# Prevalence of comorbid disorders in problem and pathological gambling: systematic review and meta-analysis of population surveys

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# ABSTRACT

Aims This paper reviews evidence pertaining to the prevalence of common comorbid disorders, including alcohol use disorder, depression, substance use disorders, nicotine dependence, anxiety disorders and antisocial personality disorder, in population-representative samples of problem and pathological gamblers. Methods A systematic search was conducted for peer-reviewed and unpublished articles reported between 1 January 1998 and 20 September 2010. Only studies which examined the prevalence of comorbid conditions in problem and/or pathological gamblers from a general population sample using randomized sampling methods and standardized measurement tools were included. Meta-analysis techniques were then performed to synthesize the included studies and estimate the weighted mean effect size and heterogeneity across studies. **Results** Eleven eligible studies were identified from the literature. Results from across the studies indicated that problem and pathological gamblers had high rates of other comorbid disorders. The highest mean prevalence was for nicotine dependence (60.1%), followed by a substance use disorder (57.5%), any type of mood disorder (37.9%) and any type of anxiety disorder (37.4%). However, there was evidence of moderate heterogeneity across studies, suggesting that rate estimates do not necessarily converge around a single population figure, and that weighted means should be interpreted with caution. Conclusions Problem and pathological gamblers experience high levels of other comorbid mental health disorders and screening for comorbid disorders upon entering treatment for gambling problems is recommended. Further research is required to explore the underlying causes of variability observed in the prevalence estimates.

Keywords Comorbidities, meta-analysis, pathological gambling, systematic review.

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## INTRODUCTION

Epidemiological studies estimate that the prevalence of past-year adult pathological gambling is between 1.1 and 3.5% [1–3], with variation across studies due probably, in part, to sampling and measurement artefacts [4]. Although usage of the terms 'problem' and 'pathological gambling' varies, problem gambling is often used to describe an intermediate or subclinical form of the disorder 'pathological gambling'. Both problem and pathological gambling are serious public and mental health concerns, with implications for individuals, families and communities [3]. Problem and pathological gambling are associated with impaired psychological functioning,

reduced quality of life, legal problems and high rates of bankruptcy, divorce and incarceration [5,6]. Gambling problems are also associated with other mental health disorders including depression, anxiety disorders, bipolar disorder, personality disorders, alcohol, substance and nicotine use [7,8]. The presence of comorbid disorders in problem and pathological gambling has been associated with increased gambling problems and severity of associated consequences [9,10]. Comorbid disorders are also suggested to partly determine access and compliance to gambling treatment [11], and may influence the efficacy of pharmacological [12] and psychological [11] interventions. Furthermore, different treatments may be more appropriate for gamblers with certain comorbid disorders. For example, Blaszczynski & Nower's pathway model of problem gambling [13] suggests counselling or minimal intervention for gamblers with secondary depression and intensive psychological and pharmacological therapy for gamblers with comorbid antisocial personality disorder. The upcoming revision to the Diagnostic and Statistical Manual of Mental Disorders (DSM-V; [14]) is proposing to re-classify pathological gambling as a 'behavioural addiction', thus the presence of psychiatric disorders in problem and pathological gambling requires further attention.

Although it is generally accepted that many psychological disorders are likely to co-occur with gambling problems [15], conclusions drawn about psychiatric comorbidity in problem and pathological gambling often rely heavily on evidence from treatment-seeking samples. Ibanez et al. [16] reported that 42% of gamblers presenting to an out-patient treatment programme had a comorbid personality disorder, 33.3% had comorbid alcohol abuse/dependence and 17.4% had an adjustment disorder. Black & Mover [17] found that 60% of treatmentseeking pathological gamblers had a comorbid mood disorder, 64% had a comorbid substance use disorder, 40% had an anxiety disorder and 87% had a personality disorder. Petry [7] reviewed such studies of treatmentseeking samples and found evidence for pathological gambling co-occurring frequently with substance use, alcohol use, affective and anxiety disorders, with mixed findings regarding co-occurring personality disorders. These findings are of relevance in an applied clinical context, as they are likely to reflect gamblers presenting for treatment.

Studies of treatment-seeking gamblers are less useful for drawing conclusions about psychiatric comorbidity in the general problem and pathological gambling population. Many gamblers never seek professional treatment, with a recent survey reporting that only 7-12% of pathological gamblers have ever sought treatment [18]. Treatment-seeking pathological gamblers may also differ systematically from gamblers in the general population. Evidence suggests that treatment-seeking samples comprise mainly pathological gamblers who are white, male and middle-aged [19], generally display more severe gambling symptoms [18] and may be more likely to present with comorbid conditions. This is consistent with the general selection bias, 'Berkson's bias', and the observation that co-occurrence of disorders increases the likelihood of treatment-seeking [20]. Paradoxically, it may be the case that problem and pathological gamblers seeking treatment are more likely to seek treatment for their comorbid disorders rather than their gambling problems [11], with gambling problems going undetected.

As there is considerable reason to suggest that treatment-seeking gamblers will differ systematically

from gamblers who do not seek treatment, studies of clinical samples should not be used to infer characteristics of the wider problem and pathological gambling population. In contrast, general population surveys using random sampling methods are appropriate for generalizing conclusions to the population. Petry [7] provided a narrative review of some representative studies, and concluded that the general pathological gambling population also demonstrated high levels of co-occurring substance use, alcohol use, mood, anxiety and personality disorders. However, variation exists in the reported prevalence of comorbid conditions. One potential reason for such variability is that problem and pathological gambling has a low base-rate and studies of the general population often obtain small numbers of gamblers, despite large overall samples. Where samples are small, variation can be attributable to sampling error, rather than any true differences between study effects [21]. Meta-analytical techniques synthesize results across studies and provide more precise estimates based on the combined sample, indicating whether differences can be attributed to sampling error or systematic factors. As far as can be ascertained, no studies have reviewed and synthesized general population surveys systematically to estimate the prevalence of comorbid disorders in the problem and pathological gambling population. Accordingly, the aim of the current study was to review results from all population studies indicating the prevalence of common comorbid disorders in problem and pathological gambling.

#### METHOD

#### Search strategy

The systematic search conducted for this paper was a component of a general search conducted for multiple purposes, including a proposed Cochrane review evaluating the efficacy of treatments for pathological gambling. The databases used for this systematic search were: Medline, CINAHL, the Cochrane Library database, EMBASE, EBM reviews, PsycInfo and ProQuest. In addition, reference lists of all included studies were handsearched, while relevant known websites were searched for unpublished articles. To ensure recency of articles, the search was restricted to 1 January 1998 until 20 September 2010. The search terms used were a combination of MESH terms and keywords with wildcards and were: exp Gambling or gambl\$ or betting or wager or gaming. A detailed description of the search strategy can be found in the online supporting information (see details at the end). After removal of duplicate articles, the search retrieved 7187 unique citations. As several different terms are used to describe gambling problems, this paper will use the

term 'pathological gambling' to refer to the most severe form of the disorder and 'problem gambling' to refer to an intermediate form of the disorder. Studies which included samples of problem and pathological gamblers will be noted.

#### Inclusion criteria

The following inclusion criteria were used: (i) participants were pathological and/or problem gamblers as assessed by a validated screening tool; (ii) the study used a community-based general population adult sample and a random sampling methodology; (iii) the study provided a prevalence estimate of problem or pathological gambling and one or more conditions including major depression, anxiety disorders, bipolar disorder, nicotine dependence, alcohol and substance use disorders and antisocial personality disorder, using a validated screening tool; and (iv) the study was in the English language.

Articles were excluded if they were review articles, used treatment-seeking populations, combined prevalence estimates for multiple comorbid disorders or did not use standardized measurement tools. Where duplicate articles using the same data set were identified, multiple articles were included if unique information was available from each article or the article containing the most comprehensive information was retained. The title and abstract of the retrieved articles were scanned for inclusion by the first author. Seventy-seven articles were deemed eligible for inclusion based on title and abstract. Full texts were obtained for the 77 articles and 11 studies met the inclusion criteria.

#### Data extraction

Information was extracted from each included study on: (i) broad study characteristics including country of origin and sample size; (ii) study methodology, including the measurement instruments used; and (iii) relevant quantitative data, including the prevalence of problem and pathological gambling in the study sample and prevalence of a comorbid condition in the problem and pathological gambling sample. The strict inclusion criteria required that standardized measurement tools and randomized sampling methods were employed; therefore, methodological quality of studies was noted during data extraction but not analysed formally. In many cases, the prevalence estimate was available from the primary study. In other instances it was necessary to derive the estimate from information reported in the article. Sufficient information for calculating a prevalence estimate was the total number of problem and pathological gamblers and the number of problem and pathological gamblers with a comorbid disorder. To ensure accuracy of the data extraction, a random selection of articles (n = 4) was

coded independently by a second reviewer. The inter-rater agreement between the two coders was 96.4%.

#### Data analysis

Meta-analysis is a technique for synthesizing results from independent studies [22]. A separate meta-analysis was conducted for each comorbid disorder, using Meta-Analyst software [23] and a random-effects model to account for heterogeneity across studies [22]. This model assumes different true effect sizes (e.g. due to variations in study design [24]) and estimates the average effect from a distribution with a mean and variance [22]. Randomeffects analysis partitions the observed variance into two parts: (i) chance variation attributed plausibly to sampling error; and (ii) additional differences reflecting true heterogeneity. Although many statistical indices that quantify heterogeneity are limited when the number of studies is small [24], the  $I^2$  statistic is suitable and indicates the amount of total variation across studies due to true differences (i.e. heterogeneity) rather than sampling error. The  $I^2$  is expressed as a proportion of the total variance and ranges from 0 to 100%, with values of 25%, 50% and 75% suggested to represent low, moderate and high levels of heterogeneity, respectively [25]. When there is evidence of heterogeneity across studies, meta-analysis considers study characteristics potentially explaining this variability [26]. In the current instance, this was limited by the small number of primary studies available [24]. When fewer than five studies were available, a summary effect and a statistical index of heterogeneity were reported, while no further analyses were conducted. Where studies numbered five or greater, limited exploratory subgroup analyses were conducted to examine potential sources of heterogeneity. Several potentially relevant factors were identified a priori, and were given emphasis in the subgroup analysis. These included: (i) the inclusion of pathological gamblers or combined samples of problem and pathological gamblers; (ii) use of clinician-administered interviews or self-report questionnaires; and (iii) focus on past-year or life-time diagnosis of problem and pathological gambling.

### RESULTS

#### Study characteristics

Characteristics of the 11 included studies are presented in Table 1. The overall sample sizes of each study ranged from 2417 to 43 093, with the sample size of problem and pathological gamblers ranging from 21 to 265. All included studies used sampling weights to adjust their data to match certain population demographic characteristics, with most studies adjusting for age, sex and race/ ethnicity. Two studies [27,28] reported both weighted and

		01	Duckland under la de de		here a feelbeer and them be end	Problem/pathological ga	mbling prevalence rate
Study	Country	size (n)	r rouent putnotogicat gambling diagnostic tool	Comorbidity diagnostic tool	1vo. of pronent puthological gamblers in sample	Past-year	Life-time
Afifi et al. 2010 <sup>c</sup> [40]	Canada	10 056	PGSI	CIDI (DSM-IV)	320 <sup>a.b</sup>	2.7%*	
Bondolfi <i>et al.</i> 2000 [38]	Switzerland	2526	SOGS	CAGE	75ª		$0.8\%^{*}$
Bondolfi <i>et al.</i> 2008 [37]	Switzerland	2803	SOGS	CAGE	93ª	0.5%	$1.1\%^{*}$
Cunningham et al. 1998 [27]	United States	3004	DSM-III	DIS (DSM-III)	161 <sup>a</sup>		$0.9\%^{*}$
Feigelman <i>et al.</i> 1998 [36]	United States	6308	SOGS	Inventory of substance use	265		$4.2\%^{*}$
				patterns (DSM-III-R)			
Gerstein <i>et al.</i> 1999 [32]	United States	2417	SUON	DSM-IV	21	0.1%	$0.8\%^{*}$
Kessler et al. 2008 [34]	United States	9282	DSM-IV	CIDI (DSM-IV)	56	0.3%	$0.6\%^{*}$
Marshall & Wynne, 2004° [39]	Canada	34 770	PGSI	CIDI (DSM-IV)	174	$0.5\%^{*}$	
Park <i>et al.</i> 2010 [35]	Korea	5333	DSM-IV	K-CIDI (DSM-IV)	43		$0.8\%^{*}$
Petry et al. 2005 [33]	United States	43 093	DSM-IV	AUDADIS	195		$0.4\%^{*}$
Welte et al. 2001 [28]	United States	2638	DSM-IV	DIS (DSM-IV)	50	$1.3\%^{*}$	2.0%
reury et al. 2003 [33] Welte et al. 2001 [28]	United States	45 095 2638	AI-WSCI	DIS (DSM-IV)	50 50	1.3%*	2.0%

 Table 1
 Characteristics of included studies.

unweighted statistics with small differences between the two. All prevalence rates, displayed in the Results section and used in the analysis, are weighted statistics.

# Characteristics of the problem and pathological gambler samples

The prevalence estimates of past-year and life-time problem and pathological gambling ranged from 0.1 to 2.7% and 0.4 to 4.2%, respectively. The most commonly used screening tools for problem and pathological gambling diagnosis were the DSM criteria [29] and the South Oaks Gambling Screen (SOGS) [30]. Studies using the DSM involved structured interviews, while the Problem Gambling Severity Index of the Canadian Problem Gambling Index (PGSI) [31], SOGS [30] and the NORC DSM Screen for Gambling Problems (NODS) [32] were administered as self-report questionnaires. Of the five studies which used the DSM criteria, four [28,33-35] used the DSM-IV pathological gambling criteria (more than five of 10 criteria met), and one [27] combined the DSM-III problem and pathological gambling criteria (more than one of nine criteria met). All three studies [36-38] using the SOGS used the problem gambling category (more than three or four of 20). Two studies used the PGSI, with one [39] using the pathological gambling category (more than eight of 27 criteria met) and the other [40] using a combined problem and pathological gambling classification (more than three of 27 criteria met). The only study [32] using the NODS used the pathological gambling criteria (more than five of 10 criteria met).

## Meta-analysis

analy

for comorbidity.

\*Prevalence rate used

<sup>c</sup>Same data set.

to women.

bRefers only

gamblers.

pathological

and

problem

'Combined

eye-opener.

annoyed, guilt,

four-item screen for alcoholism: cut-down,

interview: CAGE:

Diagnostic

Table 2 illustrates the prevalence rates of comorbid disorders in problem and pathological gambling, along with the average effect size (summary effect) and heterogeneity estimate  $(I^2)$ . For substance use disorders, the weighted mean effect size was 57.5% for any substance use disorder, 28.1% for alcohol use disorder, 17.2% for illicit drug abuse/dependence and 60.1% for nicotine dependence. For mood disorders, the average effect size was 37.9% for any mood disorder, 23.1% for major depression and 9.8% for bipolar disorder/manic episodes. The average estimate of any anxiety disorder in problem and pathological gambling was 37.4% and the mean effect size for generalized anxiety disorder was 11.1%. The prevalence of antisocial personality disorder (ASPD) in problem and pathological gambling was 28.8%. All comorbid disorders, except generalized anxiety disorder, had a moderate level of heterogeneity in their combined prevalence estimates.

## Subgroup analysis

Sensitivity analysis was performed for the three comorbid disorders that had sufficient primary studies (alcohol use

			Bipolar							
Study	Alcohol use disorder	Major depression	disorder/manic episodes	Substance use disorders <sup>a</sup>	Illicit drug abuse/dependence	Nicotine dependence	Any anxiety disorder <sup>b</sup>	Generalized anxiety disorder	Any mood disorder <sup>c</sup>	Antisocial personality disorder
Afili et al. 2010 [40]			4.0% <sup>d</sup>		$1.6\%^{ m d}$					
Bondolfi <i>et a</i> l. 2000 [38]	36.0%									
Bondolfi et al. 2008 [37]	13.5%									
Cunningham et al. 1998 [27]	44.5%	8.8%	3.1%		39.9%	76.3%		7.7%		35.0%
Fiegelman <i>et al.</i> 1998 [36]				26.0%						
Gerstein et al. 1999 [32]	9.9%	$29.1\%^{e}$	32.5%							
Kessler et al. 2008 [34]		38.6%	17.0%	76.3%		63.0%	$60.3\%^{f}$	16.6%	55.6%	
Marshall & Wynne, 2004 [39]	15.0%	$24.0\%^{g}$								
Park et al. 2010 [35]	$30.2\%^{ m h}$	11.6%	0.0%	69.8%		34.9%	14.0%		11.6%	
Petry et al. 2005 [33]	73.2%	37.0%	22.8%		38.1%	60.4%	41.3%	11.2%	49.7%	23.3%
Welte <i>et al.</i> 2001 [28]	18.0%									
Summary effect	28.1	23.1	9.8	57.5	17.2	60.1	37.4	11.1	37.9	28.8
$I^{2}$ (%)	48.9	46.9	47.7	49.1	49.2	46.9	47.2	29.8	47.1	45.3

disorder, major depression and bipolar disorder/manic episodes). For alcohol use disorder, studies were grouped initially according to their inclusion of pathological gamblers only (five studies) or combined samples of problem and pathological gamblers (three studies) which yielded similar weighted mean estimates (pathological gamblers only = 26.6%; combined problem and pathological gamblers = 29.8%), with both groups still demonstrating moderate heterogeneity ( $I^2 > 45\%$ ). Secondly, studies were grouped according to whether problem and pathological gambling was diagnosed by clinicianadministered interview (four studies) or self-report questionnaire (four studies). Results indicated that the weighted mean estimate was larger in studies using clinician-administered interviews (prevalence = 41.2%) than in studies using self-reports (prevalence = 18.2%), although heterogeneity was still evident within groups  $(I^2 > 45\%)$ . Finally, studies were grouped according to life-time (six studies) or past-year (two studies) problem and pathological gambling diagnosis, with a larger weighted mean estimate in life-time problem and pathological gambling (prevalence = 33.4%) than in past-year (prevalence = 15.7%). There was evidence of heterogeneity for the studies referring to life-time ( $I^2 = 48.7\%$ ) but not for studies referring to past-year problem and pathological gambling ( $I^2 = 0\%$ ).

Initially, for comorbid major depression in problem and pathological gambling, one study [27] that combined samples of problem and pathological gamblers was excluded. Removing this study did not alter considerably the prevalence estimate with a weighted mean estimate of 28.5% and moderate heterogeneity remaining ( $I^2 =$ 42.5%). Studies were then grouped according to whether problem and pathological gambling was diagnosed by clinician-administered interview (four studies; prevalence = 21.4%;  $I^2 = 48.1\%$ ) or self-report questionnaire (two studies; prevalence = 24.6%;  $I^2 = 0.0\%$ ). Finally, analysis was limited to five studies which referenced lifetime, rather than past-year problem and pathological gambling diagnosis, which produced a weighted mean prevalence estimate of 22.7%, with moderate heterogeneity remaining  $(I^2 = 47.4\%)$ .

lepressive episode.

<sup>d</sup>Refers to only

For comorbid bipolar disorder/manic episodes in problem and pathological gambling, studies were first grouped according to their inclusion of pathological gamblers only (four studies) or combined samples of problem and pathological gamblers (two studies), with a larger weighted mean estimate observed in studies of pathological gamblers (prevalence = 20.4%;  $I^2 = 37.0\%$ ) than in studies of problem and pathological gamblers (prevalence = 3.7%;  $I^2 = 0.0\%$ ). Studies were then grouped according to whether problem and pathological gambling was diagnosed by a clinician-administered interview (four studies; prevalence = 9.1%;  $I^2 = 46.8\%$ )

or a self-report questionnaire (two studies; prevalence = 12.1%;  $I^2 = 48.7\%$ ), with similar results found. Finally, analysis was limited to five studies which referenced life-time rather than past-year conditions. This comparison did not change substantially the prevalence for comorbid bipolar disorder in problem and pathological gambling, with a weighted mean prevalence estimate of 12.6% and moderate heterogeneity remaining ( $I^2 = 46.2\%$ ).

## DISCUSSION

Previous conclusions about psychiatric comorbidity in problem and pathological gambling are based predominantly on narrative reviews drawing heavily on treatment-seeking gamblers. The current study comprised a systematic review and synthesis of population studies, and thus provided unique evidence indicating levels of comorbidity in problem and pathological gambling in the community. Results generally found high prevalence rates for many comorbid conditions in representative samples of problem and pathological gamblers. The condition with the highest mean prevalence rate was nicotine dependence, followed by a substance use disorder, any mood disorder and any anxiety disorder. To compare with studies of treatment-seeking pathological gamblers, Petry (2005) found high life-time prevalence estimates for any mood disorder (estimates ranging from 15.9% to 77.5%), any anxiety disorder (7.2–40%), a substance use disorder (31-60%), alcohol use disorder (26–63%) and major depression (33.3–76%) [7]. Thus, the current results suggest that high levels of comorbidity characterizes problem and pathological gamblers in the community, and not simply those seeking treatment.

Results generally indicated high prevalence estimates for nicotine dependence, alcohol use disorder, illicit drug abuse/dependence and substance use disorders co-occurring with problem and pathological gambling. Nicotine dependence, alcohol use and substance use share several common features, frequently co-occur [41,42] and are referred to as addictive disorders [43]. Although pathological gambling is classified currently as an impulse control disorder, there is evidence to suggest that similar predispositions (genetic, environmental and social) may influence the co-development and maintenance of addictive disorders as well as pathological gambling [43]. Similar to problem and pathological gambling, substance use disorders have high rates of psychiatric comorbidity [44] and there is some evidence that problem and pathological gambling, alcohol, substance and nicotine use have similar personality profiles [45]. In addition, the current revision of the Diagnostic and Statistical Manual (DSM-V) is proposing to re-classify problem and pathological gambling as a 'behavioural addiction' [14].

Results also indicated that mood and anxiety disorders were highly prevalent in problem and pathological gambling. Unlike the addictive disorders which may co-develop with problem and pathological gambling, it has been suggested that mood and anxiety disorders may often precede gambling problems [34,46]. Blaszczynski & Nower's [13] pathways model highlights a subgroup of gamblers who may gamble to alleviate symptoms of depression and anxiety. For this subtype, gambling behaviours may be viewed as a manifestation of maladaptive coping, with a more general underlying psychopathology involving a mood or anxiety disorder. However, a recent review reported that mood disorders are also likely to be secondary symptoms of increasing financial losses in pathological gambling [47]. In addition, a recent longitudinal study reported that the relationship between problem and pathological gambling and mood disorders may not necessarily be causal [48], and further research using longitudinal methods is required to provide a greater insight into the onset and pattern of comorbid conditions in problem and pathological gambling.

The current results indicated that the prevalence of ASPD in problem and pathological gambling was considerably higher (mean effect size = 28.8%) than the rate reported in the general population (0.6–3.6% [49,50]). Blaszczynski & Nower's pathway model proposes a subgroup, 'antisocial impulsivist', who have severe psychopathology, high levels of impulsivity and high rates of ASPD [13]. The current results are consistent with such a subgroup. Furthermore, a twin study reported that 66% of the overlap between ASPD and pathological gambling was accounted for by familial factors, suggesting a genetic association between the two disorders [51].

Interpretation of mean prevalence estimates should be considered in light of moderate heterogeneity across studies. Planned subgroup analyses were conducted for alcohol use disorder, major depression and bipolar disorder, in an attempt to explain some of this heterogeneity. No consistent patterns were evident across the results from the three comorbid disorders; however, there was some evidence that self-report questionnaires produced less heterogeneity in the prevalence estimate for major depression, combined samples of problem and pathological gamblers produced a lower prevalence estimate with minimal heterogeneity for bipolar disorder and past-year problem and pathological gambling diagnosis produced a lower and less heterogeneous prevalence estimate for alcohol use disorder. Life-time estimates may be confounded by age, and do not necessarily suggest that the two conditions occurred at the same point in time. However, these subgroup analyses are based on a small number of studies and should be interpreted with caution.

While all problem and pathological gambling assessment tools have evidence supporting their reliability and validity [52–57], variations in the gambling diagnostic tools may have influenced the results. The DSM, a structured clinical interview, has good reliability and validity for both clinical and general population settings [54], whereas the SOGS, a self-report questionnaire, has only satisfactory psychometrics in general population surveys with a high false positive rate [55]. Furthermore, there has been some discordance between classification using the NODS and the DSM-IV [58]. The comorbid disorder diagnostic tool may have also influenced the results; however, most studies used a structured clinical interview based on the DSM criteria for diagnosis of comorbid disorder, which has good inter-rater reliability [59]. Other factors which may have influenced the results and were not analysed formally include methodological quality and country of origin. In addition, several limitations of this review should be noted. General population prevalence studies in problem and pathological gambling are still relatively rare, have been conducted predominantly in the United States and Canada, and the total sample size of gamblers was still quite small (n = 21-265). In addition, previous research has suggested that gamblers commonly have multiple comorbid conditions [34], and future research should consider the co-occurrence of comorbid disorders in problem and pathological gambling.

Overall, this study suggests strongly that problem and pathological gamblers have high prevalence rates for many comorbid disorders, thus treatment providers should assess for comorbid conditions. The presence of comorbid conditions may produce difficulties for treatment and it may be beneficial to tailor treatments to different types of gamblers [13,60]. For example, for gamblers with comorbid addictive disorders, it may be useful to focus on the underlying predispositions to addictive behaviour, rather than treating the conditions separately. In contrast, where mood/anxiety disorders are comorbid with problem and pathological gamblers, the clinician may wish to consider whether the mood/ anxiety disorder has preceded the gambling problems and whether it may be beneficial to focus treatment on the preceding mood/anxiety disorder. However, it is important to note that moderate variability existed between studies that could not be accounted for by sampling error alone; thus, prevalence estimates should be interpreted with caution.

#### Declarations of interest

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#### Supporting information

Additional Supporting Information may be found in the online version of this article:

Appendix S1 Detailed search strategy. Appendix S2 Flow diagram of search results.

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