urgency) seem to mediate the choice of some types of gambling machines, particularly among patients with escape-oriented forms of gambling (Lutri, Soldini, Ronzitti et al., 2018). Impulsivity is also present in the form of novelty seeking in our sample. Our data point out towards the cluster 1 in the study of phenotypes of Jiménez-Murcia et al. (2019) by which GD patients with low educational levels, more severe gambling symptoms but shorter duration of gambling are classified as "high emotional distress patients". Previous studies have published high co-morbidity between non-strategic gambling and tobacco use (Cheung, 2014; Moragas, Granero, Stinchfield et al., 2015; Potenza, Steinberg, McLaughlin et al., 2004), and it has also been documented that gambling behavior and smoking play a role in the management of stress and negative emotions (Mcgrath & Barrett, 2009). Therefore, it is

likely that gamblers within low socio-economic levels experience greater economic pressure, which may lead them to higher states of arousal and anxiety and to the use of tobacco as a way to reduce stress levels (Moylan, Jacka, Pasco, & Berk, 2013). This hypothesis is supported by the fact that smoking gamblers had a clinical profile with a higher GD severity and more psychological symptoms.

Tobacco use was also linked to the use of alcohol and other illegal drugs, in concordance with previous literature (Barnes, Welte, Hoffman, & Tidwell, 2009), especially among young people. We also found that smoking gamblers showed more financial problems (gambling debts). Therefore, we speculate that the casuistry of GD patients who smoke is important for targeted prevention and intervention strategies aimed at objectives different from the clinical profile in which smoking does not exist.

The smoking profile with increased abuse of alcohol and other drugs is consistent with the idea that impulsivity contributes to increased risky health behaviors (Granö, Virtanen, Vahtera, Elovainio, & Kivimäki, 2004). Also, younger ages contribute to impulsivity and severity of gambling (Savvidou, Fagundo, Fernández-Aranda et al., 2017; Secades-Villa, Martínez-Loredo, Grande-Gosende, & Fernández-Hermida, 2016; Steward, Mestre-Bach, Fernández-Aranda et al., 2017; Valero-Solís, Granero, Fernández-Aranda et al., 2018). In this sense, our patients with GD who also smoke have higher scores in novelty seeking, a personality trait linked to impulsive risk behaviors (Cloninger, Svrakic, & Przybeck, 1993). Novelty seeking is reported in different types of gamblers (Black, Coryell, Crowe, Shaw, McCormick & Allen 2015; Kim & Grant, 2001; Nordin & Nylander, 2007), being the most characteristic feature of GD. We show that GD individuals who smoke have the highest levels of this personality trait. Our data coincide with literature reporting that women are less likely to be classified in high-novelty-seeking models (Kashdan & Hofmann, 2008).

Finally, the three other characteristics of smoking gamblers, different from non-smoker patients, were the presence of low scores on reward dependence, self-directedness and self-transcendence. Gambling disorder appears to be driven by the reward-dependent system. The literature on reward dependence in gambling provides less straightforward results. Although greater sensitivity to reward has usually been described in GD samples, some studies do not always find it (Hodgins & Holub, 2015; Janiri, Martinotti, Dario, Schifano, & Bria, 2007; Tavares & Gentil, 2007). Some studies have reported higher scores in novelty seeking and a negative relationship between reward and drug dependence (Evren, Evren, Yancar, & Erkiran, 2007; Gerra, Zaimovic, Timpano et al., 2000). A negative relationship between reward dependence and impulsivity has also been found in drug dependence (Abassi & Abolghasemi, 2015). Interestingly, higher scores on reward dependence in gamblers act as a protective factor in reducing psychopathology and somatic

and psychic suffering (Moragas, Granero, Stinchfield et al., 2015). Also considering that reward dependence is characterized by a response behavior to reward signals (and, in this case, smoking patients preferred non-strategic and chance gambling), it is likely that the participants who smoke in the current sample demonstrated a low degree of gambling control (reflected in an increase in GD severity), with a reward system even less efficient than non-smoking gamblers. Thus, gamblers who smoke do not appear to benefit from this protective factor.

Regarding the decline in self-directedness and self-transcendence in patients who smoke, our data are partially consistent with the previous literature reporting low scores in self-directness (Nordin & Nylander, 2007) but not with higher scores in self-transcendence in GD (Martinotti, Andreoli, Giametta, Poli, Bria & Janiri, 2006). Higher scores in self-directedness appear to predict lower scores in both gambling severity and psychopathology, while higher scores for self-transcendence predict higher scores in both variables (Moragas, Granero, Stinchfield et al., 2015). Self-transcendence is a complex character construct related to human acceptance, identification and consciousness (Garcia-Romeu, 2010). Self-transcendence implies our own conception as part of nature (Cloninger, Svrakic, & Przybeck, 1993). Medium scores on this variable seem to reflect a healthier personality trait. A combination of low levels of self-directness but moderate levels of self-transcendence have been associated with a melancholic character, with immature traits (possessive and materialistic), in which gambling may be used as a maladaptive strategy to control negative emotions (Jiménez-Murcia, Granero, Stinchfield et al., 2013). Some types of severe personality disorders (e.g. antisocial personality disorder) have low scores for self-transcendence (de Pádua Serafim, de Barros, Bonini Castellana, & Gorenstein, 2014; Widiger, Sirovatka, Regier, & Simonsen, 2007). These low values have been related to materialism and low spirituality (Granero, Fernández-Aranda, Steward et al., 2016), and with old GD patients showing higher levels of self-transcendence (Granero, Penelo, Stinchfield et al., 2013). Finally, higher scores in novelty seeking and lower scores in self-transcendence have been directly related to tobacco use (Jiménez-Murcia, Granero, Tárrega et al., 2015).

5.1. Strengths and limitations

Considering that in clinical settings patients are heterogeneous, one of the main strengths of this study is the sample size, since the larger the sample, the more representative it is. We also provide a 15-year assessment of smoking, giving us a broader view of patients who smoke to date, and therefore, including the most recent types of gambling. However, there are some limitations to this study. Firstly, although women tend to be less frequent in studies of gambling, we cannot rule out the under-representation of women in the sample. Second, the study only included treatment-

seeking individuals, so we cannot generalize the results to the community samples. Third, smoking has not been collected having in mind variables such as Fageström test for nicotine dependence, specific tobacco use, so results should be evaluated taking into account the smoking variable as a dichotomous, losing some specificity. And finally, we have not analyzed former smokers who could provide us with results between never smokers and current smokers.

5.2. Conclusions

This study sheds light on the sociodemographic, clinical, psychopathological and personality characterisation of a large sample of patients suffering from GD and seeking treatment having in mind their smoking status. Individualized therapies require the identification of significant factors affecting patients for the assignment of more effective treatments to ensure successful outcomes. We found specific features in smoking GD patients that seem to be related to a worse level of symptom and more cumulate debts due to the gambling activity. As both smokers and non-smoker gamblers have different characteristics, we advocate different treatment strategies for them. In fact, data of clinical trials in gamblers already points towards specific pharmacological treatments addressing nicotine-GD comorbidity facilitating behavioural therapy. Thus, N-acetylcysteine has been found to reduce both nicotine dependence but also to long-term improve imaginal desensitization and gambling severity outcomes (Grant, Odlaug, Chamberlain, Potenza, Schreiber, Donahue et al., 2014). Despite gambling in general is partially explained by socio-demographic, psychopathological and personality factors, most of these factors are directly related to the tobacco uses. Smoking appears to be a factor in differentiating gamblers' profiles, so clinicians should study the presence or absence of comorbid smoking in gambling, especially when a therapy is applied.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

Acknowledgments

This study has been funded by Ministerio de Ciencia, Innovación y Universidades, which is part of Agencia Estatal de Investigación (AEI), through the project RTI2018-101837-B-I00 (Co-funded by European Regional Development Fund. ERDF, a way to build Europe). The research was also funded by the Delegación del Gobierno para el Plan Nacional sobre Drogas (project 2019I47), Instituto de Salud Carlos III (ISCIII) (FIS PI14/00290 and PI17/01167). CIBERobn and CIBERsam are both initiatives of ISCIII. The funders had no role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript. Support was received from the Secretariat for Universities and Research of the Ministry of Business and Knowledge of the Government of Catalonia. We thank CERCA Programme / Generalitat de Catalunya for institutional support.

References

Abassi, M., & Abolghasemi, A. (2015). Temperament and Character Dimensions: Correlates of Impulsivity in Morphine Addicts. International Journal of High Risk Behaviors & Addiction, 4(4). https://doi.org/10.5812/ijhrba.21142

American Psychiatric Association. (2013). Diagnostic and Statistical Manual of Mental Disorders (Fifth Edition). Washington (DC): American Psychiatric Publishing.

Barnes, G. M., Welte, J. W., Hoffman, J. H., & Tidwell, M.C. O. (2009). Gambling, Alcohol, and Other Substance Use Among Youth in the United States. Journal of Studies on Alcohol and Drugs, 70(1), 134-142.

Barrett, S.P., Collins, P., & Stewart, S.H. (2015). The acute effects of tobacco smoking and alcohol consumption on video-lottery terminal gambling. Pharmacology, Biochemistry and Behavior, 130, 34-39. https://doi.org/10.1016/j.pbb.2014.12.015

Black, D. W., Coryell, W. H., Crowe, R. R., Shaw, M., McCormick, B., & Allen, J. (2015). Personality Disorders, Impulsiveness, and Novelty Seeking in Persons with DSM-IV Pathological Gambling and Their First-Degree Relatives. Journal of Gambling Studies, 31(4), 1201-1214. https://doi.org/10.1007/s10899-014-9505-y

Buja, A., Lion, C., Scioni, M., Vian, P., Genetti, B., Vittadello, F., et al. (2017). SOGS-RA gambling scores and substance use in adolescents. Journal of Behavioral Addictions, 6(3), 425-433. https://doi.org/10.1556/2006.6.2017.043

Cheung, N. W. T. (2014). Low self-control and co-occurrence of gambling with substance use and delinquency among Chinese adolescents. Journal of Gambling Studies, 30(1), 105-124. https://doi.org/10.1007/s10899-012-9351-8

Cloninger, C. R., Svrakic, D. M., & Przybeck, T. R. (1993). A psychobiological model of temperament and character. Archives of General Psychiatry, 50(12), 975-990. https://doi.org/10.1001/archpsyc.1993.01820240059008

Cloninger, Przybeck, T. R., Svrakic, D. M., & Wetzel, R. D. (1994). The Temperament and Character Inventory (TCI): A Guide to Its Development and Use. Washington University: Center for Psychobiology of Personality.

Committee on the Public Health Implications of Raising the Minimum Age for Purchasing Tobacco Products; Board on Population Health and Public Health Practice; Institute of Medicine. (2015). The Effects of Tobacco Use on Health. Washington (DC): National Academies Press (US).

de Pádua Serafim, A., de Barros, D. M., Bonini Castellana, G., & Gorenstein, C. (2014). Personality traits and violent behavior: A comparison between psychopathic and non-psychopathic male murderers. Psychiatry Research, 219(3), 604-608. https://doi.org/10.1016/j.psychres.2014.06.026

Derogatis, L. (1975). The SCL-90-R. Baltimore (MD): Clinical Psychometric Research.

Derogatis, L. (2002). SCL-90-R. Cuestionario de 90 Síntomas-Manual. Madrid, Spain: TEA Ediciones.

Ekpu, V. U., & Brown, A. K. (2015). The Economic Impact of Smoking and of Reducing Smoking Prevalence: Review of Evidence. Tobacco Use Insights, 8, 1-35. https://doi.org/10.4137/TUI.S15628

Evren, C., Evren, B., Yancar, C., & Erkiran, M. (2007). Temperament and character model of personality profile of alcohol- and drug-dependent inpatients. Comprehensive Psychiatry, 48(3), 283-288. https://doi.org/10.1016/j.comppsych.2006.11.003

Finner, H. (1993). On a Monotonicity Problem in Step-Down Multiple Test Procedures. Journal of the American Statistical Association, 88(423), 920-923. https://doi.org/10.1080/01621459.1993.10476358

Garcia-Romeu, A. (2010). Self-transcendence as a measurable transpersonal construct. Journal of Transpersonal Psychology, 42(1), 26-47.

Gerra, G., Zaimovic, A., Timpano, M., Zambelli, U., Begarani, M., Marzocchi, G. F., et al. (2000). Neuroendocrine correlates of temperament traits in abstinent opiate addicts. Journal of Substance Abuse, 11(4), 337-354. https://doi.org/10.1016/s0899-3289(00)00031-6

Gowing, L. R., Ali, R. L., Allsop, S., Marsden, J., Turf, E. E., West, R., et al. (2015). Global statistics on addictive behaviours: 2014 status report. Addiction (Abingdon, England), 110(6), 904-919. https://doi.org/10.1111/add.12899

Granero, R., Fernández-Aranda, F., Steward, T., Mestre-Bach, G., Baño, M., del Pino-Gutiérrez, A., et al. (2016). Compulsive Buying Behavior: Characteristics of Comorbidity with Gambling Disorder. Frontiers in Psychology, 7, 625. https://doi.org/10.3389/fpsyg.2016.00625

Granero, R., Penelo, E., Stinchfield, R., Fernandez-Aranda, F., Savvidou, L., Fröberg, F., et al. (2013). Is Pathological Gambling Moderated by Age? Journal of gambling studies / co-sponsored by the National Council on Problem Gambling and Institute for the Study of Gambling and Commercial Gaming, 30, 475-492. https://doi.org/10.1007/s10899-013-9369-6

Granö, N., Virtanen, M., Vahtera, J., Elovainio, M., & Kivimäki, M. (2004). Impulsivity as a predictor of smoking and alcohol consumption. Personality and Individual Differences, 37(8), 1693-1700. https://doi.org/10.1016/j.paid.2004.03.004

Grant, J. E., Kim, S. W., Odlaug, B. L., & Potenza, M. N. (2008). Daily Tobacco Smoking in Treatment-Seeking Pathological Gamblers: Clinical Correlates and Co-occurring Psychiatric Disorders. Journal of Addiction Medicine, 2(4), 178-184. https://doi.org/10.1097/ADM.0b013e3181878673

Grant, J. E., Odlaug, B. L., Chamberlain, S. R., Potenza, M. N., Schreiber, L. R. N., Donahue, C. B., et al. (2014). A randomized, placebo-controlled trial of N-acetylcysteine plus imaginal

desensitization for nicotine-dependent pathological gamblers. Journal of Clinical Psychiatry, 75(1), 39-45.

Gutiérrez-Zotes, J. A., Bayón, C., Montserrat, C., Valero, J., Labad, A., Cloninger, C. R., et al. (2004). [Temperament and Character Inventory Revised (TCI-R). Standardization and normative data in a general population sample]. Actas Españolas De Psiquiatría, 32(1), 8-15.

Harper, T. (2003). Smoking and gambling: A trance inducing ritual. Tobacco Control, 12(2), 231-233. https://doi.org/10.1136/tc.12.2.231

Hodgins, D. C., & Holub, A. (2015). Components of Impulsivity in Gambling Disorder. International Journal of Mental Health and Addiction, 13(6), 699-711. https://doi.org/10.1007/s11469-015-9572-z

Hollingshead, A. (2011). Four Factor Index of Social Status. Yale Journal of Sociology, 8, 21-51.

Janiri, L., Martinotti, G., Dario, T., Schifano, F., & Bria, P. (2007). The Gamblers' Temperament and Character Inventory (TCI) personality profile. Substance Use & Misuse, 42(6), 975-984. https://doi.org/10.1080/10826080701202445

Jazaeri, S. A., & Habil, M. H. B. (2012). Reviewing Two Types of Addiction – Pathological Gambling and Substance Use. Indian Journal of Psychological Medicine, 34(1), 5-11. https://doi.org/10.4103/0253-7176.96147

Jiménez-Murcia, S., Granero, R., Fernández-Aranda, F., Stinchfield, R., Tremblay, J., Steward, T., et al. (2019). Phenotypes in Gambling Disorder Using Sociodemographic and Clinical Clustering Analysis: An Unidentified New Subtype? Frontiers in Psychiatry, 10, 173. https://doi.org/10.3389/fpsyt.2019.00173

Jiménez-Murcia, S., Granero, R., Stinchfield, R., Fernández-Aranda, F., Penelo, E., Savvidou, L. G., et al. (2013). Typologies of young pathological gamblers based on sociodemographic and clinical characteristics. Comprehensive Psychiatry, 54(8), 1153-1160. https://doi.org/10.1016/j.comppsych.2013.05.017

Jiménez-Murcia, S., Granero, R., Tárrega, S., Sauvaget, A., Grall-Bronnec, M., Álvarez-Moya, E. M., et al. (2015). Gambling disorder and substance use disorders: Effect of early age and personality. Drogues, santé et société, 14(1), 94-109.

Jiménez-Murcia, S., Stinchfield, R., Alvarez-Moya, E., Jaurrieta, N., Bueno, B., Granero, R., et al. (2009). Reliability, validity, and classification accuracy of a Spanish translation of a measure of DSM-IV diagnostic criteria for pathological gambling. Journal of Gambling Studies, 25(1), 93-104. https://doi.org/10.1007/s10899-008-9104-x

Kashdan, T., & Hofmann, S. (2008). The high-novelty-seeking, impulsive subtype of generalized social anxiety disorder. Depression and anxiety, 25(6), 535-541. https://doi.org/10.1002/da.20382

Kelley, K., & Preacher, K. J. (2012). On effect size. Psychological Methods, 17(2), 137-152. https://doi.org/10.1037/a0028086

Kim, S. W., & Grant, J. E. (2001). Personality dimensions in pathological gambling disorder and obsessive-compulsive disorder. Psychiatry Research, 104(3), 205-212. https://doi.org/10.1016/s0165-1781(01)00327-4

Lutri, V., Soldini, E., Ronzitti, S., Smith, N., Clerici, M., Blaszczynski, A., et al. (2018). Impulsivity and Gambling Type Among Treatment-Seeking Disordered Gamblers: An Explorative Study. Journal of Gambling Studies, 34(4), 1341-1354. https://doi.org/10.1007/s10899-018-9764-0

Martinotti, G., Andreoli, S., Giametta, E., Poli, V., Bria, P., & Janiri, L. (2006). The dimensional assessment of personality in pathologic and social gamblers: The role of novelty seeking and self-transcendence. Comprehensive Psychiatry, 47(5), 350-356. https://doi.org/10.1016/j.comppsych.2005.12.005

Mcgrath, D. S., & Barrett, S. P. (2009). The comorbidity of tobacco smoking and gambling: A review of the literature. Drug and Alcohol Review, 28(6), 676-681. https://doi.org/10.1111/j.1465-3362.2009.00097.x

Moragas, L., Granero, R., Stinchfield, R., Fernández-Aranda, F., Fröberg, F., Aymamí, N., et al. (2015). Comparative analysis of distinct phenotypes in gambling disorder based on gambling preferences. BMC Psychiatry, 15(1), 86. https://doi.org/10.1186/s12888-015-0459-0

Moylan, S., Jacka, F. N., Pasco, J. A., & Berk, M. (2013). How cigarette smoking may increase the risk of anxiety symptoms and anxiety disorders: A critical review of biological pathways. Brain and Behavior, 3(3), 302-326. https://doi.org/10.1002/brb3.137

Nordin, C., & Nylander, P.O. (2007). Temperament and character in pathological gambling. Journal of Gambling Studies, 23(2), 113-120. https://doi.org/10.1007/s10899-006-9049-x

Odlaug, B., Stinchfield, R., Golberstein, E., & Grant, J. E. (2013). The relationship of tobacco use with gambling problem severity and gambling treatment outcome. Psychology of Addictive Behaviors, 27(3), 696-704. https://doi.org/10.1037/a0029812

Pampel, F. C. (2006). Global Patterns and Determinants of Sex Differences in Smoking. International Journal of Comparative Sociology, 47(6), 466-487. https://doi.org/10.1177/0020715206070267

Petry, N. M., & Oncken, C. (2002). Cigarette smoking is associated with increased severity of gambling problems in treatment-seeking gamblers. Addiction (Abingdon, England), 97(6), 745-753. https://doi.org/10.1046/j.1360-0443.2002.00163.x

Potenza, M., Steinberg, M. A., McLaughlin, S. D., Wu, R., Rounsaville, B. J., Krishnan-Sarin, S., et al. (2004). Characteristics of tobacco-smoking problem gamblers calling a gambling helpline. The American Journal on Addictions, 13(5), 471-493. https://doi.org/10.1080/10550490490483044

Ritchie, H., & Roser, M. (2013). Smoking. Our World in Data; file: https://ourworldindata.org/smoking. Accessed June 2020.

Ronzitti, S., Lutri, V., Meleck, S., Smith, N., & Bowden-Jones, H. (2015). Smoking and Gambling Disorder: Does Tobacco Use Influence Treatment Outcome? Journal of Gambling Studies. https://doi.org/10.1007/s10899-015-9533-2

Savvidou, L. G., Fagundo, A. B., Fernández-Aranda, F., Granero, R., Claes, L., Mallorquí-Baqué, N., et al. (2017). Is gambling disorder associated with impulsivity traits measured by the UPPS-P and is this association moderated by sex and age? Comprehensive Psychiatry, 72, 106-113. https://doi.org/10.1016/j.comppsych.2016.10.005

Secades-Villa, R., Martínez-Loredo, V., Grande-Gosende, A., & Fernández-Hermida, J. R. (2016). The Relationship between Impulsivity and Problem Gambling in Adolescence. Frontiers in Psychology, 7, 1931. https://doi.org/10.3389/fpsyg.2016.01931

Stata-Corp. (2019). Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC.

Steward, T., Mestre-Bach, G., Fernández-Aranda, F., Granero, R., Perales, J. C., Navas, J. F., et al. (2017). Delay discounting and impulsivity traits in young and older gambling disorder patients. Addictive Behaviors, 71, 96-103. https://doi.org/10.1016/j.addbeh.2017.03.001

Stinchfield, R. (2003). Reliability, validity, and classification accuracy of a measure of DSM-IV diagnostic criteria for pathological gambling. The American Journal of Psychiatry, 160(1), 180-182. https://doi.org/10.1176/appi.ajp.160.1.180

Tavares, H., & Gentil, V. (2007). Pathological gambling and obsessive-compulsive disorder: Towards a spectrum of disorders of volition. Brazilian Journal of Psychiatry, 29(2), 107-117. https://doi.org/10.1590/s1516-44462007000200005

Valero-Solís, S., Granero, R., Fernández-Aranda, F., Steward, T., Mestre-Bach, G., Mallorquí-Bagué, N., et al. (2018). The Contribution of Sex, Personality Traits, Age of Onset and Disorder Duration to Behavioral Addictions. Frontiers in Psychiatry, 9, 497. https://doi.org/10.3389/fpsyt.2018.00497

Wareham, J. D., & Potenza, M. N. (2010). Pathological Gambling and Substance Use Disorders. The American Journal of Drug and Alcohol Abuse, 36(5), 242-247. https://doi.org/10.3109/00952991003721118

West, R. (2017). Tobacco smoking: Health impact, prevalence, correlates and interventions. Psychology & Health, 32(8), 1018-1036. https://doi.org/10.1080/08870446.2017.1325890

Widiger, T. A., Sirovatka, P. J., Regier, D. A., & Simonsen, E. (2007). Dimensional Models of Personality Disorders: Refining the Research Agenda for DSM-V. Washington (DC): American Psychiatric Publishing.

World Health Organization (WHO). (2013). WHO report on the global tobacco epidemic; file: https://apps.who.int/iris/bitstream/handle/10665/85380/9789241505871_eng.pdf;jsessionid=4E6A7390D8C1E1F9C510053EA43803EC?sequence=1. Accessed June 2020.

Wulfert, E., Harris, K., & Broussard, J. (2016). The Role of Cross-Cue Reactivity in Coexisting Smoking and Gambling Habits. Journal of Gambling Issues, 32(0), 28-43. https://doi.org/10.4309/jgi.2016.32.3