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Problem and non problem gamblers : clustering according to gambling characteristics and course- a prospective study

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Title : Problem and non-problem gamblers: clustering according to gambling characteristics and course- a prospective study -

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All the other authors declare that they have no conflicts of interest.

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Statement 1: Role of funding sources

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The research presented here was conducted at the initiative of and coordinated by the Addictology

and Psychiatry Department of Nantes University Hospital. Nantes University Hospital is the sponsor of this study. There were no constraints on publishing.

Statement 2: Contributors

MGB and GCB designed the JEU cohort study, conducted literature search and wrote the protocol. MGB and GCB are responsible for the project management. BP provided methodological advice, designed the statistical analysis plan and conducted the statistical analysis for this research. All authors (including those mentioned in the JEU Group) contributed to include the participants in the JEU cohort study and to the development of the protocol, especially to the selection of the assessment content. MGL, MGB and GCB wrote the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Objectives

Gambling is a widespread activity worldwide that may induce gambling disorder (GD). Gambling characteristics are factors that could influence the course of the gamblers The aim of this study was to identify a typology of gambler vulnerability based on gambling characteristics and to investigate factors associated with these different profiles in a large representative sample of gamblers.

Design and setting

The JEU cohort study is a 5-year longitudinal national case-control cohort that sought to identify protective and risk factors in gambling practice [for more information, please refer to the study protocol of the JEU cohort: Challet-Bouju et al., 2014 [30]]. The present study was carried out using the baseline data of the JEU cohort. Recruitment occurred between April 2009 and September 2011 and involved a group of French clinicians and researchers from seven institutions that offer care for, or conduct research dedicated to, pathological gambling.

Participants

The participants were gamblers who took part in the JEU cohort study : 628 non-problem gamblers (NPG), problem gamblers without treatment (PGWT) and problem gamblers seeking treatment (PGST).

Results

We identified 3 clusters with significant differences in the course of their gambling: “early onset and short course” (EOSC), “early onset and long course” (EOLC) and “late onset and short course” (LOSC). The course of gambling characteristics, which differed among the three groups, were: age at onset, age when gambling became a problem, type of gambling and gambling medium.

Conclusions

Gambling practice includes highly heterogeneous profiles. The course and characteristics of gambling may not individually explain problem gambling but may help define specific profiles with specific risks when combined. These results have implications regarding the need to develop policies and regulations to reduce exposure of vulnerable persons to gambling products.

Key words

Gambling disorder, long term course, addictive behaviors , addiction

Clinical Trial registration : NCT01207674 (ClinicalTrials.gov)

Strenghts and limitations of this study

- The sample size of gamblers (N=628) has rarely been achieved for studies with semi-structured interviews.

-The mixing of NPG and PG who have, or have not, sought treatment is one of the main strengths of our study, with inclusion directly from gambling locations.

- Recruitment of patients was done at the moment of the legalization of online gambling in France, which limits generalization , as online gambling has since become widely available.

- Risk factors are self-reported at baseline evaluation. In future studies, these results should be compared to the longitudinal data.

1. INTRODUCTION

Gambling is a widespread social activity worldwide. Almost all national surveys conclude that there are more gamblers than non-gamblers [1]; 75% of males and 71% of females had gambled in the past year in the UK [2], and 74% of the general population in France had gambled in their lifetime [3]. The gambling industry has developed many types of gambling games on different media, especially on the Internet. This expansion of legalized gambling has been identified as a public health concern [4-6].

Social gambling may become a gambling disorder (GD) in a minority of cases [7, 8]. GD is a persistent, maladaptive pattern of gambling resulting in clinically significant impairment or distress [9]. The lifetime prevalence of combined problem and pathological gambling across the world ranges from 0.7% to 6.5% [1]. In France, a national survey estimated that 2.7% of the population could be considered problem gamblers [3].

The status of the problem gambler is unstable over time [10], and gamblers can have very different courses of gambling development. Different factors—individual, environmental or those linked to gambling behavior characteristics—may influence gambling status and the course of their gambling course [1]. Many studies have focused on individual or environmental factors [1-3, 7, 10-14].

To facilitate prevention and to help an early identification of at-risk gamblers, different studies identified profiles for vulnerable gamblers through clustering. Blasczcynszki and Nower defined a theoretical pathway model of problem gambling [15]. They identified 3 clusters of problem gamblers (conditioned gambler, emotionally vulnerable, and antisocial impulsivist) based mainly on clinical experience with pathological gamblers. They assumed that certain clinical variables, such as psychiatric comorbidities or impulsivity, could influence the course of their gambling. Several empirical studies on the Pathways Model and on other subtyping approaches to gambling confirmed clinical differences between PG profiles, even though no study has conclusively supported this classification and the underlying prognosis hypotheses [16-19].

To the very best of our knowledge, only a few studies have analyzed gambling characteristics and their influence on gambling status and the course of gambling. Gambling characteristics include many variables: age at initiation, gambling medium or type of gambling, gambling history, the amounts wagered, frequency of gambling, gambling status, etc. An early initiation age is a high-risk factor for the development of GD later in life and is associated with a higher level of GD severity [19-21]. Online gambling contributes to, and enhances, the risk of developing GD [2, 22], even though most online gamblers also gamble offline [2, 23]. When considering a favorite gambling activity, gamblers who preferentially play the same type of game share a common profile, independent of pathological characteristics [24]. Hing et al. identified profile differences between online EGM gamblers and those who bet online on sport or horses [8].

All these studies were, in a large majority of cases, undertaken within the PG population [17-19, 25-27] , analyzed one specific gambling characteristic or defined clustering according to psychological variables and psychometric or cognitive assessment tests [17, 25, 27-29]. We did not find any studies in literature which involved a broad sample of gamblers, and included non-problem and problem gamblers and which were specifically concerned with gambling characteristics.

Our objective was to identify a typology of gamblers, based on gambling characteristics and the course of gambling and to investigate factors associated with these different profiles (such as gambling severity, personality traits or sociodemographic characteristics) in a large representative sample of gamblers.

2. MATERIAL AND METHODS

2.1. Participants

The participants were 628 non-problem gamblers (NPG), problem gamblers without treatment (PGWT) and problem gamblers seeking treatment (PGST) who took part in the JEU cohort study. The

JEU cohort study is a 5-year longitudinal national case-control cohort that sought to identify protective and risk factors in gambling practice [for more information, please refer to the study protocol of the JEU cohort: Challet-Bouju et al., 2014 [30]]. The present study was carried out using the baseline data of the JEU cohort.

Recruitment occurred between April 2009 and September 2011 and involved a group of French clinicians and researchers from seven institutions that offer care for, or conduct research dedicated to, pathological gambling.

Inclusion and exclusion criteria are presented in table 1.

Inclusion criteria	Exclusion criteria
Participants who reported gambling on at least one occasion in the previous year Between 18 and 65 years old Understanding of French language Written consent	No gambling in the past year Under 18 or over 65 years old Cognitive impairment Inability to understand the French language No consent

Table 1. Inclusion and exclusion criteria

NPGs and PGWTs were recruited in gambling locations (casinos, cafés, bars, etc.) and through the press to cover the broadest possible range of severity levels and gambling activities. In gambling locations, participation in the study was offered to each gambler at the in the gambling venue reception area (never during a gambling session). For those who were interested in participating, the study was presented in detail and eligibility was verified. The interview was conducted either in a room or a private location at the gambling venue or at the research team's offices (according to participants' preferences). PGSTs were recruited in the seven care centers where they had started their treatment less than 6 months previously. To be included, problem gamblers (both PGWT and

PGST) had to meet the diagnostic criteria for problem gambling, according to the DSM-IV (see the Assessment section).

2.2. Ethical approval

Participants were informed about the research and gave their written informed consent prior to their inclusion in the study. This study was approved by the French Research Ethics Committee (CPP) on January 8, 2009. The approval granted from the CPP applies to all sites at which the study occurred.

Patient and public involvement

No patients nor the public were involved in the development of the research question. No patient advisers was included in the research project.

2.3.Assessment

The baseline assessment was performed at inclusion in the study. This was a clinical structured interview carried out by a trained researcher or psychologist with experience in working with pathological gamblers.

2.3.1. Sociodemographic characteristics

We collected information about age, gender, marital status, income, and work status.

2.3.2. Gambling characteristics

Pathological gambling section in the DSM-IV TR (APA 1994)

We used a clinical interview based on the 10 diagnostic criteria for pathological gambling according to the DSM-IV TR (APA, 2000). The gambling disorder section of the DSM-5 could not have been used because the recruitment was conducted in 2009-2011. Gamblers who met at least three DSM-IV

criteria were classified as problem gamblers, including both gamblers "at risk" of pathological gambling and gamblers with a diagnosis of pathological gambling. We used a non-standard threshold of three instead of five to include subclinical forms of pathological gambling. Previous literature has supported the relevance of this categorization [31-33]. The number of positive DSM-IV criteria for pathological gambling was also used as a dimensional score of PG severity.

Gambling course and characteristics

We constructed a questionnaire to collect information concerning the course of their gambling and characteristics. The course of the gambling was approached by investigating the history of their gambling practice: age at initiation and of first gambling-related problems, duration of gambling history (from age at initiation to current age) and age at the time of the diagnosis of comorbid psychiatric disorders (if relevant). We collected information about the familial and social support attitudes towards the problem gambler's difficulties. The individual's experimentation with a gambling-free period of at least one month's duration since his/her initiation was also investigated.

We collected information on participation in, and frequency of, various gambling forms over the past year. This included the mean average amount of money wagered monthly in gambling and the maximum wager placed in a single day. With regard to gambling preferences, we investigated the preferred type of gambling and medium for gambling. Gamblers identified their preferred gambling activity among all those they had experienced and we classified the preferred type of gambling according to the three categories proposed by Boutin in 2010: pure chance games (lotteries, slot machines, scratch cards, video lottery terminals, etc.), bank games with an element of skill (sports betting, horserace betting, Blackjack) or social games with skill (mainly Texas Hold'em and Omaha variants of poker) [34]. We also asked them to specify if they preferred gambling on the Internet or in offline forms.

2.3.3. Psychiatric comorbidities

Mini International Neuropsychiatric Interview (MINI) **[35]**

The MINI is a structured diagnostic interview that is compatible with the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10), and the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV).

It explores the lifetime and actual main axis 1 disorders (mood and anxiety disorders, psychotic syndrome, alcohol and substance use disorders).

Wender-Utah Rating Scale-Child (WURS-C) **[36, 37]**

This self-report questionnaire has been validated for the retrospective evaluation of childhood ADHD in adults. Its specificity (89.1%) is good. It is designed to assess ADHD symptoms represented by 25 items on a 5-point Likert scale. A score greater than, or equal to, 46/100 would indicate that diagnosis [36, 37].

2.3.4. Personality

A 125-item version of the Temperament and Character Inventory (TCI-125) **[38, 39]**

The TCI-125 is used to rapidly explore the four dimensions of temperament and the three dimensions of character in personality as defined by Cloninger's psychobiological model [40].

2.4. Statistical analysis

A descriptive analysis of the sociodemographic, clinical and gambling characteristics was carried out in order to obtain means, medians and standard deviations for continuous variables, as well as the number of people and the percentage of categorical variables.

To identify a typology of gamblers based on the course of their gambling and their preferences, we performed a clustering of gamblers with eight variables: age at initiation, age at onset of gambling

problem, duration of gambling history, age at diagnosis of comorbid psychiatric disorder, history of a gambling-free period of at least one month's duration, familial and social support, and preferred type of gambling and medium for gambling. We used the Latent Gold software [41, 42] to perform a latent class clustering (LCC) of the gamblers. LCC is a person-centered approach that seeks to identify homogenous subgroups, each group being defined by a specific probability distribution. LCC has been found to be more likely to give superior classification results than the more traditional methods such as k-means or hierarchical clustering [43], particularly because it requires fewer assumptions. Moreover, LCC can handle mixed-mode data (i.e., both categorical and continuous variables) without transformation of variables. We ran models that comprised 1 to 6 clusters. Missing data were supposed missing at random because this missing data was considered independent of the values of the variable but dependent on another variable (e.g. missing values for age at onset of gambling problems were independent of the age at onset of gambling problems *variable*, and depended, instead, on whether or not the participant had ever had gambling problems at all). Missing data were handled with full information maximum likelihood (FIML) estimation. FIML consists of estimating a likelihood function for each individual based on the variables that are not missing so that all the available data are used. The Bayesian information criterion (BIC) (a lower BIC indicating a better model) and the classification errors rate (which represents the precision of individuals' classification) were used to select the best model. Statistical differences between clusters were assessed by Wald tests. Variables that do not influence the estimation of the model were included as covariates to describe and compare the clusters. For these inactive covariates, a 3-step approach (Vermunt, 2010) was used to test differences between clusters.

3. RESULTS

Descriptive analysis

The sample was composed of 256 NPG, 169 PGWT and 203 PGST. The sociodemographics data of the whole sample (N = 628) are detailed in Table 2. Participants were mainly men (N = 418, 66.6%),

and the mean age was 43.4 years (SD = 12.9).

	N	%
Gender		
Male	418	66.6
Female	210	33.4
Marital status		
Single	313	49.9
In a relationship	314	50.1
Educational level		
Below high school graduation	306	48.9
Higher than or equal to high school graduation	320	51 .1
Professional activity		
Working	398	63.5
Not working	229	36.5
Level of income		
Regular and higher than the French minimum wage (approximately 1100€ or 1400$)	440	70.1
Others	188	29.9
	M	**SD**
Age	43.4	12.9

TABLE 2. Descriptive analysis of sociodemographic variables for the whole sample

Most participants were employed, with a regular income higher than 1,100€ (i.e., approximately 1,400 US$). The mean age at gambling initiation was 20.7 years for NPG, 21 years for PGWT, and 19.5 years for PGST. Gambling characteristics are presented in Table 3.

Gambling status	NPG	PGWT	PGST
Mean age at initiation (y.)	20.7	21.0	19.5
Mean age at onset of regular gambling (y.)	27	27.6	24.5
Mean age at onset of problem gambling (y.)	*not applicable*	34.9	34.1
Preferred gambling activity			
Pure chance games (%)	67	62	40
Chance games with pseudo skills (%)	20	27	40
Chance games with elements of skills (%)	13	11	14

Table 3. **Descriptive analysis of gambling characteristics among the three groups**

Clustering

Among the 6 tested models, 2 were very similar in terms of the BIC indicator: a model with 3 clusters (BIC = 18253.8) and another with 4 clusters (BIC = 18252.6). Between the two models, the one with 3 clusters displayed a lower classification error rate (7.92% vs 13.80% for the 4-cluster solution) and was better suited to clinical interpretation. We thus chose the 3-cluster partition.

Clinical, socio-professional, psychological variables and gambling characteristics of the 3 clusters are presented in table 4.

	Cluster 1 EOSC	Cluster 2 EOLC	Cluster 3 LOSC	P value Wald test
Cluster size (%)	47.5	35.0	17.5	
VARIABLES INCLUDED IN THE CLUSTERING ANALYSIS				
Age at gambling initiation (y.)	16.4	17.9	36.1	<0.001***
Age at onset of problem gambling (y.)	26.5	41.3	45.1	<0.001***
Duration of gambling history (y.)	16.2	35.4	16.2	<0.001***
Age at diagnosis of the first psychiatric comorbidities (*if relevant*) (y.)	15.3	23.7	26.5	<0.001***
History of gambling-free period of at least one month (%)	71.0	53.6	58.3	0.001**
Familial and social support related to gambling problems (%)	92.6	84.3	92.5	0.018*
Preferred type of gambling				
Pure chance games (lotteries, slots, scratch cards, video lottery terminals, etc.)	48.2	58.2	79.8	<0.001***
Bank games with an element of skill (sports betting, horserace betting, Blackjack)	30.8	36.1	16.9	
Social games with skill (Texas Hold'em and Omaha variants of poker)	21.0	5.7	3.4	

Preferred gambling medium (on the Internet)	20.0	8.1	2.3	<0.001***
CO-VARIABLES				
Sociodemographic characteristics				
Gender (%)				
Women	23.5	32.4	62.5	<0.001***
Men	76.5	67.6	37.5	
Age (y.)	32.7	53.4	52.3	<0.001***
Level of income ≥1100 € (1400 $ US) (%)	67.2	72.8	72.4	0.250 (NS)
Marital status (single) (%)	55.4	38.7	57.0	<0.001***
Employment status (active) (%)	73.0	56.0	52.0	<0.001***
Gambling severity				
Gambling status (%)				
Non-problem gamblers (NPG)	48.1	51.6	55.7	0.020*
Problem gamblers without treatment (PGWT)	16.8	23.0	21.3	
Problem gamblers seeking treatment (PGST)	35.2	25.4	23.0	
Number of DSM-5 criteria (mean)	3.8	3.7	3.3	0.200(NS)
Gambling habits				
Amount wagered monthly in gambling (in euros)	592 .4	632.5	512.3	0.560(NS)
Gambling frequency over the past 12 months (%)				0.067(NS)

Less than once a month	8.2	6.9	8.6	
More than once a month	17.6	12.9	19.2	
Once a week	13.2	14.6	20.6	
More than once a week	61.0	65.7	51.6	
Comorbid psychiatric disorders				
Mood disorders (%)	46.1	45.5	56.0	0.110(NS)
Depressive episode (%)	40.2	41.7	48.6	0.260(NS)
Hypomanic or manic episode (%)	13.6	9.2	12.9	0.240(NS)
Anxiety disorders (%)	38.2	36.4	40.0	0.780(NS)
Panic disorder (with or without agoraphobia)	18.4	21.4	25.4	0.220(NS)
Social phobia	11.7	8.4	15.9	0.082(NS)
Obsessive Compulsive disorder	3.8	2.5	1.0	0.360(NS)
Generalized Anxiety Disorder	17.4	12.0	11.7	0.087(NS)
Post-Traumatic Stress Disorder	7.2	6.3	9.7	0.490(NS)
Addictive disorders (%)	42.7	32.8	19.8	<0.001***
Alcohol Use Disorder	28.7	27.0	13.7	0.007**
Substance Use Disorder	25.5	10.1	6.1	<0.001***
Antisocial personality disorder (%)	5.5	3.3	1.1	0.220(NS)
Current suicide risk (%)	19.4	26.7	29.5	0.027*
Lifetime suicide attempts (%)	11.4	18.2	15.4	0.055(NS)
ADHD				
WURS score (M)	31.7	28.7	28.3	0.096(NS)

Personality				
TCI scores (M)				
Novelty Seeking (NS)	54 .9	51.5	48.6	0.001**
Harm Avoidance (HA)	43.7	44.7	42.8	0.730(NS)
Determination (D)	67.8	67.0	68.7	0.720(NS)
Cooperation (C)	73.6	73.5	75.6	0.450(NS)
Reward Dependence (RD)	60.8	59.1	60.7	0.460(NS)
Transcendence (T)	27.7	33.8	36.7	<0.001***
Persistence (P)	52.8	55.9	59.2	0.069(NS)

Table 4 . Profile of the three clusters identified

NS: non-significant; *: p<0.05; **: p< 0.01; ***: p<0.001

We identified 3 clusters with significant differences among the courses of gambling. Figure 1 represents the **3 clusters**, and the **significant variables and co variables**.

FIGURE 1.

4. DISCUSSION

Main findings

Three different profiles of gamblers

Three distinct clinical profiles of gamblers were identified through the analysis of gambling characteristics. Differences in the course of gambling and in the characteristics corresponded to psychopathological profiles and they were significant in terms of socio-demographic variables (gender, age, work and marital status) and also in terms of gambling status and some comorbidities (addictive disorders, hypomanic episodes and personality traits). We propose a classification of our clusters, according to gambling characteristics: Early onset and Short course (EOSC) (Cluster 1) , Early onset and long Course (EOLC) (Cluster 2) and Late Onset and Short course (Cluster 3).

Our 3-clusters model, defined through the analysis of gambling characteristics, is partially comparable to the theoretical pathways model of Blaszczynski and Nower [15] which were, in turn, defined through psychopathological variables.

The Early Onset and Short Course cluster (Cluster 1-EOSC)

The EOSC cluster shares similarities with the third pathway, "antisocial impulsivist problem gamblers" [15]. The mean age at gambling initiation is under 18 years, which is the legal age for gambling in France. Lynch *et al*. found that young adults who had started gambling prior to the age of 18 were more likely to experience at least one symptom of GD than those who started gambling at the age of 18 or later [44]. Early initiation is described as a marker of risk of GD in later life: Kessler *et al*. (2008) found that the mean age at the onset of gambling was significantly lower among those who subsequently developed pathological gambling than among those who did not develop gambling problems [45, 46], and Jimenez et al. identified that a younger age at the onset of gambling was associated with greater severity of pathological gambling . Our results agreed with this hypothesis: the EOSC group had a higher frequency of problem gambling and higher gambling severity than the two other groups. Nevertheless, age at initiation did not explain the course of gambling in itself : the two clusters associated with the earlier age at onset presented two different courses of gambling, either a short development (approximately 10 years) for the EOSC cluster or a long development (approximately 23 years) for the EOLC cluster. One may suppose that

psychopathological variables combined with age at onset may influence the course of gambling, as defined in the pathways model. Impulsivity is a key point of the antisocial impulsivist pathway, associated with gambling-related criminal behaviors and addictive comorbidities [15]. In our study, the EOSC cluster presented the highest level of ADHD symptomatology. Novelty seeking was also high, as reported in the literature, especially in social games with skill [47, 48]. This was associated with a high prevalence of psychiatric and addictive comorbidities, as previously described for PG with impulsivity and ADHD [15, 49, 50]. This cluster in particular had a significantly higher preference for online gambling than the others. Gambling on the Internet is associated with a high availability of gambling opportunity, and online poker induces specific problems, leading problem gamblers to lose money but also to spend a large amount of time gambling [51]. Moreover, involvement in gambling and attraction to strategic games are risk factors for problem gambling [52]. Strategic games usually attract young males, with an earlier onset of the disorder [48]. They tend to engage in more than one specific type of problematic game and to take more risks, including betting high amounts of money [48]. This cluster included the highest frequency of PG and the highest frequency of PGST and they most frequently indicated the occurrence of gambling-free periods of one month, probably in an effort to regain control over gambling or in reaction to negative consequences.

EOLC cluster (Cluster 2)

The EOLC cluster shares similarities with the first pathway defined by Blaszczynski and Nower as "conditioned problem gamblers" (CG). This CG group is defined by gamblers preoccupied with gambling, who engage in chasing and who fluctuate between excessive gambling and problem gambling. In our study, the EOLC cluster had a long course of gambling (35.4 years). They spent the highest amount of money on gambling, and only 53.6% had experienced a gambling cessation for at least one month. Moreover, an important characteristic is the absence of any lifetime premorbid feature of psychopathology before the onset of the gambling problem. Symptoms of anxiety or

depression were the consequences of problem gambling-related difficulties. However, at inclusion, they presented the highest prevalence of attempted suicide (and a current suicide risk in 26.7% of cases). One can assume that suicide risk and attempted suicides could be consequences of problem gambling-related difficulties [53].

We showed important results concerning familial support : although EOLC gamblers lived predominantly with partners, they reported the lowest level of familial and social support related to gambling problems. We could hypothesize that gambling had severe consequences on the family, as shown in the literature [54, 55], thus reducing the familial support.

The LOSC cluster (Cluster 3)

The LOSC cluster shares similarities with the pathway "emotionally vulnerable problem gamblers"(EV) [15, 25, 26]. This cluster presented premorbid anxiety and/or depression: 56.0% had a lifetime history of mood disorder, with 29.5% experiencing a current suicide risk, which are the highest percentages of our sample. This cluster was also notable for the lowest frequency of seeking treatment. Suicide risk is one of the main dramatic consequences of gambling [53], and suicidal thoughts can lead to giving up gambling and accepting treatment. This course of gambling characteristic could support the hypothesis that participation in gambling is motivated by desire on the part of gamblers to modulate their emotional distress and their negative feelings [15]. The LOSC gamblers predominantly preferred pure chance games. Different studies have shown that gamblers who preferred slot machines had higher levels of depression [24, 56].

We can underline two noticeable points in our LOSC cluster. First, in the LOSC cluster women were in the majority (62.5%), and in this cluster the course of gambling was the shortest observed in our study. These results support the concept of a "telescoping effect" in the course of problem gambling among women [57-59]. In the literature, this effect was indicated by female gamblers seeking treatment [60, 61], but it was not confirmed in the general population [62]. In our study, we included a mixed population of gamblers (NPG, PGWT and PGST), and our sample also consisted of gamblers

who were somewhat older, (M=52 y. in LOSC cluster) in contrast to the Slustke sample [62].

Second, the LOSC gamblers had the highest mean age at gambling initiation but also the shortest gambling trajectory. As a consequence, we could conclude that the course of gambling and the risk of problem gambling were not systematically linked to an early age of onset, but maybe to a combination of psychopathological variables, age at initiation, gender vulnerabilities and type of gambling , as hypothesized in some studies [18, 19].

Strengths and weaknesses of the study

The study has several limitations, especially the relatively restricted amount of data collected. Characteristics related to the course of gambling (age at initiation, age at onset of gambling problems, etc.) and lifetime psychiatric disorders were assessed in a retrospective manner, they were self-reported , which could induce a recall bias. Moreover, we did not use DSM 5 criteria, and we did not analyze impulsivity and cognitive distortions in this population. Recruitment of patients was done at the moment of the legalization of online gambling in France (2010) , which limits generalization , as online gambling has since become widely available. However, the mixing of NPG and PG who have, or have not, sought treatment is one of the main strengths of our study. We also included gamblers recruited directly from gambling locations. This method gave us access to a broad spectrum of gambling activities. Finally, the sample size has rarely been achieved for studies with semi-structured interviews (studies with such high numbers of participants are generally based on telephone-based surveys).

Implications for clinicians and policymakers

It is important to consider gambling characteristics because preventive interventions or policy measures may reduce the risk of problem gambling or minimize harm from gambling [8]. We defined a clustering of gamblers through the analysis of variables which were easy to identify, either by

psychiatrists or by physicians in primary care: gambling characteristics, age at gambling initiation, type of gambling and gambling medium, duration of gambling activities, age at onset of psychiatric comorbidities, history of gambling-free periods of at least one month's duration. We could hypothesize that simple pointers concerning these gambling characteristics could be constructed to prevent PG and to help PG identification.

Prevention interventions should be tailored to these at-risk profiles. We demonstrated that a large majority of gamblers in this sample started to gamble before the legal age of 18 years. For the gambling prevention policy, it is worth noting that, despite the ban on gambling under 18 years of age, minors are able to gamble very early. We stress the need to develop early interventions to provide information and prevent gambling, especially among adolescents. Prevention programs could include targeted interventions for youth to explain gambling risks and how to avoid them. One explanation for the vulnerability of youth may be gambling advertising and availability. Gambling marketing is present in many media (advertising posters, the Internet, magazines, television, etc.) that are accessible to adolescents, and the content is very attractive. A recent study showed that marketing significantly influences attitudes towards gambling, behaviors and intention to participate [63].

We also should pay attention to the type of gambling and the medium used for gambling. In our study, strategic games and Internet gambling seemed to be associated with more serious gambling profiles and short courses of gambling development in younger men. Targeted prevention on the Internet, especially regarding strategic games, could be developed to reduce harm from gambling. On the contrary, a large majority of the LOSC cluster preferred to gamble in pure chance games offline. Unlike casino or Internet games, pure chance offline games (especially scratch games) in France do not include any self-exclusion programs, and identity controls are not systematic when a ban is in place. As a consequence, French gamblers, with gambling problems, participating in pure chance games offline, are less able to put in place safeguards that may help them to quit or reduce

gambling. This point is a public health concern, particularly when we consider, as in our study, that gambling problems occur in vulnerable persons. These results raise questions about the need for governments to develop policies and regulations to reduce young people's exposure to gambling products and marketing and to protect vulnerable persons from harm caused by gambling.

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Figure 1. Clustering : 3 clusters and significant variables and covariables

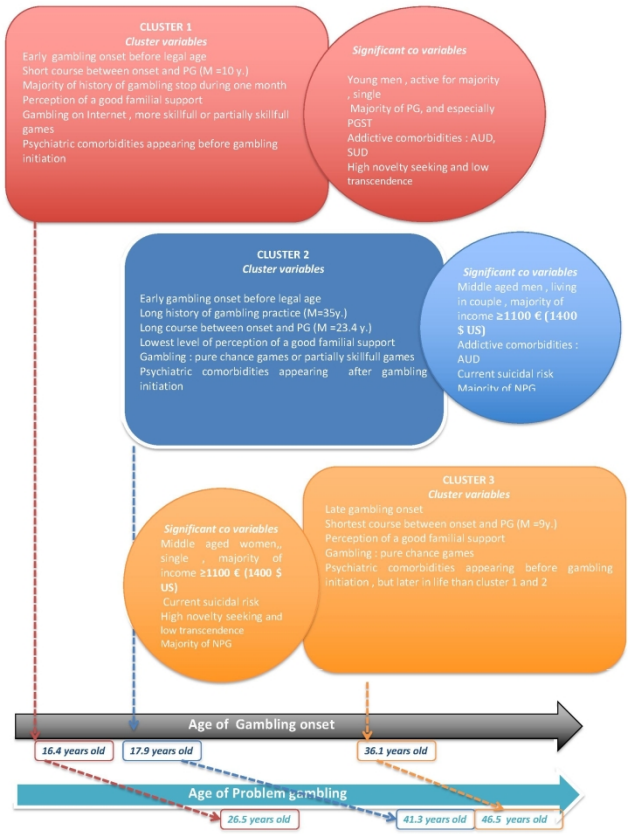

figure 1 . clustering : 3 clusteres and significant variables and covariables

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Problem and non-problem gamblers: A prospective cross-sectional clustering study by gambling characteristics

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MGB and GCB declare that the University Hospital of Nantes has received funding from the gambling industry (FDJ and PMU) in the form of a sponsorship that supports the gambling section of the BALANCED Unit (Reference Centre for Excessive Gambling). Scientific independence towards gambling industry operators is warranted. There were no constraints on publishing.

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All the other authors declare that they have no conflicts of interest.

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Statement 1: Role of funding sources

The JEU cohort study was supported by joint support of the French Inter-Departmental Mission for the Fight against Drugs and Drug Addiction (MILDT) and the French National Institute of Health and Medical Research (INSERM), as part of the call for research projects launched by these two organisations in 2007 [MIL08010], and a grant from the French Ministry of Health [PHRC 2009 – RCB 2008-A01188-47]. They had no role in the study design, collection, analysis, or interpretation of the data, writing of the manuscript, or decision to submit the paper for publication.

The research presented here was conducted at the initiative of and coordinated by the Addictology and Psychiatry Department of Nantes University Hospital. Nantes University Hospital is the sponsor of this study. There were no constraints on publishing.

Statement 2: Authors' contributions:

MGB and GCB designed the JEU cohort study, conducted the literature search, and wrote the

protocol. MGB and GCB were responsible for project management. BP provided methodological advice, designed the statistical analysis plan, and conducted the statistical analysis for this research. All authors (including those mentioned in the JEU Group) contributed to the recruitment and inclusion of the participants in the JEU cohort study and to the development of the protocol, especially to the selection of the assessment content. MGL, MGB, and GCB wrote the manuscript. All authors read and approved the final manuscript.

Statement 4: Acknowledgements

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Statement 5 : Data availability

No additional data available

ABSTRACT

Objectives

Gambling characteristics are factors that could influence problem gambling development. The aim of this study was to identify a typology of gamblers to frame risky behaviour based on gambling characteristics (age of initiation, age of problem gambling, type of gambling: pure chance/chance with pseudoskills/chance with elements of skill, media of gambling: online/offline, amount wagered monthly) and to investigate clinical factors associated with these different profiles in a large representative sample of gamblers.

Design and setting

The study is a cross-sectional analysis to the baseline data of the french JEU cohort study (study protocol of the JEU cohort: Challet-Bouju et al., 2014). Recruitment between April 2009 and September 2011 involved clinicians and researchers from seven institutions that offer care for or conduct research on PG. Participants were recruited in gambling places, and in care centres. Only participants who reported gambling in the previous year between 18 and 65 years old were included.

Participants gave their written informed consent, it was approved by the French Research Ethics Committee.

Participants

The participants were 628 gamblers : 256 non-problem gamblers (NPG), 169 problem gamblers without treatment (PGWT), and 203 problem gamblers seeking treatment (PGST).

Results

We identified three clusters with significant differences in the development of their gambling: 'Early Onset and Short Course' (47.5%), 'Early Onset and Long Course' (35%), and 'Late Onset and Short Course' (17.5%). Gambling characteristics differed significantly between the three clusters.

Conclusions

We defined clusters through the analysis of gambling variables , easy to identify, either by psychiatrists or by physicians in primary care. Simple pointers concerning these gambling characteristics could be constructed to prevent PG and to help PG identification. It is also important to consider gambling characteristics because policy measures targeting gambling characteristics may reduce the risk of problem gambling or minimise harm from gambling.

Key words

Gambling disorder, long term course, addictive behaviours, addiction

Clinical Trial Registration: NCT01207674 (ClinicalTrials.gov)

Strengths and limitations of this study

- The sample size of gamblers (*N* = 628) has rarely been achieved for studies with semi-structured interviews.

-The mixed sample of NPGs and PGs who have or have not sought treatment is one of the main strengths of our study, with inclusion directly from gambling locations.

- Recruitment of patients was performed at the moment of the legalisation of online gambling in France, which limits generalisation, as online gambling has since become widely available.

- Risk factors are self-reported at baseline evaluation. In future studies, these results should be compared to longitudinal data.

1. INTRODUCTION

Gambling is a widespread social activity worldwide. Almost all national surveys conclude that there are more gamblers than non-gamblers [1]. For example, 74% of the general population in France had gambled in their lifetime [2]. The gambling industry has developed many types of gambling on different media, especially on the Internet. This expansion of legalised gambling has been identified as a public health concern [3-5]. Participation in gambling increases with gambling deregulation, prolific advertising, and the growing availability of gambling [6, 7].

Social gambling may become a gambling disorder (GD) in a minority of cases [7, 8]. GD is defined as a persistent, maladaptive pattern of gambling resulting in clinically significant impairment or distress, according to the Fifth Edition of the *Diagnostic and Statistical Manual of Mental Disorders* [9]. Around the world, between 0.2% and 2.1% of the population develops a GD [10], but a larger proportion experiences 'problem gambling', meaning having difficulties with gambling, but not as severe as those classified as GD [10]. Throughout this paper, 'problem gamblers' or 'problem gambling' will refer to a heterogeneous group of persons or conditions encompassing GD and its subthreshold symptoms. The lifetime prevalence of problem gambling across the world ranges from 0.7% to 6.5% [1]. In France, the last national survey estimated that 2.7% of the population could be considered problem gamblers [2].

The status of the problem gambler is unstable over time [11], and gamblers can have very different types of problem gambling development. Different factors—individual, environmental, or those linked to gambling behaviour characteristics—may influence gambling status and the development of problem gambling [1].

Most of the studies of problem gambling risk factors have focused on individual or environmental factors. Problem gambling is more likely to occur among men [1, 2, 11, 12], individuals with psychiatric disorders (anxiety, depression, and Attention Deficit/Hyperactivity Disorder [ADHD]) [11], or individuals of extreme old or young age [13-16]. Environmental factors such as level of income, socio-economic integration, or social support have an influence both on problem gambling prevalence worldwide and on individual gambling development and transitions between social gambling and problem gambling [1, 8, 11]. Different clusters of problem gamblers emerged through the analysis of these clinical variables [17-21]. Blaszczynski and Nower defined a theoretical pathway model of problem gambling [17]. They identified three clusters of problem gamblers (conditioned gamblers, emotionally vulnerable gamblers, and antisocial impulsivist gamblers) based mainly on clinical experience with problem gamblers and through analysis of psychopathological variables. They assumed that certain clinical variables, such as psychiatric comorbidities or impulsivity, could influence the development of problem gambling. Several empirical studies of this pathways model

and other subtyping approaches confirmed clinical differences between problem gamblers' profiles, even though no study has conclusively supported this clinical classification and the underlying prognosis hypotheses [18-21]. In all these studies, clustering was made through analysis of psychopathological variables measured with psychometrics tools and did not include gambling characteristics.

Only a few studies have analysed gambling characteristics and their influence on gambling status (social gambling or problem gambling) and problem gambling development [7, 12, 21-26]. Gambling characteristics include many variables: age of initiation, medium or type of gambling, gambling history, wagering amounts, frequency of gambling, gambling status (problem or non-problem gamblers), etc. An early age of initiation is a high risk factor for the development of problem gambling later in life and is associated with a higher level of problem gambling severity [21-23]. Online gambling contributes to and enhances the risk of problem gambling development [6, 12], even if most online gamblers also gamble in offline forms [12, 24]. When considering preferred gambling activity, gamblers who preferentially play the same type of games share a common profile independent of the pathological characteristics [25]. Hing *et al.* compared the profiles of online gamblers according to their preferred type of gambling (electronic gaming machine (EGM), horse racing, or sport betting); they showed that online bettors were younger men, with more frequent substance use [7].

All these previous studies were, in a large majority of cases, undertaken within the problem gambling population [19-21, 27-29]. They analysed one specific gambling characteristic or defined clustering according to psychological variables and psychometric or cognitive assessment tests [19, 27, 29-31]. Combined with individual at-risk factors as psychopathological variables, clinicians should be aware of gambling characteristics.

We hypothesised that gambling structural characteristics influenced gamblers' profiles and problem gambling development, that clustering through gambling characteristics would help to identify different types of problem gamblers, and that this classification would be clinically pertinent.

We did not find any studies in the literature which involved a broad sample of gamblers, included non-problem and problem gamblers, and specifically concerned gambling characteristics.

Our objective was to identify a typology of gamblers based on clinical and gambling characteristics, and to investigate factors associated with these different profiles in a large representative sample of gamblers.

The findings can help all clinicians, even non-specialists, to be aware of and identify at-risk problem gamblers through the evaluation of gambling characteristics. It may also improve at-risk gambler interventions tailored to the specific gambling characteristics.

2. MATERIAL AND METHODS

2.1. Participants

The participants were 628 gamblers who took part in the JEU cohort study. The sample included 256 non-problem gamblers (NPG), 169 problem gamblers without treatment (PGWT), and 203 problem gamblers seeking treatment (PGST). The JEU cohort study is a 5-year longitudinal national case-control cohort in France that seeks to identify protective and risk factors in gambling practice (for more information, please refer to the study protocol of the JEU cohort: Challet-Bouju et al., 2014 [32]). The present study applied a cross sectional analysis to the baseline data of the JEU cohort.

Recruitment occurred between April 2009 and September 2011 and involved a group of French clinicians and researchers from seven institutions that offer care for or conduct research on pathological gambling.

The sample was constituted based on an approximate equality of size between problem and non-problem gamblers because of the low prevalence of gambling problems in the general population. Participants were recruited in different gambling places (casinos, cafés, smoke shops, etc.) and via the press in order to cover the broadest possible range of gambling activities. In gambling places, all the gamblers were solicited outside of gambling time, because gamblers are particularly irritable when gambling and in order to avoid disturbing the gambling venue activity. We have no information about non-responders as a consequence of the arrangements with the gambling places which agreed to help us, whereby we sought no information from gamblers who refused to participate in the first instance. Problem gamblers were also recruited in seven care centres, where they had started treatment less than 6 months before. Only participants who reported gambling on at least one occasion in the previous year and who were between 18 and 65 years old were included in the study. Participants were given a compensation of €15, except for problem gamblers from care centres with whom the interview would have been held for care purposes anyway.

Inclusion and exclusion criteria are presented in Table 1.

Inclusion criteria	Exclusion criteria
Participants who reported gambling on at least one occasion in the previous year	No gambling in the past year
Between 18 and 65 years old	Under 18 or over 65 years old
Understanding of French language	Cognitive impairment
Written consent	Inability to understand the French language
	No consent

Table 1. Inclusion and exclusion criteria

2.2. Ethical approval

Participants were informed about the research and gave their written informed consent prior to their inclusion in the study. This study was approved by the French Research Ethics Committee (CPP) on January 8, 2009. The approval granted from the CPP applies to all sites at which the study occurred.

Participants gave their written informed consent prior to their inclusion in the study. This study was approved by the French Research Ethics Committee.

Patient and public involvement

No patients nor the public were involved in the development of the research question. No patient advisers were included in the research project.

2.3. Assessment

The baseline assessment was performed just after inclusion in the study. The assessment combines a clinical structured interview carried out with a trained researcher or psychologist with a set of standardised self-report questionnaires. Participants completed the baseline interview in the research centre or the gambling place in which they were recruited.

2.3.1. Sociodemographic characteristics

We collected information about age, gender, marital status, income, and work status.

2.3.2. Gambling characteristics

Pathological gambling section in the DSM-IV TR (APA 1994)

We used a clinical interview based on the 10 diagnostic criteria for pathological gambling according to the DSM-IV TR (APA, 2000). The gambling disorder section of the DSM-5 could not have been used because the recruitment was conducted in 2009–2011. Gamblers who met at least three DSM-IV criteria were classified as problem gamblers, including both gamblers "at risk" of pathological gambling and gamblers with a diagnosis of pathological gambling. We used a non-standard threshold of three instead of five so as to include subclinical forms of pathological gambling. Previous literature has supported the relevance of this categorisation [33-35]. The number of positive DSM-IV criteria for pathological gambling was also used as a dimensional score of PG severity.

Problem gambling development and characteristics

We constructed a questionnaire to collect information concerning the course and characteristics of their gambling. The development of the gambling was approached by investigating the history of their gambling practice: age at initiation and of first gambling-related problems, duration of gambling history (from age at initiation to current age), and age at the time of the diagnosis of comorbid

psychiatric disorders (if relevant). We collected information about the familial and social support attitudes towards the problem gambler's difficulties. The individual's experimentation with a gambling-free period of at least one month's duration since his/her initiation was also investigated.

We collected information on participation in and frequency of various forms of gambling over the past year. This included the mean average amount of money wagered monthly in gambling and the maximum wager placed in a single day. With regard to gambling preferences, we investigated the preferred type of gambling and medium for gambling , presented in Table 2. Gamblers identified their preferred gambling activity among all those they had experienced and we classified the preferred type of gambling according to the three categories proposed by Boutin in 2010: pure chance games (lotteries, slot machines, scratch cards, video lottery terminals, etc.), bank games with an element of skill (sports betting, horserace betting, blackjack), or social games with skill (mainly Texas Hold'em and Omaha variants of poker) [36]. We also asked them to specify if they preferred gambling on the Internet or offline.

Type of gambling	Pure chance games (video lottery terminals, scratch games, lotteries) Chance games with pseudoskills (sport and horse betting, blackjack) Chances games with element of skills (poker)
Medium of gambling	Online: gambling on the Internet Offline: smoke shop, café, casino, etc.
Gambling status	Non-problem gambler (NPG) Problem gambler seeking treatment (PGST) Problem gambler without treatment (PGWT)

Table 2. Types and media of gambling and gambling status

2.3.3. Psychiatric comorbidities

Mini International Neuropsychiatric Interview (MINI)

The MINI is a structured diagnostic interview that is compatible with the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10), and the Diagnostic and *Statistical Manual of Mental Disorders*, Fourth Edition (DSM-IV) **[37]**.
It explores the lifetime and current main Axis I disorders (mood and anxiety disorders, psychotic syndrome, alcohol and substance use disorders).

Wender-Utah Rating Scale-Child (WURS-C)

This self-report questionnaire has been validated for the retrospective evaluation of childhood ADHD in adults. Its specificity (89.1%) is good. It is designed to assess ADHD symptoms represented by 25 items on a 5-point Likert scale. A score greater than or equal to 46/100 would indicate that diagnosis [38, 39].

2.3.4. Personality

A 125-item version of the Temperament and Character Inventory (TCI-125)

The TCI-125 is used to rapidly explore the four dimensions of temperament and the three dimensions of character in personality as defined by Cloninger's psychobiological model [40]. It measures seven dimensions through four temperaments and three characters [41, 42]. The dimensions related to temperament (genetic and stable tendencies of personality) and the dimensions related to character (acquired under the influence of apprenticeship, experience, and environment) were assessed.

2.4. Statistical analysis

A descriptive analysis of the sociodemographic, clinical, and gambling characteristics was carried out in order to obtain means, medians, and standard deviations of continuous variables, as well as the number of people and the percentages of categorical variables.

To identify a typology of gamblers based on the course of their gambling and their preferences, we led an exploratory analysis. We performed a clustering of gamblers with eight variables: age at initiation, age at onset of gambling problem, duration of gambling history, age at diagnosis of comorbid psychiatric disorder, history of a gambling-free period of at least one month's duration, familial and social support, and preferred type of gambling and medium for gambling. We used the Latent Gold software [43, 44] to perform a latent class clustering (LCC) of the gamblers. LCC is a person-centred approach that seeks to identify homogenous subgroups, each group being defined by a specific probability distribution. LCC has been found to be more likely to give superior classification results than more traditional methods such as *k*-means or hierarchical clustering [45], particularly

because it requires fewer assumptions. Moreover, LCC can handle mixed-mode data (i.e., both categorical and continuous variables) without transformation of variables. We ran models that comprised 1 to 6 clusters. Missing data were supposed missing at random because these missing data were considered independent of the values of the variable but dependent on another variable (e.g., missing values for age at onset of gambling problems were independent of the variable of age at onset of gambling problems, and depended instead on whether or not the participant had ever had gambling problems at all). Missing data were handled with full information maximum likelihood (FIML) estimation. FIML consists of estimating a likelihood function for each individual based on the data that are not missing so that all the available data are used. The Bayesian information criterion (BIC) (a lower BIC indicating a better model) and the classification error rate (which represents the precision of individuals' classification) were used to select the best model. Statistical differences between clusters were assessed by Wald tests. Variables that do not influence the estimation of the model were included as covariates to describe and compare the clusters. For these inactive covariates, a three-step approach [46] was used to test differences between clusters.

3. RESULTS

3.1. Descriptive analysis

The sample comprised 256 NPGs, 169 PGWTs, and 203 PGSTs. The sociodemographic data of the whole sample (*N* = 628) are detailed in Table 3. Participants were mainly men (*N* = 418, 66.6%), and the mean age was 43.4 years (*SD* = 12.9). Most participants were employed, with a regular income higher than €1,100 (i.e., approximately 1,400 USD).

	N	**%**
Gender		
Male	418	66.6
Female	210	33.4
Marital status		
Single	313	49.9
In a relationship	314	50.1
Educational level		
Below high school graduation	306	48.9
Higher than or equal to high school graduation	320	51 .1
Professional activity		

Working	398	63.5	
Not working	229		36.5
Level of income			
Regular and higher than the French minimum wage (approximately €1100 or 1400 USD)	440	70.1	
Others	188	29.9	
	M	***SD***	
Age	43.4	12.9	

Table 3. Descriptive analysis of sociodemographic variables for the whole sample

3.2. Clustering

Gambling characteristics were used for clustering : age at gambling initiation, age at problem gambling onset, duration of gambling history , age at diagnosis of first psychiatric comorbidities (if relevant, History of gambling-free period of at least one month, Familial and social support related to gambling problems, preferred type of gambling, preferred medium of gambling) , Among the six models tested, two were very similar in terms of the BIC indicator: a model with three clusters (BIC = 18253.8) and another with four clusters (BIC = 18252.6). Of these two models, the one with three clusters displayed a lower classification error rate (7.92% vs 13.80% for the four-cluster solution) and was better suited to clinical interpretation. We thus chose the three-cluster partition.

Clinical, socio-professional, psychological variables, and gambling characteristics of the three clusters are presented in Table 4.

	Cluster 1 EOSC	Cluster 2 EOLC	Cluster 3 LOSC	*P*-value, Wald test
Cluster size %, *N*	47.5 (298)	35.0 (220)	17.5 (110)	
VARIABLES INCLUDED IN THE CLUSTERING ANALYSIS				
Age at gambling initiation (yrs)	16.4	17.9	36.1	< 0.001
Age at onset of problem gambling (yrs)	26.5	41.3	45.1	< 0.001
Duration of gambling history (yrs)	16.2	35.4	16.2	< 0.001
Age at diagnosis of the first psychiatric comorbidities (*if relevant*) (yrs)	15.3	23.7	26.5	< 0.001
History of gambling-free period of at least one month (%)	71.0	53.6	58.3	0.001
Familial and social support related to gambling problems (%)	92.6	84.3	92.5	0.018
Preferred type of gambling				< 0.001
Pure chance games (lotteries, slots, scratch cards, video lottery terminals, etc.)	48.2	58.2	79.8	
Bank games with an element of skill (sports betting, horserace betting, blackjack)	30.8	36.1	16.9	
Social games with skill (Texas Hold'em and Omaha variants of poker)	21.0	5.7	3.4	
Preferred gambling medium (on the Internet)	20.0	8.1	2.3	< 0.001

CO-VARIABLES (Not included in clustering)				
Sociodemographic characteristics				
Gender (%)				
Women	23.5	32.4	62.5	< 0.001
Men	76.5	67.6	37.5	
Age (yrs)	32.7	53.4	52.3	< 0.001
Level of income ≥ €1100 (1400 USD) (%)	67.2	72.8	72.4	0.250
Marital status (single) (%)	55.4	38.7	57.0	< 0.001
Employment status (active) (%)	73.0	56.0	52.0	< 0.001
Gambling severity				
Gambling status (%)				
Non-problem gamblers (NPG)	48.1	51.6	55.7	0.020
Problem gamblers without treatment (PGWT)	16.8	23.0	21.3	
Problem gamblers seeking treatment (PGST)	35.2	25.4	23.0	
Number of DSM-IV criteria (mean)	3.8	3.7	3.3	0.200
Gambling habits:				
Amount wagered monthly in gambling (in euros)	592 .4	632.5	512.3	0.560
Gambling frequency over the past 12 months (%)				0.067
Less than once a month	8.2	6.9	8.6	
More than once a month	17.6	12.9	19.2	
Once a week	13.2	14.6	20.6	
More than once a week	61.0	65.7	51.6	
Comorbid psychiatric disorders				
Mood disorders (%)	46.1	45.5	56.0	0.110

Depressive episode (%)	40.2	41.7	48.6	0.260
Hypomanic or manic episode (%)	13.6	9.2	12.9	0.240
Anxiety disorders (%)	38.2	36.4	40.0	0.780
Panic disorder (with or without agoraphobia)	18.4	21.4	25.4	0.220
Social phobia	11.7	8.4	15.9	0.082
Obsessive Compulsive disorder	3.8	2.5	1.0	0.360
Generalised Anxiety Disorder	17.4	12.0	11.7	0.08
Post-Traumatic Stress Disorder	7.2	6.3	9.7	0.490
Addictive disorders (%)	42.7	32.8	19.8	< 0.001
Alcohol Use Disorder	28.7	27.0	13.7	0.007
Substance Use Disorder	25.5	10.1	6.1	< 0.001
Antisocial personality disorder (%)	5.5	3.3	1.1	0.220
Current suicide risk (%)	19.4	26.7	29.5	0.027
Lifetime suicide attempts (%)	11.4	18.2	15.4	0.055
ADHD	31.7			
WURS score (M)		28.7	28.3	0.096
Personality				
TCI scores (M)	54 .9	51.5	48.6	0.001
Novelty Seeking (NS)	43.7	44.7	42.8	0.730
Harm Avoidance (HA)	67.8	67.0	68.7	0.720
Determination (D)	73.6	73.5	75.6	0.450
Cooperation (C)	60.8	59.1	60.7	0.460
Reward Dependence (RD)	27.7	33.8	36.7	< 0.001
Transcendence (T)	52.8	55.9	59.2	0.069
Persistence (P)				

Table 4. Profiles of the three clusters identified

We identified three clusters with significant differences among the courses of gambling. Figure 1 represents the **three clusters** and the **significant variables and covariables**.

The Early Onset and Short Course (EOSC) cluster (47.5%)

This group was predominantly represented by young men (76.5% men, mean age 32.7). This group was more active than the others (73.0% were active), and more than half were single (55.4%). This cluster has the lowest onset age (16.4 years old) and the earliest beginning of problem gambling (26.5 years old). Problem gambling thus appeared approximately 10 years after gambling initiation. Moreover, psychiatric comorbidities appeared earlier in life (15.3 years). Nearly half of this cluster (46.1%) had a history of mood disorders, with the highest frequency of lifetime hypomanic or manic episodes (13.6%). This cluster had significantly the highest level of Novelty Seeking (*M* = 54.9). Addictive comorbidities were also more prevalent in this group, with 28.7% and 25.5%, respectively, reporting an alcohol use disorder and a substance use disorder. This group was the only one with a majority of PG (52%) and had the highest proportion of PGST (35.2%). Seventy-one percent had already experienced at least one month without gambling, which was significantly higher than in other groups. For the two other clusters, the favourite type of gambling was predominantly pure chance games (48.2%). However, contrariwise, a majority of these gamblers identified strategic games (regrouping bank games with an element of skill and social games with skill) as their preferred gambling type (51.8%). Moreover, 20% preferred gambling on the Internet, a higher proportion than in the other clusters.

The Early Onset and Long Course (EOLC) cluster (35.0%)

This group was also predominantly constituted by men (67.6%), but was older than in the EOSC cluster (*M* = 53.4 years old). The majority lived with a partner (61.3%), contrary to the two other clusters, even though they were those who reported the lowest frequency of familial support (84.3%). The mean gambling onset age was 17.9 years. Problem gambling in problem gamblers

appeared 23.4 years after gambling initiation, and the mean duration of the gambling practice at the moment of the inclusion was 35.4 years, which was more than twice the length for the two other clusters. 45.5% presented mood disorders and 36.4% anxiety disorders. Alcohol use disorders were quite prevalent in this cluster (27.0%). Psychiatric comorbidities appeared late in life, with the mean age of the first diagnosis of psychiatric comorbidity being 23.7 years, much older than the mean age of gambling initiation. They had the highest prevalence of suicidal attempts (18.2%) and a higher frequency of current suicidal risk than the EOSC cluster (26.7%). They had the lowest prevalence of gamblers having experienced a gambling cessation for at least one month (53.6%). The majority (51.6%) of this cluster was NPG, and the proportion of PGWT was the highest in this group (23.0%). This group had the highest proportion of bank games with an element of skill as the preferred gambling type (36.1%). Slightly less than 10% preferred Internet gambling.

The Late Onset and Short Course (LOSC) cluster (17.5%)

This group was the only one predominantly constituted by women (62.5%), with a mean age of 52.3 years old. However, the majority lived alone (57.0%), and this cluster had the lowest prevalence of active employment (52.0%). The mean age of gambling initiation was 36.1 years old, significantly older than the other two groups. However, the gambling course between the mean age of initiation and the mean age of problem gambling was the shortest among the whole sample: 9 years. Psychiatric comorbidities were more prevalent in this group; 56.0% had a history of mood disorders, especially a high prevalence of lifetime depressive disorder (48.6%). 29.5% reported a current suicidal risk, more than the two other groups. Psychiatric comorbidities appeared later in life. Indeed, the mean age of the first diagnosis of psychiatric comorbidity was 26.5 years old. The frequency of addictive disorders was the lowest in this group (19.8%). They displayed significantly the highest personality scores for transcendence (M = 36.7). In this cluster, the frequency of NPG was the highest (55.7%), and the problem gamblers were equally either seeking treatment (23.0%) or not (21.3%). The preferred type of gambling was predominantly pure chance games for 79.8% of the cluster, and only 2.3% preferred Internet gambling.

FIGURE 1.

4. DISCUSSION

4.1. Main findings

4.1.1. Three different profiles of gamblers

Three distinct clinical profiles of gamblers were identified through the analysis of gambling characteristics. Differences in the course and characteristics of gambling corresponded to psychopathological profiles, and they were significant in terms of socio-demographic variables (gender, age, work, and marital status) and also in terms of gambling status and some comorbidities (addictive disorders, hypomanic episodes, and personality traits). We propose a classification of our clusters according to gambling characteristics: Early Onset and Short Course (EOSC) (Cluster 1), Early Onset and Long Course (EOLC) (Cluster 2), and Late Onset and Short Course (Cluster 3). Regarding significant clinical and psychopathological covariables, this three-cluster model defined through the analysis of gambling characteristics is partly comparable to the theoretical pathways model of Blaszczynski and Nower [17], which was in turn defined through psychopathological variables.

The Early Onset and Short Course cluster (Cluster 1-EOSC)

The mean age at gambling initiation is under 18 years, which is the legal age for gambling in France. Lynch *et al*. found that young adults who had started gambling prior to the age of 18 were more likely to experience at least one symptom of GD than those who started gambling at the age of 18 or later [47]. Early initiation is described as a marker of risk of GD in later life: Kessler *et al*. (2008) found that the mean age at the onset of gambling was significantly lower among those who subsequently developed pathological gambling than among those who did not [48, 49], and Jimenez et al. identified a younger age at the onset of gambling as associated with a greater severity of pathological gambling. Our results agreed with this hypothesis: the EOSC group had a higher frequency of problem gambling and higher gambling severity than the two other groups. Nevertheless, age at initiation did not explain the course of gambling in itself: the two clusters associated with the earlier age at onset presented two different courses of gambling, either a short development (approximately 10 years) for the EOSC cluster or a long development (approximately 23 years) for the EOLC cluster.

This cluster had a significantly higher preference for online gambling than the others. Gambling on the Internet is associated with a high availability of gambling opportunity, and online poker induces specific problems, leading problem gamblers to lose money but also to spend a large amount of time gambling [50]. Moreover, involvement in gambling and attraction to strategic games are risk factors for problem gambling [51]. Male Internet bettors face heightened risks of related gambling problems [52]. Mirroring the comments made above regarding EGM players, much may depend on the patterns of use exhibited by online sports betters. For example, if online betting is done sporadically in a social context (e.g., watching a game together), then online play may represent no extra risk over venue-based play. On the other hand, if online sports betting facilitates different patterns of use

(e.g., solitary betting in extended sessions late at night), then this would provide further evidence that the online product presents a greater risk. At the present time, concern appears to be justified, as young men in particular are increasingly seeking treatment for difficulties in controlling their online sports betting [53]

Strategic games usually attract young males, with an earlier onset of the disorder [54]. They tend to engage in more than one specific type of problematic game and to take more risks, including betting large amounts of money [54]. This cluster included the highest frequency of PG and the highest frequency of PGST, and they most frequently indicated the occurrence of gambling-free periods of one month, probably in an effort to regain control over gambling or in reaction to negative consequences.

The EOSC cluster presented the highest level of ADHD symptomatology. One may suppose that psychopathological variables combined with age at onset may influence the course of gambling, as defined in the pathways model [17]. Impulsivity is also a key point of the antisocial impulsivist pathway, defined by Blaszczynski and Nower as being associated with gambling-related criminal behaviours and addictive comorbidities [17]. Novelty seeking was also high in our study, as reported in the literature, especially in social games with skill [54, 55]. This was associated with a high prevalence of psychiatric and addictive comorbidities, as previously described for PG with impulsivity and ADHD [17, 56, 57].

EOLC cluster (Cluster 2)

The EOLC cluster had a long course of gambling (35.4 years). They spent the highest amount of money on gambling, and only 53.6% had experienced a gambling cessation for at least one month.

We found important results concerning familial support: although EOLC gamblers lived predominantly with partners, they reported the lowest level of familial and social support related to gambling problems. We hypothesise that gambling had severe consequences on the family, as shown in the literature [58, 59], thus reducing familial support.

An important characteristic is the absence of any lifetime premorbid feature of psychopathology before the onset of the gambling problem. We may hypothesise that symptoms of anxiety or depression were the consequences of problem-gambling-related difficulties. However, at inclusion, they presented the highest prevalence of attempted suicide (and a current suicide risk in 26.7% of cases). One can assume suicide risk and attempted suicides to be consequences of problem-gambling-related difficulties [60]. The EOLC cluster could share similarities with the first pathway, defined by Blaszczynski and Nower as ‘conditioned problem gamblers’ (CG). This CG group is defined

as gamblers without comorbidities who are preoccupied with gambling, engage in chasing, and fluctuate between excessive gambling and problem gambling.

The LOSC cluster (Cluster 3)

The LOSC gamblers predominantly preferred pure chance games. Different studies have shown that gamblers who preferred slot machines had higher levels of depression [25, 61].

We can underline two notable points in our LOSC cluster. First, women made up the majority of the LOSC cluster (62.5%), and in this cluster the course of gambling was the shortest observed in our study. These results support the concept of a 'telescoping effect' in the course of problem gambling among women [62-64]. In the literature, this effect was indicated by female gamblers seeking treatment [65, 66] but was not confirmed in the general population [67]. In our study, we included a mixed population of gamblers (NPG, PGWT, and PGST), and our sample also consisted of gamblers who were somewhat older (*M* = 52 years in the LOSC cluster) than in the Slustke sample [67].

Second, the LOSC gamblers had the highest mean age at gambling initiation but also the shortest gambling trajectory. As a consequence, we could conclude that the course of gambling and the risk of problem gambling were not systematically linked to an early age of onset, but perhaps to a combination of psychopathological variables, age at initiation, gender, and type of gambling, as hypothesised in some studies [20, 21].

This cluster presented premorbid anxiety and/or depression: 56.0% had a lifetime history of mood disorder, with 29.5% experiencing a current suicide risk, which are the highest percentages of our sample. This cluster was also notable for the lowest frequency of seeking treatment. Suicide risk is one of the main dramatic consequences of gambling [60], and suicidal thoughts can lead to giving up gambling and accepting treatment. This course of gambling characteristic could support the hypothesis that participation in gambling is motivated by desire on the part of gamblers to modulate their emotional distress and their negative feelings [17]. The LOSC cluster might share similarities with the pathway of 'emotionally vulnerable problem gamblers' (EV) [17, 27, 28].

4.2. Strengths and weaknesses of this study

This study has several limitations, especially the relatively restricted amount of data collected. Characteristics related to the course of gambling (age at initiation, age at onset of gambling problems, etc.) and lifetime psychiatric disorders were assessed in a retrospective manner and were self-reported, which could induce a recall bias. Moreover, we did not use DSM 5 criteria, and we did not analyse impulsivity and cognitive distortions in this population. Recruitment of patients occurred

at the moment of the legalisation of online gambling in France (2010), which limits generalisation, as online gambling has since become widely available. However, the combination of NPGs and PGs who have and who have not sought treatment is one of the main strengths of our study. We also included gamblers recruited directly from gambling locations. This method gave us access to a broad spectrum of gambling activities. Finally, this sample size has rarely been achieved by studies with semi-structured interviews (studies with such high numbers of participants are generally based on telephone-based surveys).

That study more accurately categorised profiles of gamblers and problem gamblers through gambling characteristics and course. It did not examine factors that increase the risk of transitioning from a non-problem gambler to a problem gambler, nor did it define vulnerability profiles associated with the emergence of problem gambling in a longitudinal study.

4.3. Implications for clinicians and policymakers

It is important to consider gambling characteristics because preventive interventions or policy measures may reduce the risk of problem gambling or minimise harm from gambling [7]. We defined a clustering of gamblers through the analysis of variables which were easy to identify by psychiatrists or physicians in primary care: gambling characteristics, age at gambling initiation, type of gambling and gambling medium, duration of gambling activities, age at onset of psychiatric comorbidities, and history of gambling-free periods of at least one month's duration. We hypothesise that simple pointers concerning these gambling characteristics could be constructed to prevent PG and to help PG identification.

Prevention interventions should be tailored to these at-risk profiles. The preceding results imply that interventions need to particularly target prevention at different profiles: young adult males gambling online in strategic games, for example, or middle-aged women gambling offline to hazardous games. Public health messages should be available online and offline which are adapted to these profiles. Clinical programmes could also be adapted to these specific profiles, for we may suppose that with respect to the respective cognitive distortions, motivational training would certainly differ between these profiles.

The gambling characteristics identified in this study as significantly different between the three clusters are easily identified but could also be target of specific intervention to reduce harm in gambling, especially in at-risk profiles.

We demonstrated that a large majority of gamblers in this sample started to **gamble before the legal age of 18 years**. For gambling prevention policy, it is worth noting that despite the ban on gambling under 18 years of age, minors can gamble very early. We stress the need to develop early interventions to provide information and prevent gambling, especially among adolescents. Prevention programmes could include targeted interventions for youth to explain gambling risks and how to avoid them. One explanation for the framing of risky gambling behaviour of youth may be gambling advertising and availability. Gambling marketing is present in many media (advertising posters, the Internet, magazines, television, etc.) that are accessible to adolescents, and its content is very attractive. A recent study showed that marketing significantly influences attitudes towards gambling, gambling behaviours, and intention to participate [68].

We also should pay attention to the **type of gambling and the medium used for gambling**. In our study, strategic games and Internet gambling seemed to be associated with more serious gambling profiles and short courses of gambling development in younger men. Targeted prevention on the Internet, especially regarding strategic games, could be developed to reduce harm from gambling. Contrariwise, a large majority of the LOSC cluster preferred to gamble in pure chance games offline. Unlike casino or Internet games, pure chance offline games (especially scratch games) in France do not include any self-exclusion programmes, and identity controls are not systematic when a ban is in place. Consequently, French gamblers with gambling problems participating in pure chance games offline are less able to put in place safeguards that may help them to quit or reduce gambling. This point is a public health concern, particularly when we consider, as in our study, that gambling problems occur in vulnerable persons. These results raise questions about the need for governments to develop policies and regulations to reduce young people's exposure to gambling products and marketing and to protect vulnerable persons from harm caused by gambling.

Caption : figure 1 . clustering : 3 clusters and significant variables and covariables

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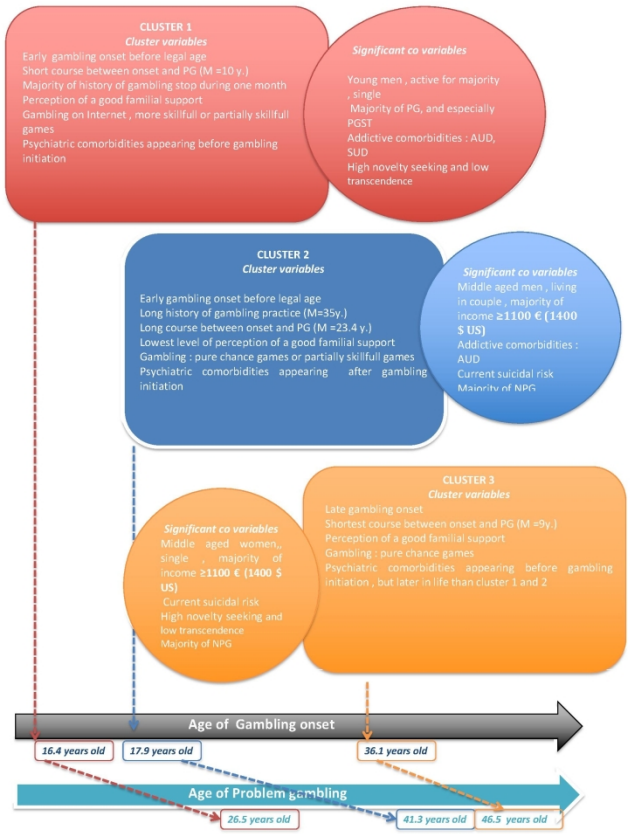
Figure 1. Clustering : 3 clusters and significant variables and covariables



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Problem and non-problem gamblers: A cross-sectional clustering study by gambling characteristics

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Statement 1: Role of funding sources

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The research presented here was conducted at the initiative of and coordinated by the Addictology and Psychiatry Department of Nantes University Hospital. Nantes University Hospital is the sponsor of this study. There were no constraints on publishing.

Statement 2: Authors' contributions:

MGB and GCB designed the JEU cohort study, conducted the literature search, and wrote the

protocol. MGB and GCB were responsible for project management. BP provided methodological advice, designed the statistical analysis plan, and conducted the statistical analysis for this research. All authors (including those mentioned in the JEU Group) contributed to the recruitment and inclusion of the participants in the JEU cohort study and to the development of the protocol, especially to the selection of the assessment content. MGL, MGB, and GCB wrote the manuscript. All authors read and approved the final manuscript.

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Statement 5 : Data availability

No additional data available

ABSTRACT

Objectives

Gambling characteristics are factors that could influence problem gambling development. The aim of this study was to identify a typology of gamblers to frame risky behaviour based on gambling characteristics (age of initiation/ of problem gambling, type of gambling: pure chance/chance with pseudoskills/chance with elements of skill, gambling online/offline, amount wagered monthly) and to investigate clinical factors associated with these different profiles in a large representative sample of gamblers.

Design and setting

The study is a cross-sectional analysis to the baseline data of the french JEU cohort study (study protocol : Challet-Bouju et al., 2014). Recruitment (April 2009 - September 2011) involved clinicians and researchers from seven institutions that offer care for or conduct research on PG. Participants were recruited in gambling places, and in care centres. Only participants who reported gambling in the previous year between 18 and 65 years old were included.

Participants gave their written informed consent, it was approved by the French Research Ethics Committee.

Participants

The participants were 628 gamblers : 256 non-problem gamblers (NPG), 169 problem gamblers without treatment (PGWT), and 203 problem gamblers seeking treatment (PGST).

Results

Six clustering models were tested, the one with three clusters displayed a lower classification error rate (7.92%) and was better suited to clinical interpretation : 'Early Onset and Short Course' (47.5%), 'Early Onset and Long Course' (35%), and 'Late Onset and Short Course' (17.5%). Gambling characteristics differed significantly between the three clusters.

Conclusions

We defined clusters through the analysis of gambling variables , easy to identify, by psychiatrists or by physicians in primary care. Simple screening concerning these gambling characteristics could be constructed to prevent and to help PG identification. It is important to consider gambling characteristics : policy measures targeting gambling characteristics may reduce the risk of PG or minimise harm from gambling.

Key words

Gambling disorder, long term course, addictive behaviours, addiction

Clinical Trial Registration: NCT01207674 (ClinicalTrials.gov)

Strengths and limitations of this study

- The sample size of gamblers (*N* = 628) has rarely been achieved for studies with semi-structured interviews.
-The mixed sample of NPGs and PGs who have or have not sought treatment is one of the main strengths of our study, with inclusion directly from gambling locations.
- Recruitment of patients was performed at the moment of the legalisation of online gambling in France, which limits generalisation, as online gambling has since become widely available.
- Risk factors are self-reported at baseline evaluation. In future studies, these results should be compared to longitudinal data.

1. INTRODUCTION

Gambling is a widespread social activity worldwide. Almost all national surveys conclude that there are more gamblers than non-gamblers [1]. For example, 74% of the general population in France had gambled in their lifetime [2]. The gambling industry has developed many types of gambling on different media, especially on the Internet. This expansion of legalised gambling has been identified as a public health concern [3-5]. Participation in gambling increases with gambling deregulation, prolific advertising, and the growing availability of gambling [6, 7].

Social gambling may become a gambling disorder (GD) in a minority of cases [7, 8]. GD is defined as a persistent, maladaptive pattern of gambling resulting in clinically significant impairment or distress, according to the Fifth Edition of the *Diagnostic and Statistical Manual of Mental Disorders* [9]. Around the world, between 0.2% and 2.1% of the population develops a GD [10], but a larger proportion experiences 'problem gambling', meaning having difficulties with gambling, but not as severe as those classified as GD [10]. Throughout this paper, 'problem gamblers' or 'problem gambling' will refer to a heterogeneous group of persons or conditions encompassing GD and its subthreshold symptoms. The lifetime prevalence of problem gambling across the world ranges from 0.7% to 6.5% [1]. In France, the last national survey estimated that 2.7% of the population could be considered problem gamblers [2].

The status of the problem gambler is unstable over time [11], and gamblers can have very different types of problem gambling development. Different factors—individual, environmental, or those linked to gambling behaviour characteristics—may influence gambling status and the development of problem gambling [1].

Most of the studies of problem gambling risk factors have focused on individual or environmental factors. Problem gambling is more likely to occur among men [1, 2, 11, 12], individuals with psychiatric disorders (anxiety, depression, and Attention Deficit/Hyperactivity Disorder [ADHD]) [11], or individuals of extreme old or young age [13-16]. Environmental factors such as level of income, socio-economic integration, or social support have an influence both on problem gambling prevalence worldwide and on individual gambling development and transitions between social gambling and problem gambling [1, 8, 11]. Different clusters of problem gamblers emerged through the analysis of these clinical variables [17-21]. Blaszczynski and Nower defined a theoretical pathway model of problem gambling [17]. They identified three clusters of problem gamblers (conditioned gamblers, emotionally vulnerable gamblers, and antisocial impulsivist gamblers) based mainly on clinical experience with problem gamblers and through analysis of psychopathological variables. They assumed that certain clinical variables, such as psychiatric comorbidities or impulsivity, could influence the development of problem gambling. Several empirical studies of this pathways model

and other subtyping approaches confirmed clinical differences between problem gamblers' profiles, even though no study has conclusively supported this clinical classification and the underlying prognosis hypotheses [18-21]. In all these studies, clustering was made through analysis of psychopathological variables measured with psychometrics tools and did not include gambling characteristics.

Only a few studies have analysed gambling characteristics and their influence on gambling status (social gambling or problem gambling) and problem gambling development [7, 12, 21-26]. Gambling characteristics include many variables: age of initiation, medium or type of gambling, gambling history, wagering amounts, frequency of gambling, gambling status (problem or non-problem gamblers), etc. An early age of initiation is a high risk factor for the development of problem gambling later in life and is associated with a higher level of problem gambling severity [21-23]. Online gambling contributes to and enhances the risk of problem gambling development [6, 12], even if most online gamblers also gamble in offline forms [12, 24]. When considering preferred gambling activity, gamblers who preferentially play the same type of games share a common profile independent of the pathological characteristics [25]. Hing *et al.* compared the profiles of online gamblers according to their preferred type of gambling (electronic gaming machine (EGM), horse racing, or sport betting); they showed that online bettors were younger men, with more frequent substance use [7].

All these previous studies were, in a large majority of cases, undertaken within the problem gambling population [19-21, 27-29]. They analysed one specific gambling characteristic or defined clustering according to psychological variables and psychometric or cognitive assessment tests [19, 27, 29-31]. Combined with individual at-risk factors as psychopathological variables, clinicians should be aware of gambling characteristics.

We hypothesised that gambling structural characteristics influenced gamblers' profiles and problem gambling development, that clustering through gambling characteristics would help to identify different types of problem gamblers, and that this classification would be clinically pertinent.

We did not find any studies in the literature which involved a broad sample of gamblers, included non-problem and problem gamblers, and specifically concerned gambling characteristics.

Our objective was to identify a typology of gamblers based on clinical and gambling characteristics, and to investigate factors associated with these different profiles in a large representative sample of gamblers.

The findings can help all clinicians, even non-specialists, to be aware of and identify problem gamblers through the evaluation of gambling characteristics. It may also improve gamblers interventions tailored to the specific gambling characteristics.

2. MATERIAL AND METHODS

2.1. Participants

The participants were 628 gamblers who took part in the JEU cohort study. The sample included 256 non-problem gamblers (NPG), 169 problem gamblers without treatment (PGWT), and 203 problem gamblers seeking treatment (PGST). The JEU cohort study is a 5-year longitudinal national case-control cohort in France that seeks to identify protective and risk factors in gambling practice (for more information, please refer to the study protocol of the JEU cohort: Challet-Bouju et al., 2014 [32]). The present study applied a cross sectional analysis to the baseline data of the JEU cohort.

Recruitment occurred between April 2009 and September 2011 and involved a group of French clinicians and researchers from seven institutions that offer care for or conduct research on problem gambling.

The sample was constituted based on an approximate equality of size between problem and non-problem gamblers because of the low prevalence of gambling problems in the general population. Participants were recruited in different gambling places (casinos, cafés, smoke shops, etc.) and via the press in order to cover the broadest possible range of gambling activities. In gambling places, all the gamblers were solicited outside of gambling time, because gamblers are particularly irritable when gambling and in order to avoid disturbing the gambling venue activity. We have no information about non-responders as a consequence of the arrangements with the gambling places which agreed to help us, whereby we sought no information from gamblers who refused to participate in the first instance. Problem gamblers were also recruited in seven care centres, where they had started treatment less than 6 months before. Only participants who reported gambling on at least one occasion in the previous year and who were between 18 and 65 years old were included in the study. Participants were given a compensation of €15, except for problem gamblers from care centres with whom the interview would have been held for care purposes anyway.

Inclusion and exclusion criteria are presented in Table 1.

Inclusion criteria	Exclusion criteria
Participants who reported gambling on at least one occasion in the previous year	No gambling in the past year
Between 18 and 65 years old	Under 18 or over 65 years old
Understanding of French language	Cognitive impairment
Written consent	Inability to understand the French language
	No consent

Table 1. Inclusion and exclusion criteria

2.2. Ethical approval

Participants were informed about the research and gave their written informed consent prior to their inclusion in the study. This study was approved by the French Research Ethics Committee (CPP) on January 8, 2009. The approval granted from the CPP applies to all sites at which the study occurred.

Patient and public involvement

No patients nor the public were involved in the development of the research question. No patient advisers were included in the research project.

2.3. Assessment

The baseline assessment was performed just after inclusion in the study. The assessment combines a clinical structured interview carried out with a trained researcher or psychologist with a set of standardised self-report questionnaires. Participants completed the baseline interview in the research centre or the gambling place in which they were recruited.

2.3.1. Sociodemographic characteristics

We collected information about age, gender, marital status, income, and work status.

2.3.2. Gambling characteristics

Pathological gambling section in the DSM-IV TR (APA 1994)

We used a clinical interview based on the 10 diagnostic criteria for pathological gambling according to the DSM-IV TR (APA, 2000). The gambling disorder section of the DSM-5 could not have been used because the recruitment was conducted in 2009–2011. Gamblers who met at least three DSM-IV criteria were classified as problem gamblers, including both gamblers "at risk" of pathological gambling and gamblers with a diagnosis of pathological gambling. We used a non-standard threshold of three instead of five so as to include subclinical forms of problem gambling. Previous literature has supported the relevance of this categorisation [33-35]. The number of positive DSM-IV criteria for problem gambling was also used as a dimensional score of PG severity.

Problem gambling development and characteristics

We constructed a questionnaire to collect information concerning the course and characteristics of their gambling. The development of the gambling was approached by investigating the history of their gambling practice: age at initiation and of first gambling-related problems, duration of gambling history (from age at initiation to current age), and age at the time of the diagnosis of comorbid psychiatric disorders (if relevant). We collected information about the familial and social support attitudes towards the problem gambler's difficulties. The individual's experimentation with a

gambling-free period of at least one month's duration since his/her initiation was also investigated.

We collected information on participation in and frequency of various forms of gambling over the past year. This included the mean average amount of money wagered monthly in gambling and the maximum wager placed in a single day. With regard to gambling preferences, we investigated the preferred type of gambling and medium for gambling , presented in Table 2. Gamblers identified their preferred gambling activity among all those they had experienced and we classified the preferred type of gambling according to the three categories proposed by Boutin in 2010: pure chance games (lotteries, slot machines, scratch cards, video lottery terminals, etc.), bank games with an element of skill (sports betting, horserace betting, blackjack), or social games with skill (mainly Texas Hold'em and Omaha variants of poker) [36]. We also asked them to specify if they preferred gambling on the Internet or offline.

Type of gambling	Pure chance games (video lottery terminals, scratch games, lotteries) Chance games with pseudoskills (sport and horse betting, blackjack) Chances games with element of skills (poker)
Medium of gambling	Online: gambling on the Internet Offline: smoke shop, café, casino, etc.
Gambling status	Non-problem gambler (NPG) Problem gambler seeking treatment (PGST) Problem gambler without treatment (PGWT)

Table 2. Types and media of gambling and gambling status

2.3.3. Psychiatric comorbidities

Mini International Neuropsychiatric Interview (MINI)

The MINI is a structured diagnostic interview that is compatible with the International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10), and the Diagnostic and *Statistical Manual of Mental Disorders*, Fourth Edition (DSM-IV) **[37]**.
It explores the lifetime and current main Axis I disorders (mood and anxiety disorders, psychotic syndrome, alcohol and substance use disorders).

Wender-Utah Rating Scale-Child (WURS-C)

This self-report questionnaire has been validated for the retrospective evaluation of childhood ADHD in adults. Its specificity (89.1%) is good. It is designed to assess ADHD symptoms represented by 25 items on a 5-point Likert scale. A score greater than or equal to 46/100 would indicate that diagnosis [38, 39].

2.3.4. Personality

A 125-item version of the Temperament and Character Inventory (TCI-125)

The TCI-125 is used to rapidly explore the four dimensions of temperament and the three dimensions of character in personality as defined by Cloninger's psychobiological model [40]. It measures seven dimensions through four temperaments and three characters [41, 42]. The dimensions related to temperament (genetic and stable tendencies of personality) and the dimensions related to character (acquired under the influence of apprenticeship, experience, and environment) were assessed.

2.4. Statistical analysis

A descriptive analysis of the sociodemographic, clinical, and gambling characteristics was carried out in order to obtain means, medians, and standard deviations of continuous variables, as well as the number of people and the percentages of categorical variables.

To identify a typology of gamblers based on the course of their gambling and their preferences, we led an exploratory analysis. We performed a clustering of gamblers with eight variables: age at initiation, age at onset of gambling problem, duration of gambling history, age at diagnosis of comorbid psychiatric disorder, history of a gambling-free period of at least one month's duration, familial and social support, and preferred type of gambling and medium for gambling. We used the Latent Gold software [43, 44] to perform a latent class clustering (LCC) of the gamblers. LCC is a person-centred approach that seeks to identify homogenous subgroups, each group being defined by a specific probability distribution. LCC has been found to be more likely to give superior classification results than more traditional methods such as *k*-means or hierarchical clustering [45], particularly

because it requires fewer assumptions. Moreover, LCC can handle mixed-mode data (i.e., both categorical and continuous variables) without transformation of variables. We ran models that comprised 1 to 6 clusters. Missing data were supposed missing at random because these missing data were considered independent of the values of the variable but dependent on another variable (e.g., missing values for age at onset of gambling problems were independent of the variable of age at onset of gambling problems, and depended instead on whether or not the participant had ever had gambling problems at all). Missing data were handled with full information maximum likelihood (FIML) estimation. FIML consists of estimating a likelihood function for each individual based on the data that are not missing so that all the available data are used. The Bayesian information criterion (BIC) (a lower BIC indicating a better model) and the classification error rate (which represents the precision of individuals' classification) were used to select the best model. Statistical differences between clusters were assessed by Wald tests. Variables that do not influence the estimation of the model were included as covariates to describe and compare the clusters. For these inactive covariates, a three-step approach was used to test differences between clusters. This method provides an unbiased estimation of the association between cluster-membership probabilities and external covariates by maximizing a weighted log-likelihood function for clustered data. [46]

3. RESULTS

3.1. Descriptive analysis

The sample comprised 256 NPGs, 169 PGWTs, and 203 PGSTs. The sociodemographic data of the whole sample (*N* = 628) are detailed in Table 3. Participants were mainly men (*N* = 418, 66.6%), and the mean age was 43.4 years (*SD* = 12.9). Most participants were employed, with a regular income higher than €1,100 (i.e., approximately 1,400 USD).

	N	**%**
Gender		
Male	418	66.6
Female	210	33.4
Marital status		
Single	313	49.9
In a relationship	314	50.1
Educational level		
Below high school graduation	306	48.9

Higher than or equal to high school graduation	320	51 .1
Professional activity		
Working	398	63.5
Not working	229	36.5
Level of income		
Regular and higher than the French minimum wage (approximately €1100 or 1400 USD)	440	70.1
Others	188	29.9
	M	***SD***
Age	43.4	12.9

Table 3. Descriptive analysis of sociodemographic variables for the whole sample

3.2. Clustering

Gambling characteristics were used for clustering : age at gambling initiation, age at problem gambling onset, duration of gambling history , age at diagnosis of first psychiatric comorbidities (if relevant, History of gambling-free period of at least one month, Familial and social support related to gambling problems, preferred type of gambling, preferred medium of gambling) , Among the six models tested, two were very similar in terms of the BIC indicator: a model with three clusters (BIC = 18253.8) and another with four clusters (BIC = 18252.6). Of these two models, the one with three clusters displayed a lower classification error rate (7.92% vs 13.80% for the four-cluster solution) and was better suited to clinical interpretation. We thus chose the three-cluster partition.

Clinical, socio-professional, psychological variables, and gambling characteristics of the three clusters are presented in Table 4.

	Cluster 1 EOSC	Cluster 2 EOLC	Cluster 3 LOSC	*P*-value, Wald test
Cluster size %, *N*	47.5 (298)	35.0 (220)	17.5 (110)	
VARIABLES INCLUDED IN THE CLUSTERING ANALYSIS				
Age at gambling initiation (yrs)	16.4	17.9	36.1	< 0.001 [a,b,c]
Age at onset of problem gambling (yrs)	26.5	41.3	45.1	< 0.001 [a,b,c]
Duration of gambling history (yrs)	16.2	35.4	16.2	< 0.001 [a,c]
Age at diagnosis of the first psychiatric comorbidities (*if relevant*) (yrs)	15.3	23.7	26.5	< 0.001 [a,b]
History of gambling-free period of at least one month (%)	71.0	53.6	58.3	0.001 [a,c]
Familial and social support related to gambling problems (%)	92.6	84.3	92.5	0.018 [a]
Preferred type of gambling				
Pure chance games (lotteries, slots, scratch cards, video lottery terminals, etc.)	48.2	58.2	79.8	< 0.001 [a,b,c]
Bank games with an element of skill (sports betting, horserace betting, blackjack)	30.8	36.1	16.9	
Social games with skill (Texas Hold'em and Omaha variants of poker)	21.0	5.7	3.4	
Preferred gambling medium (on the Internet)	20.0	8.1	2.3	< 0.001 [a,b] < 0.001 [a,b]
CO-VARIABLES (Not included in clustering)				
Sociodemographic characteristics				

Gender (%)				
Women	23.5	32.4	62.5	< 0.001 [a,b,c]
Men	76.5	67.6	37.5	
Age (yrs)	32.7	53.4	52.3	< 0.001 [a,b]
Level of income ≥ €1100 (1400 USD) (%)	67.2	72.8	72.4	0.250
Marital status (single) (%)	55.4	38.7	57.0	< 0.001 [a,c]
Employment status (active) (%)	73.0	56.0	52.0	< 0.001 [a,b]
Gambling severity				
Gambling status (%)				
Non-problem gamblers (NPG)	48.1	51.6	55.7	0.020 [a,c]
Problem gamblers without treatment (PGWT)	16.8	23.0	21.3	
Problem gamblers seeking treatment (PGST)	35.2	25.4	23.0	
				0.200
Number of DSM-IV criteria (mean)	3.8	3.7	3.3	0.200
Gambling habits:				
Amount wagered monthly in gambling (in euros)	592 .4	632.5	512.3	0.560
Gambling frequency over the past 12 months (%)				0.067 [c]
Less than once a month	8.2	6.9	8.6	
More than once a month	17.6	12.9	19.2	
Once a week	13.2	14.6	20.6	
More than once a week	61.0	65.7	51.6	
Comorbid psychiatric disorders				
Mood disorders (%)	46.1	45.5	56.0	0.110
Depressive episode (%)	40.2	41.7	48.6	0.260
Hypomanic or manic episode (%)	13.6	9.2	12.9	0.240
Anxiety disorders (%)	38.2	36.4	40.0	0.780

Panic disorder (with or without agoraphobia)	18.4	21.4	25.4	0.220
Social phobia	11.7	8.4	15.9	0.082
Obsessive Compulsive disorder	3.8	2.5	1.0	0.360
Generalised Anxiety Disorder	17.4	12.0	11.7	0.08
Post-Traumatic Stress Disorder	7.2	6.3	9.7	0.490
Addictive disorders (%)	42.7	32.8	19.8	< 0.001 [a,b,c]
Alcohol Use Disorder	28.7	27.0	13.7	0.007
Substance Use Disorder	25.5	10.1	6.1	< 0.001
Antisocial personality disorder (%)	5.5	3.3	1.1	0.220
Current suicide risk (%)	19.4	26.7	29.5	0.027 [a,b]
Lifetime suicide attempts (%)	11.4	18.2	15.4	0.055 [a]
ADHD				
WURS score (M)	31.7	28.7	28.3	0.096 [a]
Personality				
	54 .9			
TCI scores (M)				
Novelty Seeking (NS)	54.9	51.5	48.6	0.001 [a,b]
Harm Avoidance (HA)	43.7	44.7	42.8	0.730
Determination (D)	67.8	67.0	68.7	0.720
Cooperation (C)	73.6	73.5	75.6	0.450
Reward Dependence (RD)	60.8	59.1	60.7	0.460
Transcendence (T)	27.7	33.8	36.7	< 0.001 [a,b]
Persistence (P)	52.8	55.9	59.2	0.069 [b]

Table 4. Profiles of the three clusters identified

Note:

[a] significant test (p<0.05) for the comparison between cluster 1 and cluster 2

[b] significant test (p<0.05) for the comparison between cluster 1 and cluster 3

[c] significant test (p<0.05) for the comparison between cluster 2 and cluster 3

We identified three clusters with significant differences among the courses of gambling. Figure 1 represents the **three clusters** and the **significant variables and covariables**.

The Early Onset and Short Course (EOSC) cluster (47.5%)

This group was predominantly represented by young men (76.5% men, mean age 32.7). This group was more active than the others (73.0% were active), and more than half were single (55.4%). This cluster has the lowest onset age (16.4 years old) and the earliest beginning of problem gambling (26.5 years old). Problem gambling thus appeared approximately 10 years after gambling initiation. Moreover, psychiatric comorbidities appeared earlier in life (15.3 years). Nearly half of this cluster (46.1%) had a history of mood disorders, with the highest frequency of lifetime hypomanic or manic episodes (13.6%). This cluster had significantly the highest level of Novelty Seeking (*M* = 54.9). Addictive comorbidities were also more prevalent in this group, with 28.7% and 25.5%, respectively, reporting an alcohol use disorder and a substance use disorder. This group was the only one with a majority of PG (52%) and had the highest proportion of PGST (35.2%). Seventy-one percent had already experienced at least one month without gambling, which was significantly higher than in other groups. For the two other clusters, the favourite type of gambling was predominantly pure chance games (48.2%). However, contrariwise, a majority of these gamblers identified strategic games (regrouping bank games with an element of skill and social games with skill) as their preferred gambling type (51.8%). Moreover, 20% preferred gambling on the Internet, a higher proportion than in the other clusters.

The Early Onset and Long Course (EOLC) cluster (35.0%)

This group was also predominantly constituted by men (67.6%), but was older than in the EOSC cluster (*M* = 53.4 years old). The majority lived with a partner (61.3%), contrary to the two other clusters, even though they were those who reported the lowest frequency of familial support (84.3%). The mean gambling onset age was 17.9 years. Problem gambling in problem gamblers appeared 23.4 years after gambling initiation, and the mean duration of the gambling practice at the moment of the inclusion was 35.4 years, which was more than twice the length for the two other clusters. 45.5% presented mood disorders and 36.4% anxiety disorders. Alcohol use disorders were quite prevalent in this cluster (27.0%). Psychiatric comorbidities appeared late in life, with the mean age of the first diagnosis of psychiatric comorbidity being 23.7 years, much older than the mean age

of gambling initiation. They had the highest prevalence of suicidal attempts (18.2%) and a higher frequency of current suicidal risk than the EOSC cluster (26.7%). They had the lowest prevalence of gamblers having experienced a gambling cessation for at least one month (53.6%). The majority (51.6%) of this cluster was NPG, and the proportion of PGWT was the highest in this group (23.0%). This group had the highest proportion of bank games with an element of skill as the preferred gambling type (36.1%). Slightly less than 10% preferred Internet gambling.

The Late Onset and Short Course (LOSC) cluster (17.5%)

This group was the only one predominantly constituted by women (62.5%), with a mean age of 52.3 years old. However, the majority lived alone (57.0%), and this cluster had the lowest prevalence of active employment (52.0%). The mean age of gambling initiation was 36.1 years old, significantly older than the other two groups. However, the gambling course between the mean age of initiation and the mean age of problem gambling was the shortest among the whole sample: 9 years. Psychiatric comorbidities were more prevalent in this group; 56.0% had a history of mood disorders, especially a high prevalence of lifetime depressive disorder (48.6%). 29.5% reported a current suicidal risk, more than the two other groups. Psychiatric comorbidities appeared later in life. Indeed, the mean age of the first diagnosis of psychiatric comorbidity was 26.5 years old. The frequency of addictive disorders was the lowest in this group (19.8%). They displayed significantly the highest personality scores for transcendence (*M* = 36.7). In this cluster, the frequency of NPG was the highest (55.7%), and the problem gamblers were equally either seeking treatment (23.0%) or not (21.3%). The preferred type of gambling was predominantly pure chance games for 79.8% of the cluster, and only 2.3% preferred Internet gambling.

FIGURE 1.

4. DISCUSSION

4.1. Main findings

4.1.1. Three different profiles of gamblers

Three distinct clinical profiles of gamblers were identified through the analysis of gambling characteristics. Differences in the course and characteristics of gambling corresponded to psychopathological profiles, and they were significant in terms of socio-demographic variables (gender, age, work, and marital status) and also in terms of gambling status and some comorbidities (addictive disorders, hypomanic episodes, and personality traits). We propose a classification of our clusters according to gambling characteristics: Early Onset and Short Course (EOSC) (Cluster 1), Early

Onset and Long Course (EOLC) (Cluster 2), and Late Onset and Short Course (Cluster 3). Regarding significant clinical and psychopathological covariables, this three-cluster model defined through the analysis of gambling characteristics is partly comparable to the theoretical pathways model of Blaszczynski and Nower [17], which was in turn defined through psychopathological variables.

The Early Onset and Short Course cluster (Cluster 1-EOSC)

The mean age at gambling initiation is under 18 years, which is the legal age for gambling in France. Lynch *et al*. found that young adults who had started gambling prior to the age of 18 were more likely to experience at least one symptom of GD than those who started gambling at the age of 18 or later [47]. Early initiation is described as a marker of risk of GD in later life: Kessler *et al*. (2008) found that the mean age at the onset of gambling was significantly lower among those who subsequently developed problem gambling than among those who did not [48, 49], and Jimenez et al. identified a younger age at the onset of gambling as associated with a greater severity of problem gambling. Our results agreed with this hypothesis: the EOSC group had a higher frequency of problem gambling and higher gambling severity than the two other groups. Nevertheless, age at initiation did not explain the course of gambling in itself: the two clusters associated with the earlier age at onset presented two different courses of gambling, either a short development (approximately 10 years) for the EOSC cluster or a long development (approximately 23 years) for the EOLC cluster.

This cluster had a significantly higher preference for online gambling than the others. Gambling on the Internet is associated with a high availability of gambling opportunity, and online poker induces specific problems, leading problem gamblers to lose money but also to spend a large amount of time gambling [50]. Moreover, involvement in gambling and attraction to strategic games are risk factors for problem gambling [51]. Male Internet bettors face heightened risks of related gambling problems [52]. Mirroring the comments made above regarding EGM players, much may depend on the patterns of use exhibited by online sports betters. For example, if online betting is done sporadically in a social context (e.g., watching a game together), then online play may represent no extra risk over venue-based play. On the other hand, if online sports betting facilitates different patterns of use (e.g., solitary betting in extended sessions late at night), then this would provide further evidence that the online product presents a greater risk. At the present time, concern appears to be justified, as young men in particular are increasingly seeking treatment for difficulties in controlling their online sports betting [53]

Strategic games usually attract young males, with an earlier onset of the disorder [54]. They tend to engage in more than one specific type of problematic game and to take more risks, including betting large amounts of money [54]. This cluster included the highest frequency of PG and the highest

frequency of PGST, and they most frequently indicated the occurrence of gambling-free periods of one month, probably in an effort to regain control over gambling or in reaction to negative consequences.

The EOSC cluster presented the highest level of ADHD symptomatology. One may suppose that psychopathological variables combined with age at onset may influence the course of gambling, as defined in the pathways model [17]. Impulsivity is also a key point of the antisocial impulsivist pathway, defined by Blaszczynski and Nower as being associated with gambling-related criminal behaviours and addictive comorbidities [17]. Novelty seeking was also high in our study, as reported in the literature, especially in social games with skill [54, 55]. This was associated with a high prevalence of psychiatric and addictive comorbidities, as previously described for PG with impulsivity and ADHD [17, 56, 57].

EOLC cluster (Cluster 2)

The EOLC cluster had a long course of gambling (35.4 years). They spent the highest amount of money on gambling, and only 53.6% had experienced a gambling cessation for at least one month.
We found important results concerning familial support: although EOLC gamblers lived predominantly with partners, they reported the lowest level of familial and social support related to gambling problems. We hypothesise that gambling had severe consequences on the family, as shown in the literature [58, 59], thus reducing familial support.
An important characteristic is the absence of any lifetime premorbid feature of psychopathology before the onset of the gambling problem. We may hypothesise that symptoms of anxiety or depression were the consequences of problem-gambling-related difficulties. However, at inclusion, they presented the highest prevalence of attempted suicide (and a current suicide risk in 26.7% of cases). One can assume suicide risk and attempted suicides to be consequences of problem-gambling-related difficulties [60]. The EOLC cluster could share similarities with the first pathway, defined by Blaszczynski and Nower as 'conditioned problem gamblers' (CG). This CG group is defined as gamblers without comorbidities who are preoccupied with gambling, engage in chasing, and fluctuate between excessive gambling and problem gambling.

The LOSC cluster (Cluster 3)

The LOSC gamblers predominantly preferred pure chance games. Different studies have shown that gamblers who preferred slot machines had higher levels of depression [25, 61].
We can underline two notable points in our LOSC cluster. First, women made up the majority of the

LOSC cluster (62.5%), and in this cluster the course of gambling was the shortest observed in our study. These results support the concept of a 'telescoping effect' in the course of problem gambling among women [62-64]. In the literature, this effect was indicated by female gamblers seeking treatment [65, 66] but was not confirmed in the general population [67]. In our study, we included a mixed population of gamblers (NPG, PGWT, and PGST), and our sample also consisted of gamblers who were somewhat older (*M* = 52 years in the LOSC cluster) than in the Slustke sample [67].
Second, the LOSC gamblers had the highest mean age at gambling initiation but also the shortest gambling trajectory. As a consequence, we could conclude that the course of gambling and the risk of problem gambling were not systematically linked to an early age of onset, but perhaps to a combination of psychopathological variables, age at initiation, gender, and type of gambling, as hypothesised in some studies [20, 21].

This cluster presented premorbid anxiety and/or depression: 56.0% had a lifetime history of mood disorder, with 29.5% experiencing a current suicide risk, which are the highest percentages of our sample. This cluster was also notable for the lowest frequency of seeking treatment. Suicide risk is one of the main dramatic consequences of gambling [60], and suicidal thoughts can lead to giving up gambling and accepting treatment. This course of gambling characteristic could support the hypothesis that participation in gambling is motivated by desire on the part of gamblers to modulate their emotional distress and their negative feelings [17]. The LOSC cluster might share similarities with the pathway of 'emotionally vulnerable problem gamblers' (EV) [17, 27, 28].

4.2. Strengths and weaknesses of this study

This study has several limitations, especially the relatively restricted amount of data collected. Characteristics related to the course of gambling (age at initiation, age at onset of gambling problems, etc.) and lifetime psychiatric disorders were assessed in a retrospective manner and were self-reported, which could induce a recall bias. Moreover, we did not use DSM 5 criteria, and we did not analyse impulsivity and cognitive distortions in this population. Recruitment of patients occurred at the moment of the legalisation of online gambling in France (2010), which limits generalisation, as online gambling has since become widely available. However, the combination of NPGs and PGs who have and who have not sought treatment is one of the main strengths of our study. We also included gamblers recruited directly from gambling locations. This method gave us access to a broad spectrum of gambling activities. Finally, this sample size has rarely been achieved by studies with semi-structured interviews (studies with such high numbers of participants are generally based on telephone-based surveys).

That study more accurately categorised profiles of gamblers and problem gamblers through gambling characteristics and course. It did not examine factors that increase the risk of transitioning from a non-problem gambler to a problem gambler, nor did it define vulnerability profiles associated with the emergence of problem gambling in a longitudinal study.

4.3. Implications for clinicians and policymakers

It is important to consider gambling characteristics because preventive interventions or policy measures may reduce the risk of problem gambling or minimise harm from gambling [7]. We defined a clustering of gamblers through the analysis of variables which were easy to identify by psychiatrists or physicians in primary care: gambling characteristics, age at gambling initiation, type of gambling and gambling medium, duration of gambling activities, age at onset of psychiatric comorbidities, and history of gambling-free periods of at least one month's duration. We hypothesise that simple screening concerning these gambling characteristics could be constructed to prevent PG and to help PG identification.

Prevention interventions should be tailored to these at-risk profiles. The preceding results imply that interventions need to particularly target prevention at different profiles: young adult males gambling online in strategic games, for example, or middle-aged women gambling offline to hazardous games. Public health messages should be available online and offline which are adapted to these profiles. Clinical programmes could also be adapted to these specific profiles, for we may suppose that with respect to the respective cognitive distortions, motivational training would certainly differ between these profiles.

The gambling characteristics identified in this study as significantly different between the three clusters are easily identified but could also be target of specific intervention to reduce harm in gambling, especially in at-risk profiles.

We demonstrated that a large majority of gamblers in this sample started to **gamble before the legal age of 18 years**. For gambling prevention policy, it is worth noting that despite the ban on gambling under 18 years of age, minors can gamble very early. We stress the need to develop early interventions to provide information and prevent gambling, especially among adolescents. Prevention programmes could include targeted interventions for youth to explain gambling risks and how to avoid them. One explanation for the framing of risky gambling behaviour of youth may be gambling advertising and availability. Gambling marketing is present in many media (advertising posters, the Internet, magazines, television, etc.) that are accessible to adolescents, and its content is

very attractive. A recent study showed that marketing significantly influences attitudes towards gambling, gambling behaviours, and intention to participate [68].

We also should pay attention to the **type of gambling and the medium used for gambling**. In our study, strategic games and Internet gambling seemed to be associated with more serious gambling profiles and short courses of gambling development in younger men. Targeted prevention on the Internet, especially regarding strategic games, could be developed to reduce harm from gambling. Contrariwise, a large majority of the LOSC cluster preferred to gamble in pure chance games offline. Unlike casino or Internet games, pure chance offline games (especially scratch games) in France do not include any self-exclusion programmes, and identity controls are not systematic when a ban is in place. Consequently, French gamblers with gambling problems participating in pure chance games offline are less able to put in place safeguards that may help them to quit or reduce gambling. This point is a public health concern, particularly when we consider, as in our study, that gambling problems occur in vulnerable persons. These results raise questions about the need for governments to develop policies and regulations to reduce young people's exposure to gambling products and marketing and to protect vulnerable persons from harm caused by gambling.

Caption : figure 1 . clustering : 3 clusters and significant variables and covariables

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Figure 1. Clustering : 3 clusters and significant variables and covariables

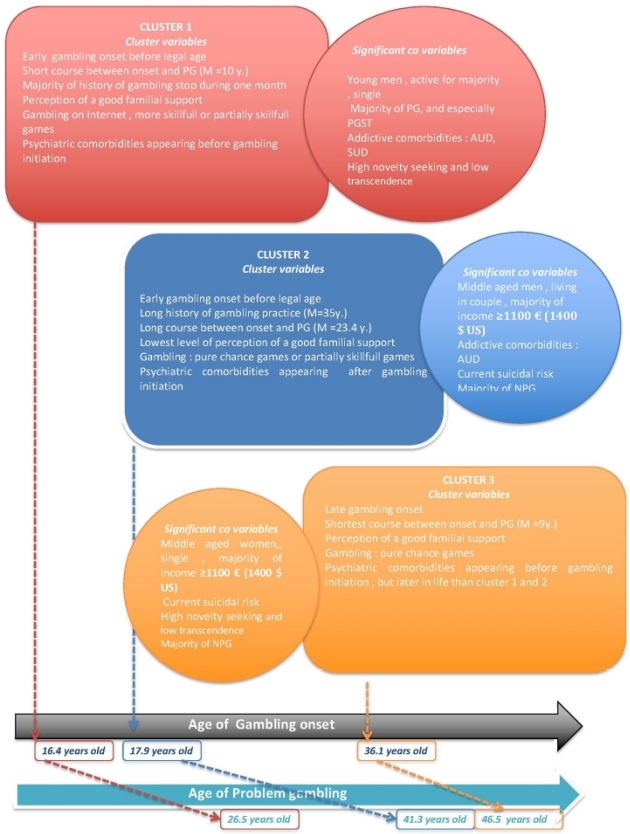

figure 1 . clustering : 3 clusteres and significant variables and covariables

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract p.1 P.3	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale P.5	2	Explain the scientific background and rationale for the investigation being reported
Objectives p.6	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design p.7	4	Present key elements of study design early in the paper
Setting p.7	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants p. 7	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables p.8	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement p.8	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias p.21	9	Describe any efforts to address potential sources of bias
Study size p.7	10	Explain how the study size was arrived at
Quantitative variables p.10	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods p.10- p.11	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy

(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants **p.11**	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data **p.11-P.12**	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data **p.13**	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results **p.14-16**	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses **p.16**	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results **p.18-p.20**	18	Summarise key results with reference to study objectives
Limitations **p.20-p.21**	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation **p.21-p.22**	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability **p.21-p.22**	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding **p.2**	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.