

A systematic review of gambling-related findings from the National Epidemiologic Survey on Alcohol and Related Conditions

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Background and aims: This systematic review analyzes and summarizes gambling-related findings from the nationally representative US National Epidemiological Survey on Alcohol and Related Conditions (NESARC) data. **Methods:** Systematic literature searches in accordance with PRISMA guidelines found 51 eligible studies that met inclusion criteria. Eight studies utilized both Waves 1 and 2 NESARC data, and selection of sample sizes varied from 185 to 43,093 individuals, consistent with specified research objectives of each study. **Results:** The prevalence of lifetime pathological gambling was 0.42% (0.64% among men, 0.23% among women), while past-year prevalence was 0.16%. Pathological gambling rates were generally higher in populations with substance-use disorders and other psychiatric diagnoses. Rates of adverse childhood experiences and suicidal attempts were higher among individuals with problem or pathological gambling. Early-onset gamblers were more likely to be male, be never married, have incomes below \$70,000, belong to younger cohorts and have Cluster B personality disorders, but less likely to be diagnosed with mood disorders. While pathological gambling was related to obesity, increased stress, and poorer physical health among general age groups, recreational gambling was linked with improved physical and mental functioning in older adults. **Conclusions:** The NESARC has provided important information on the correlates of pathological gambling and subdiagnostic patterns of gambling behaviors. Additional studies should examine these relationships in the current gambling environment and longitudinally with aims of implementing policies to improve the public health.

Keywords: systematic review, NESARC, gambling, pathological gambling, national data sets

INTRODUCTION

Gambling may be defined as placing monetary or material items at risk in hopes of gaining money or items of greater material value. Gambling may be viewed along a severity continuum with “Pathological Gambling” in DSM-IV and ICD-10 (World Health Organization, 1992) and “Gambling Disorder” in DSM-5 referring to gambling behavior that leads to significant distress and interference with functioning in major life domains (American Psychiatric Association, 2013). Meanwhile, “Problem Gambling” refers to gambling that negatively affects functioning and relationships (Morasco et al., 2006) but may not meet DSM or ICD criteria for pathological gambling/gambling disorder; that is, the term problem gambling is often used to describe subdiagnostic levels of gambling that are concerning. Recreational gambling has been operationalized in the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) as lifetime gambling of more than five times per year without meeting more than two DSM

criteria (Desai, Desai, & Potenza, 2007). Other designations such as low-risk and at-risk gambling have been used and defined in the context of NESARC data, with designations relating to numbers of inclusionary criteria for pathological gambling acknowledged (Desai & Potenza, 2008). These definitions will guide our discussion in this systematic review on gambling-related NESARC findings.

Nationally representative data provide important descriptive and inferential findings that assist in policy-making, industry compliance assessments, community development, and generation of improved treatment and prevention strategies. For example, data collected from the US National Comorbidity Survey Replication (NCS-R), a nationally

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representative US household survey, assessed 9,282 English-speaking respondents aged 18 years and older and was conducted between February 2001 and April 2003 in a nationally representative multistage clustered area probability sample of the US household population. Specifically, the NCS-R found lifetime prevalence estimates of problem gambling (defined as having one or more criteria of pathological gambling) at 2.3% and pathological gambling at 0.6% (Kessler et al., 2008). In other countries, the British Gambling Prevalence Survey in 2010 – as a follow-up to the 1999 and 2007 surveys – was conducted to allow comparisons pre- and post-implementation of the Gambling Act 2005 (Wardle et al., 2011). Prior to this survey, the 2007 British Gambling Prevalence Survey aimed to examine the nature and extent of gambling in Great Britain before administering the Act. Similarly in Asia, the Singapore National Council on Problem Gambling has conducted gambling participation surveys every 3 years from 2005 to 2014 to guide development of systemic regulatory assessment, community engagement activities, prevention programs, and treatment provision (National Council on Problem Gambling, 2014). It is important that national follow-up surveys attempt to achieve maximal comparability with previous surveys by standardizing methodology and measurement instruments.

Comparing prevalence estimates between countries is often challenging as data-collection protocols, sampling procedures, and gambling assessments are often different, all of which may influence pathological gambling and problem gambling estimates. As such, prevalence estimates in this context may best be considered as an illustration of the range of worldwide approximations, and arguably not as definitive comparisons. Overall, national pathological gambling prevalence estimates in Western countries range from 0.3% in Sweden (Binde, 2014), 0.7% in Britain (Wardle et al., 2011) to 0.8% in Denmark (Ekholm et al., 2014). In Australia and New Zealand, estimates range from 0.5% in New Zealand (Devlin & Walton, 2012) to 2.1% in Australia (Productivity Commission, 2010). Meanwhile, pathological gambling prevalence estimates in Asia are generally higher with a range from 0.5% in Singapore (National Council on Problem Gambling, 2014), 2.5% in Macau (Fong & Ozorio, 2005; Wu, Lai, & Tong, 2014), 4% in Hong Kong (Wong & So, 2003) to 4.4% in Malaysia (Loo & Ang, 2013). The prevalence rate observed in the US is like other Western countries, notably Sweden.

The National Institute on Alcohol Abuse and Alcoholism's NESARC is the largest ($N = 43,093$ adults) comorbidity survey conducted in the US that assessed DSM-IV pathological gambling and multiple substance-use, mood, anxiety, and personality disorders (Petry, Stinson, & Grant, 2005). The nationally representative sample with statistical weights has enabled multivariate investigations of prevalence estimates, gender-related associations, sociodemographic correlates, potential risk factors, and physical and psychiatric comorbidities. Furthermore, NESARC data collected from Wave 1 (2001–2002) and Wave 2 (2004–2005) provide for a unique opportunity to evaluate longitudinal and prospective research questions, although pathological gambling was only assessed in Wave 1. To date, although 51 articles have reported pathological-gambling-related

findings based on NESARC data, there have been no systematic reviews synthesizing results from more than a decade of publications. Such a summary could shed light on lessons learned from NESARC as well as inform future research efforts aimed at understanding the correlates and impact of pathological gambling and subdiagnostic levels.

A review of the gambling-related investigations from the NESARC data will help synthesize information gleaned from this data set and lay the foundation for future investigations of these and other data. This systematic review seeks to collect, evaluate, and discuss gambling-related NESARC findings, as the NESARC-related findings are important in informing policy makers, governmental bodies, researchers, and treatment providers. In the following sections, we will provide details on the systematic review methodology, evaluate findings from selected studies, and discuss implications for future directions. These findings are described and partitioned into relevant sections such as psychometrics, model testing, symptom analysis, prevalence estimates, gambling subtypes, sociodemographic correlates, potential risk factors, and comorbidities. Finally, "Discussion" section will highlight key findings, research and practical implications, and future directions.

METHODS

Search strategy

Protocols and strategies employed in this systematic review were in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, Altman, & PRISMA Group, 2009). Electronic Boolean searches of databases (PsycInfo, PubMed, and Web of Science) included all articles from inception to June 2019. The search strategy included a combination of keywords such as "National Epidemiologic Survey on Alcohol and Related Conditions" or "NESARC" and "gambling," "pathological gambling," "problem gambling," or "gambling disorder." Only articles in English were selected in the three search engines. Reference lists of included articles were checked manually for additional relevant publications.

Inclusion criteria and review process

All citations were managed with Endnote reference management software. Each reference title and abstract was screened by the authors independently and discussed as a group for eligibility against the inclusion criteria: (a) original empirical publications in English, (b) studies included NESARC Wave 1 and/or Wave 2 data, and (c) studies reported data from the gambling component of the Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS-IV). The resulting full-text copies of all articles considered to be relevant were retrieved and screened.

Data from included studies were extracted into MS Excel 2013 by the first author and independently checked by the other authors. Although the authors agreed upon the manuscripts to be included in the final analyses, data on independent evaluation for inclusion were not systematically

collected. The following characteristics of each study were retrieved: (a) general information – title, authors, and publication year; (b) sample size and other characteristics; (c) instrument and thresholding for pathological gambling; (d) other variables investigated in each study; (e) statistical analyses; (f) main findings or prevalence of pathological gambling; and (g) other findings.

RESULTS

Study selection

Upon removal of duplicates, the searches identified 67 records that were screened, whereby 51 empirical papers met the inclusion criteria and were included in this systematic review (see Figure 1 for PRISMA flow diagram). Nine excluded articles were not written based on NESARC data, while one excluded record was a conference abstract that was eventually published as an article and included in this systematic review. Details extracted from articles ($n = 43$) that examined pathological gambling as one of the main variables within specified research questions are

summarized in Table 1. Information extracted from the remaining 8 articles (out of the 51 included) that investigated pathological gambling as a peripheral variable in the context of other psychopathology is summarized in Table 2.

Study characteristics

All 51 included studies utilized either Wave 1 (Year 2001–2002) and/or Wave 2 (2005–2006) nationally representative NESARC data (Grant, Moore, Shepard, & Kaplan, 2003) and were published between years 2005 and 2019. Ten studies utilized both Wave 1 and 2 data sets for prospective evaluations of associations between pathological gambling at Wave 1 and medical/psychiatric disorders at Wave 2. Selection of sample sizes varied from 185 to 43,093 individuals depending on specified sample selection built upon research objectives.

Instrument

Assessment of pathological-gambling criteria based on the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (DSM-IV; American Psychiatric Association, 2000)

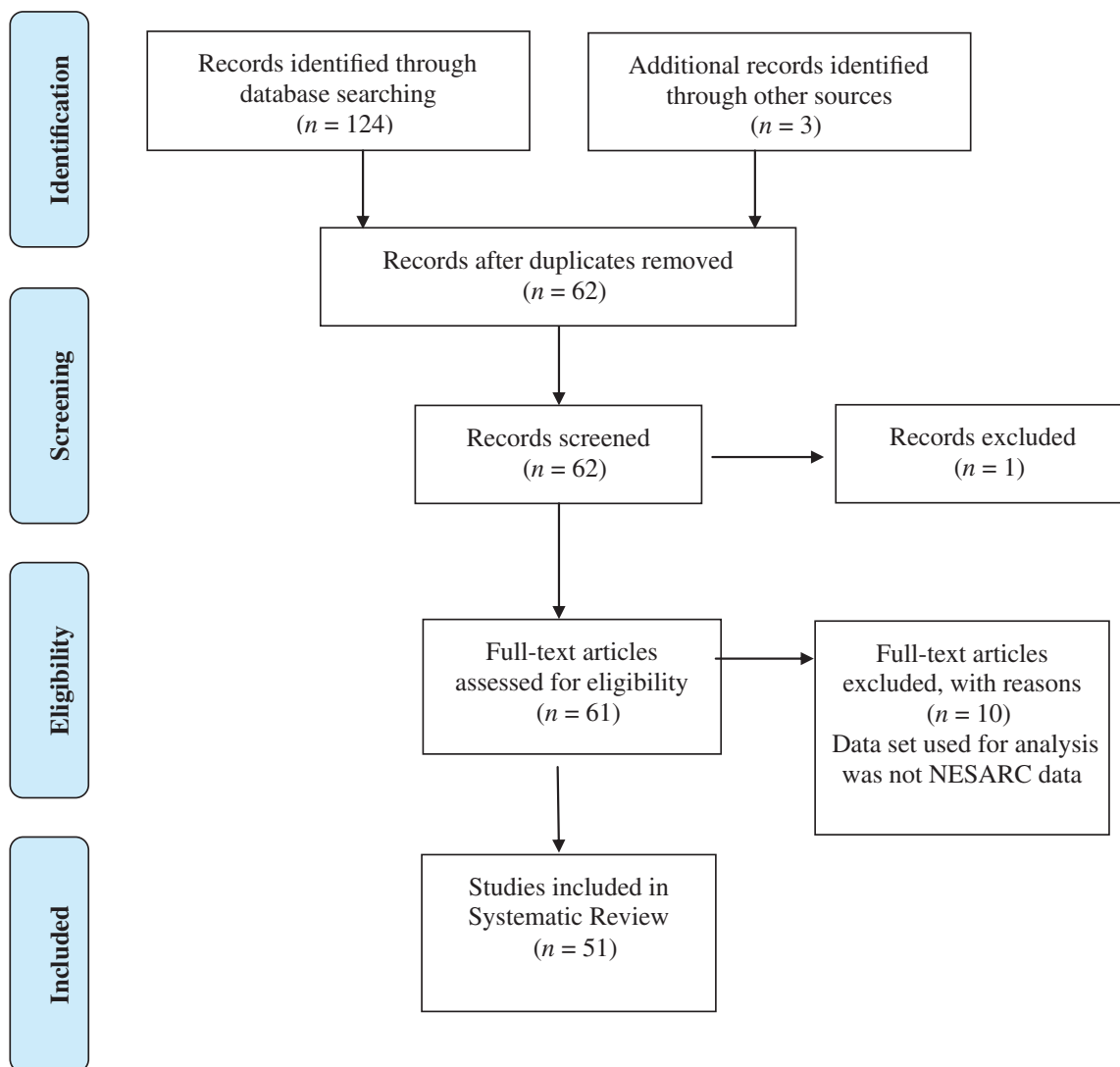


Figure 1. PRISMA flow diagram of the systematic review phases

Table 1. Summary table of NESARC findings on gambling disorder as the main construct

Article	Sample (N and other characteristics)	Instrument and diagnostic/subdiagnostic assessments	Other variables investigated	Main findings
Petry et al. (2005)	43,093 from Wave 1 (2001–2002); 81% response rate. Aim: to present nationally representative prevalence rates for pathological gambling, gender differences and comorbid psychiatric disorders	AUDADIS-IV; pathological gambling – 5 out of 10 DSM-IV criteria (15 symptom items operationalized the 10 pathological-gambling criteria)	Alcohol, drug use, mood, anxiety, and personality disorders	Lifetime prevalence rates = 0.42% (0.64% men, 0.23% women). Higher prevalence linked with being male, Black, 45–64 years of age, and widowed/separated/divorced. Pathological-gambling rates for substance-use disorder (0.61%–1.83%), mood disorder (0.85% hypomania and 2.92% mania), anxiety disorders (0.90% social phobia and 5.01% panic disorder), and personality disorders (1.53%–3.02%)
Blanco, Hasin, Petry, Stinson, and Grant (2006)	43,093 from Wave 1; non-institutional population ≥18 years residing in households and group quarters; weighted data – socioeconomic variables (2000 Decennial Census); non-response adjustment – household and person level	AUDADIS-IV; pathological gambling – 5 out of 10 DSM-IV criteria; gatekeeping question: “Have you gambled ≥5 times in any 1 year of your life?”; Subclinical pathological gambling – meet 1–4 pathological-gambling criteria	Mental disability scores – mental component summary (MCS) and social functioning (SF); pathological-gambling group only – onset age, number of criteria met, gambling venues, recovery age, and treatment-seeking	Lifetime prevalence rates = 0.64% men, 0.23% women; Subclinical pathological gambling = 6.79% men, 3.26% women. Past-year pathological-gambling prevalence among lifetime gamblers = 1.92% men, 1.05% women; past-year subclinical pathological gambling = 20.43% men, 15.09% women; past-year non-gambling = 77.65% men, 83.86% women. Men more likely than women to report past-year pathological gambling
Morasco et al. (2006)	43,093 from Wave 1 (2001–2002); weighted data – design characteristics, oversampling, non-response, demographics; mean age = 45.2 years (SD = 17.6) 52.1% female	AUDADIS-IV and SF-12v2 (physical and emotional functioning); 4 gambling groups: (1) “low-risk” never gambled ≥5 times in 1 year (never gambled and may have gambled in lifetime), (2) “At-risk” ≤2 criteria met in DSM-IV, (3) “Problem gambling” met 3–4 criteria, (4) “Pathologic gambling” met ≥5 DSM-IV criteria	Physical and mental health functioning, medical diagnoses, medical utilization, behavioral risk factors (body mass index, lifetime history of alcohol dependence, nicotine dependence, and diagnoses of mood/anxiety disorder)	Lifetime prevalence of pathological gambling = 0.42%, 0.90% problem gambling, 25.84% at-risk gambling and 72.84% low-risk gambling individuals. Increased problem-gambling severity associated with current obesity status, alcohol abuse/dependence, nicotine dependence, and mood and anxiety disorders
Slutske (2006)	n = 185 Wave 1 NESARC (N = 43,093) and n = 21 Gambling Impact and Behavior Study (N = 2,417) who met criteria of lifetime DSM-IV pathological gambling	AUDADIS-IV for NESARC and NORC DSM-IV for Gambling Problems (NODS) for Gambling Impact and Behavior Study. Assessment tool changes made to make Gambling Impact and Behavior Study and NESARC diagnoses comparable. Lifetime pathological gambling – meet ≥5 of 10 DSM-IV criteria at any time in life. Problem gambling – 3 or 4 DSM-IV pathological-gambling criteria	Treatment-seeking (sought professional help), recovery (lifetime history but did not endorse pathological gambling in the past 12 months), natural recovery (recovery but never sought treatment)	Gambling Impact and Behavior Study – 0.8% lifetime pathological-gambling prevalence (44.6% females), 1.3% lifetime problem-gambling prevalence (39.7% females). NESARC – 0.4% lifetime pathological gambling (29.6% females), 0.8% lifetime problem gambling (29.8% females). 7% (Gambling Impact and Behavior Study) and 12% (NESARC) treatment-seeking rates among lifetime pathological gambling. 36% (Gambling Impact and Behavior Study) and 39% (NESARC) “recovery” rates. “Natural recovery” was seen among 33%–36% of individuals with lifetime pathological gambling. Pathological gambling may not necessarily follow a chronic and persistent course

Desai et al. (2007)	25,485 Wave 1 NESARC participants age ≥ 40 years. Weights to adjust SEs for over-sampling, cluster sampling and non-response	AUDADIS-IV- gambling problems in three groups: (a) Non-gamblers – never gambled >5 times in a year for their lifetime, (b) Recreational gamblers – gambled >5 times/year but ≤ 2 criteria of pathological gambling in previous year, and (c) Problem/pathological gamblers with ≥ 3 criteria of pathological gambling in previous year	Health status – obesity, body mass index, self-rated health; nicotine dependence and alcohol abuse/dependence; chronic medical conditions; sociodemographics; SF-12 score – physical and mental	Participants aged 40–64 years (younger group): weighted prevalence estimates were calculated for non-gambling (68.70%), recreational gambling (30.80%) and problem/pathological gambling (0.30%). Participants >64 years (older group): prevalence estimates were 71.10% for non-gambling, 28.70% recreational gambling, and 0.30% problem/pathological gambling
Pietrzak, Morasco, Blanco, Grant, and Petry (2007)	10,563 Wave 1 NESARC older adults age ≥ 60 years. Cronbach's α for symptom items and pathological gambling for full sample were .92 and .80, respectively. Cronbach's α for symptom items and pathological gambling for older adults sample were 0.85 and 0.71, respectively	AUDADIS-IV to assess pathological gambling (meet at least 5 of 10 DSM-IV criteria). Gatekeeping question: "Have you gambled ≥ 5 times in any 1 year of your life?" – Those who answered "NO": Non-gambling (70.41%). Recreational gambling: Those who answered YES and met 0–2 of the 10 DSM-IV criteria. Disordered gambling: ≥ 3 criteria, included those with problem gambling and pathological gambling	Alcohol- and drug-use, mood, anxiety, and personality disorders. Medical diagnoses of past-year prevalence of 11 medical conditions	28.74% lifetime recreational gambling and 0.85% lifetime problem/pathological gambling with 0.29% meeting diagnostic criteria for pathological gambling and 0.56% reporting subdiagnostic symptoms. Recreational gambling relatively common among older adults (30% lifetime gambling ≥ 5 times in a year). Pathological gambling rate as 0.3% older adults met lifetime pathological-gambling diagnoses and 0.1% met past-year pathological-gambling criteria
Strong and Kahler (2007)	11,153 Wave 1 participants (46.1% females) who answered "yes" to "Have you ever gambled at least 5 times in any one year of your life?". Aim: to assess unidimensionality, symptom severity and relative patterns	AUDADIS-IV – pathological gambling represents 5 out of 10 DSM-IV criteria; included 12-month clustering criterion – whether multiple symptoms occurred within the past year	Sociodemographics – age, gender, race, and income level	Gamblers were 76.8% White, 20.1% Black, 14.2% Hispanic. Mean age was 45.75 years ($SD = 18.51$). Gender and age differences: women more likely than men to report gambling to improve mood and forget problems, while younger gamblers reported chasing losses at lower levels of problem-gambling severity
Desai and Potenza (2008)	43,093 from Wave 1; non-institutional population ≥ 18 years residing in households and group quarters; weighted data – socioeconomic variables (2000 Decennial Census); non-response adjustment – household and person level	AUDADIS-IV to assess pathological gambling, used past-year diagnoses with illness and substance exclusions- primary/independent DSM diagnoses. Four groups: (1) Non-gambling/low frequency gambling – never gambled >5 times/year in lifetime, (2) Low-risk gambling – gambled >5 times/year in lifetime but no pathological-gambling criteria in past year, (3) At-risk gambling – reported 1–2 pathological-gambling criteria in past year, and (4) Problem/pathological gambling – ≥ 3 pathological-gambling criteria in past year	Substance abuse and 7 Axis II personality disorders (no time periods applied). Sociodemographics (covariates): age, race/ethnicity, education, employment, marital status, and household income	Problem/pathological gambling rates: 0.7% in men and 0.4% in women. Both men and women may engage in low-frequency gambling without experiencing problem/pathological gambling. High rates of co-occurrence between Axis-I psychiatric disorders and problem/pathological gambling. Strong association between antisocial personality disorder and problem/pathological gambling. Males more likely than females to gamble and develop problem/pathological gambling, but stronger associations between at-risk or problem/pathological gambling and psychopathology among females than males

(Continued)

Table 1. (Continued)

Article	Sample (N and other characteristics)	Instrument and diagnostic/subdiagnostic assessments	Other variables investigated	Main findings
Alegria et al. (2009)	43,093 from Wave 1 (2001–2002); 11,153 for subgroup – prevalence of problem/pathological gambling among those who had engaged in gambling (lifetime conditional prevalence of disordered gambling)	AUDADIS-IV; Combined problem gambling (problem gambling – i.e., met 3 or 4 DSM-IV criteria for pathological gambling) with pathological gambling and labeled this group as “disordered gambling”	Medical conditions, stressful life events (Social Readjustment Rating Scale), psychosocial functioning and disability	Prevalence of problem/pathological gambling among black (2.2%), Native American/Asian (2.3%), and White (1.2%) groups. Lifetime conditional prevalence of problem/pathological gambling among black (9.0%), Native American/Asian (8.2%), and white (4.0%) groups. Potential risk factors for pathological gambling: socioeconomic status, alcohol-use disorders, psychiatric disorders
Boudreau, Labrie, and Shaffer (2009)	43,093 from Wave 1 (2001–2002); 11,153 for gambling subgroup. Aim: to investigate shadow syndromes and co-occurring symptoms within individuals with pathological-gambling features and individuals who gamble but no evidence of pathological-gambling features	AUDADIS-IV; selected 658 out of total 3,008 questions for testing prior 1-year symptom presence. 2 groups: past-year pathological gambling ($n = 121$) and gamblers without pathological-gambling features ($n = 9,930$). <i>Shadow syndromes</i> – clinical symptoms that are insufficiently clustered to satisfy criteria for diagnoses	29 DSM diagnostic categories with gambling-relevant symptoms (alcohol, drug dependence, mood disorders, and personality disorder)	25% of individuals with pathological gambling reported enough symptoms to meet criteria for at least one of the four pathological-gambling-relevant symptom clusters (dysthymia, generalized anxiety, anxiety related to other factors, specific phobias). Factor analysis reduced symptoms to 13 clusters
Grant, Desai, and Potenza (2009)	43,093 from Wave 1 multi-stage stratified sample; non-institutional population ≥ 18 years residing in households and group quarters; weighted data. Aim: to investigate associations between nicotine dependence, problem/pathological gambling and psychopathology	AUDADIS-IV – 4 groups: (1) Non-gambling/low-frequency gambling – never gambled >5 times/year in lifetime, (2) Low-risk gambling – gambled >5 times/year in lifetime but no pathological-gambling criteria in past year, (3) At-risk gambling – gambled >5 times/year in lifetime and reported 1–2 pathological-gambling criteria in past year, and (4) problem/pathological gambling – reported ≥ 3 pathological-gambling criteria in past year	Past-year measures for mood disorders, anxiety disorders, drug abuse and dependence, alcohol abuse and dependence, nicotine dependence; lifetime measures for Axis II personality disorders; sociodemographic variables	Out of 43,093, 12.8% nicotine dependent and 71.7% non-gambling, 23.1% low-risk gambling, 2.2% at-risk gambling and 0.5% problem/pathological gambling. Among individuals who were nicotine dependent, prevalence estimates for 4 problem-gambling-severity groups were 59.7%, 31.6%, 4.9% and 1.9%, respectively
Nelson et al. (2009)	11,153 (26% of 43,093) individuals who reported gambling ≥ 5 times/year in lifetime. Aim: to examine how specific pathological-gambling criteria relate to symptom patterns and stability (severity and course)	AUDADIS-IV – pathological gambling represents 5 out of 10 DSM-IV criteria	Past-year pathological gambling and prior to past-year pathological gambling	Preoccupation was the most endorsed symptom at 12.1%, followed by chasing (7.1%), tolerance (6.4%), escape (6%), lying (3.3%), loss of control (2.9%), reliance on others (1.3%), withdrawal (1.2%), jeopardizing other experiences (1%), and illegal acts (0.4%)

<p>Brewer, Potenza, and Desai (2010)</p>	<p>43,093 from Wave 1 (2001–2002); 81% response rate</p>	<p>AUDADIS-IV – 4 groups: (a) Non-gambling/low frequency gambling – never gambled >5 times/year in lifetime, (b) Low-risk gambling – gambled >5 times/year in lifetime but no pathological-gambling diagnoses in past year, (c) At-risk gambling – 1 or 2 pathological-gambling symptoms in past year, (d) problem/pathological gambling – ≥3 pathological-gambling symptoms in past year</p>	<p>Alcohol dependence and/or abuse; sociodemographics; Alcohol use groups (final): alcohol-use disorder and non-alcohol-use disorder</p>	<p>2.3% problem/pathological gambling among non-alcohol-use-disorder group and 8.3% problem/pathological gambling among alcohol-use-disorder group. Complex relationship between problem/pathological gambling, alcohol-use disorder and psychopathology. Among non-alcohol-use-disorder group, problem/pathological gambling was associated with elevated odds for most Axis I and II disorders. Among alcohol-use-disorder group, the same pattern was not evident. Data suggest that alcohol-use disorders account for some of the variance in the relationship between problem-gambling severity and psychopathology</p>
<p>Gebauer et al. (2010)</p>	<p>43,093 from Wave 1; non-institutional population ≥18 years residing in households and group quarters. Aim: to develop a brief biosocial gambling screen for the general population</p>	<p>AUDADIS-IV – pathological gambling represents ≥5 out of 10 DSM-IV criteria in past year and utilized the Mapped Lie/Bet scale</p>	<p>Lie/Bet Questionnaires as a reference point</p>	<p>Developed a psychometrically sound 3-item questionnaire as an alternative to the Lie/Bet Questionnaire. The questionnaire is consistent with the syndrome model of addiction</p>
<p>Barry et al. (2011b)</p>	<p>31,830 adults (13% Hispanic, 87% white), 48% men and 52% women. Aim: to examine associations between race/ethnicity, sociodemographics, psychopathology and problem/pathological gambling</p>	<p>AUDADIS-IV – 3 groups: (a) Non-gambling/low frequency gambling – never gambled >5 times/year in lifetime, (b) Low-risk or at-risk gambling – gambled >5 times/year in lifetime with 0–2 inclusionary pathological-gambling criteria in previous year, and (c) problem/pathological gambling – ≥3 past-year pathological-gambling criteria</p>	<p>Past-year measures for mood disorders, drug abuse, alcohol abuse and dependence, nicotine dependence (as per Grant et al., 2009). Lifetime measures for Axis II personality disorders. Sociodemographic variables included</p>	<p>White respondents (0.5%) more likely to exhibit problem/pathological gambling as compared to Hispanic respondents (0.4%). Rates of psychiatric disorders significantly related to past-year problem-gambling severity in both Hispanic and White participants</p>
<p>Barry et al. (2011a)</p>	<p>32,316 adults (12.98% Black, 87.12% White), 42% men and 58% women. Aim: to examine associations between sociodemographics, psychiatric disorders, and past-year problem-gambling severity among Black and White respondents</p>	<p>AUDADIS-IV – 3 groups: (a) Non-gambling/low frequency gambling – never gambled >5 times/year in lifetime, (b) Low-risk or at-risk gamblers- gambled >5 times/year in lifetime with 0–2 inclusionary pathological-gambling criteria in previous year, and (c) problem/pathological gambling – ≥3 past-year pathological-gambling criteria</p>	<p>Past-year measures for mood disorders, drug abuse, alcohol abuse and dependence, nicotine dependence. Lifetime measures for DSM-IV Axis II personality disorders. Sociodemographic variables included</p>	<p>65.7% Black and 63.9% White respondents had non-gambling/low-frequency gambling. Prevalence rates of problem/pathological gambling were higher for Black (0.96%) than White (0.45%). Respondents. Rates of psychiatric disorders were associated with past-year problem-gambling severity for both Black and White participants</p>

(Continued)

Table 1. (Continued)

Article	Sample (N and other characteristics)	Instrument and diagnostic/subdiagnostic assessments	Other variables investigated	Main findings
Carragher and McWilliams (2011)	11,104 adults who reported having gambled ≥5 times in lifetime and provided complete data on 15 past-year DSM-IV pathological-gambling criteria items. Aim: latent class analysis to derive and validate typology of gambling groups using epidemiological data	AUDADIS-IV – pathological gambling represents 5 out of 10 DSM-IV criteria. “Chasing” behavior is represented differently in DSM-IV (long-term chasing) and AUDADIS-IV (both short- and long-term chasing)	Demographic variables, psychiatric, and substance use disorders. Included lifetime measures for mood disorders, anxiety disorders and personality disorders. Composite variables of past-year alcohol use and drug-use disorders	93.3% respondents grouped in the class, without gambling problems while 6.1% in the moderate- and 0.6% in the pervasive-gambling-problems classes, respectively. In the class without gambling problems, there were very low endorsement probabilities of all 10 DSM-IV pathological-gambling criteria. Moderate-gambling-problems class endorsed primarily the preoccupation, tolerance and chasing criteria. Pervasive-gambling-problems class endorsed most criteria
Chou and Afifi (2011)	33,231 Waves 1 and 2 NESARC reflecting follow-up completions and complete data (Respondents with missing items removed). Aim: to examine association between past-year problem/pathological gambling with Axis 1 psychiatric disorders 3 years later (longitudinal and prospective study design)	AUDADIS-IV – past-year problem/pathological gambling represents respondents having met ≥3 criteria in the past year. Non-disordered gambling – all participants not classified under problem/pathological gambling, including lifetime non-gamblers	Sociodemographics (covariate-1); Axis 1 disorders – mood, anxiety and substance use; 11 medical conditions (covariate-2); SF-12 physical and mental health component summary scores (covariate-3); 12 stressful life events (covariate-4)	Overall prevalence of problem/pathological gambling was 0.6% with 0.82% prevalence among males and 0.4% among females. Past-year problem/pathological gambling linked with increased odds of the incidence of some Axis 1 disorders at 3-year follow-up, and these relationships remained significant after adjusting for the effects of potential confounds
Oleski et al. (2011)	43,093 from Wave 1. Aim: confirmatory factor analysis to investigate how pathological gambling loads on Krueger’s (1999) 3-factor model of common mental disorders (internalizing, externalizing, and anxious-misery factors)	AUDADIS-IV to assess pathological gambling (meet at least 5 of 10 DSM-IV criteria). Gatekeeping question: “Have you gambled ≥5 times in any 1 year of your life?”	10 mental disorders: major depression, dysthymia, generalized anxiety disorder, panic disorder, agoraphobia, social phobia, specific phobia, alcohol dependence, and antisocial personality disorder	Confirmatory factor analysis showed Krueger’s 3-factor model fitted NESARC data. DSM-IV pathological gambling shows highest loading onto externalizing factor comprised of pathological gambling, drug and alcohol dependence, and antisocial personality disorder for both men and women
Sacco et al. (2011)	43,093 from Wave 1. Aim: to examine differential item functioning in DSM-IV pathological gambling criteria based on ethnicity, age and gender	AUDADIS-IV – pathological gambling represents 5 out of 10 DSM-IV criteria in any 1 year of their lives. Past-year and lifetime prevalence obtained.	Sociodemographics – age, gender, race, employment, and income level	Differential item functioning evidenced for gender, ethnicity and age. Women and Asians individuals less likely to endorse preoccupation (Criterion 1) than reference groups (male, Caucasian and ages 25-59 years). Females more likely to endorse gambling to escape (Criterion 5), while young adults were less likely to endorse gambling to escape

<p>Giddens et al. (2012)</p>	<p>43,093 from Wave 1 (2001–2002). Aim: to investigate the impact of past-year anxiety disorders on the relationships between past-year problem/pathological gambling and non-anxiety psychopathology</p>	<p>AUDADIS-IV – four groups: (a) Non-gambling/low frequency gambling – gambled <5 times/year in lifetime, (b) Low-risk gambling – gambled >5 times/year in lifetime but no pathological-gambling criteria in past year, (c) At-risk gambling – gambled >5 times/year in lifetime and reported 1–2 pathological-gambling criteria in past year, and (d) problem/pathological gambling – reported ≥3 pathological-gambling criteria in previous year</p>	<p>Sample stratified into two groups: (a) individuals who met past-year anxiety-disorder criteria (personality disorder, generalized anxiety disorder, social phobia, or simple phobia), and (b) individuals who did not meet past-year anxiety-disorder criteria</p>	<p>Higher problem-gambling severity associated with Axis I and II psychiatric disorders in both anxiety-disorder and non-anxiety-disorder groups. Significant interactions (anxiety-by-gambling), especially for mood and personality disorders. Anxiety-by-gambling interactions indicate stronger associations between problem-gambling severity and psychiatric disorders among individuals without anxiety disorder than those with anxiety disorders</p>
<p>Barry et al. (2013)</p>	<p>41,987 adults (Wave 1) with complete information on pain interference and problem-gambling severity</p>	<p>AUDADIS-IV – 3 groups: (a) Non-gambling/low frequency gambling – never gambled >5 times/year in lifetime, (b) Low-risk or at-risk gambling – gambled >5 times/year in lifetime with 0-2 inclusionary pathological-gambling criteria in past year, and (c) problem/pathological gambling – ≥3 past-year pathological-gambling criteria</p>	<p>Past-year measures for mood, anxiety, substance-use disorders and lifetime measures for DSM-IV Axis II personality disorders; socio-demographic variables. Pain interference – measured by SF-12 subscale and divided into 2 groups: no/low pain interference and moderate/severe pain interference</p>	<p>Prevalence of problem/pathological gambling higher for moderate/severe pain interference group (0.79%) than for no/low pain interference (0.48%). Associations between problem-gambling severity and psychiatric disorders are largely not modified by pain interference. Pain interference moderates the relationships between problem-gambling severity and 4 psychiatric disorders: dysthymia, panic disorder, dependent personality disorder, specific phobia</p>
<p>Nower, Martins, Lin, and Blanco (2013)</p>	<p>581 problem/pathological gambling participants from Wave 1 NESARC. Aim: to derive empirical subtypes relating to problem/pathological gambling based on etiological and clinical characteristics in the Pathways Model</p>	<p>AUDADIS-IV; pathological gambling – 5 out of 10 DSM-IV criteria; gatekeeping question: “Have you gambled ≥5 times in any 1 year of your life?”; Problem/pathological gambling – ≥3 DSM-IV pathological-gambling criteria</p>	<p>Other psychiatric disorders; general health, physical functioning, bodily pain and mental health scores of the SF12v2; family history of drug/alcohol problems and antisocial personality disorder; current events (separation, divorce, death of loved ones, problems with the law); demographics</p>	<p>1.36% problem/pathological gambling out of 43,093 participants. Latent class analyses showed a 3-class solution as best-fitting model. 50.76% in Class 1 reported lowest overall psychiatric disorders including problem-gambling severity and mood disorders. 20.06% in Class 2 reported high probability of endorsing past-year substance-use disorders, moderate probability of having personality disorder and having parents with alcohol/drug-use problems and highest probability for past-year mood disorders. 29% in Class 3 had the highest probabilities of personality and prior-to-past year mood disorders, substance-use disorders, separation/divorce, drinking-related physical fights, and parents with alcohol/drug problems and/or a history of antisocial personality disorder</p>
<p>Pilver, Libby, Hoff, and Potenza (2013a)</p>	<p>34,653 participants who completed both Wave 1 and Wave 2 data (87% response rate)</p>	<p>AUDADIS-IV – at-risk/problem/pathological gambling – gambled >5 times a year and acknowledged one to ten inclusionary criteria for pathological gambling – Non-at-risk/problem/pathological gambling – no inclusionary criteria for pathological gambling</p>	<p>3-year incidence (from Wave 1 to Wave 2) of alcohol-use disorders, nicotine dependence, drug-use disorders (both prescribed and non-prescribed) and illicit drug-use disorders</p>	<p>At-risk/problem/pathological gambling (in comparison with non-at-risk/problem/pathological gambling) showed: (a) positive association with incident nicotine dependence among women, (b) negative association with incident prescription drug-use disorders among men, (c) positive association with incident alcohol-use disorders among men</p>

(Continued)

Table 1. (Continued)

Article	Sample (N and other characteristics)	Instrument and diagnostic/subdiagnostic assessments	Other variables investigated	Main findings
Pilver, Libby, Hoff, and Potenza (2013b)	10,231 participants aged 55 years or older to examine incident cases of Axis I disorders. Aim: to evaluate past-year problem gambling severity at Wave 1 and incident Axis I psychopathology at Wave 2	AUDADIS-IV – at-risk/problem/pathological gambling –gambled >5 times a year and acknowledged one to ten inclusionary criteria for pathological gambling – Non-at-risk/problem/pathological gambling – no inclusionary criteria for pathological gambling	Binary (presence or absence); combined category of Axis 1, mood, anxiety and any substance-use disorder. Covariates – assessed at Wave 1	67.3% non-gambling/low-frequency gambling, 29.9% low-risk gambling, and 2.8% at-risk/problem and pathological gambling (84.7% 1–2 features of pathological gambling, 13.3% 3–4 features of pathological gambling, 2.0% endorsed ≥5 features of pathological gambling). At-risk/problem/pathological-gambling group was more likely to report incidence of mental illness as compared to non-gambling/low-frequency-gambling group
Pilver and Potenza (2013)	10,231 participants aged 55 years or older. Aim: to evaluate prospective associations between at-risk/problem/pathological gambling (Wave 1) and incident medical conditions among older adults (Wave 2)	IV – At-risk/problem/pathological gambling assessed at Wave 1. – Only individuals without a lifetime history of outcome of interest in Wave 1 were included in each analytical sample	Incident physical health conditions (binary outcomes) at Wave 2. Other variables – socio-demographic covariates at Wave 1, baseline psychiatric comorbidity, substance use, body mass index	67.3% non-gambling/low-frequency gambling, 28.8% low-risk gambling, and 2.4% at-risk/problem/pathological gambling. At baseline (Wave 1), at-risk/problem/pathological-gambling group was younger, more likely to be male, have past-year history of mood disorder and Axis II disorder, and report using alcohol, tobacco, and drugs. At-risk/problem/pathological gambling was associated with incident arteriosclerosis and heart conditions
Parhami et al. (2014)	34,653 Wave 1 (81% response rates) and Wave 2 (87% response rates) NESARC participants. Aim: to use longitudinal data to determine whether problem-gambling severity is related to the onset of psychiatric disorders	AUDADIS-IV – non-gambling/low-frequency-gambling comparison group (individuals who gambled <5 times/year in lifetime) and 3 gambling groups: (1) Recreational gambling – gambled >5 times/year in lifetime without meeting any past-year gambling-disorder criteria, (2) Subthreshold gambling disorder – gambled >5 times/year in lifetime with 1–3 inclusionary past-year gambling-disorder criteria, and (3) Gambling disorder – met 4–9 past-year gambling-disorder criteria	DSM-IV Axis I disorders grouped into three categories: mood, anxiety and substance-use disorders. Posttraumatic stress disorder assessed in Wave 2 and sociodemographics	Non-weighted baseline prevalence of recreational gambling (23%), subthreshold gambling disorder (2.6%) and gambling disorder (0.33%) with 73.2% non-gambling. At 3 years after initial intake interview, individuals with higher problem-gambling severity at baseline demonstrated greater odds of experiencing incident mood, anxiety or substance-use disorders, with a graded relationship observed
Vizecaino et al. (2014)	43,093 from Wave 1. Aim: to investigate differences between early- vs. later-onset pathological gambling in sociodemographics, Axis I and II psychopathology, preferred gambling and treatment-seeking rates	AUDADIS-IV to assess pathological gambling (meet at least 5 of 10 DSM-IV criteria). Gatekeeping question: “Have you gambled ≥5 times in any 1 year of your life?” Age of pathological-gambling onset was divided as ≤25 years (earlier onset) and ≥26 years (later-onset)	Strategic (blackjack, poker, sports betting, etc) vs. non-strategic (keno, bingo, pull-tabs, slot machines) gambling; Aggregated alcohol-use disorders and drug-use disorders; mood and anxiety disorders; 7 DSM-IV personality disorders	Early-onset pathological gambling was associated with being male, being never married, having incomes below \$70,000, belonging to younger cohorts and having Cluster B personality disorders and inversely associated with mood disorders. Gender differences may relate to telescoping effects

Blanco et al. (2015)	43,093 from Wave1. Aim: to develop etiological model of pathological gambling for males and females based on Kendler's developmental model for major depression	AUDADIS-IV – stratified into three samples: (a) Lifetime gambling – gambled at least 5 times per year in any one year, (b) Lifetime history of pathological gambling – individuals who met DSM-IV pathological-gambling criteria in any one year of their life, (c) Past-year pathological gambling – individuals meeting 5 out of 10 DSM-IV criteria in the prior year AUDADIS-IV – pathological gambling represents 5 out of 10 DSM-IV criteria in any 1 year. Past-year and lifetime prevalence obtained. Problem/pathological gambling represents meeting 3 or more DSM-IV criteria. 4 groups: recreational (0 criteria), at-risk gambling (1–2 criteria), problem gambling (3–4 criteria) and pathological gambling (≥5 criteria)	Variables selected were related to five developmental periods: childhood, early adolescence, late adolescence, adulthood and past year	12-month pathological-gambling prevalence was 0.16%. Modified Kendler's model provides a foundation for a comprehensive developmental model of pathological gambling. Lifetime and 12-month pathological gambling can be statistically predicted by factors in several developmental levels with carry-over effects from preceding to subsequent levels
Cowlishaw and Hakes (2015)	402 patients who reported past-year treatment of substance-use problems from Wave 1 and Wave 2 ($n = 308$). Aim: to estimate prevalence of pathological gambling and problem gambling across treatment settings and associations with constructs in mental and physical health, healthcare utilization and psychosocial problems	AUDADIS-IV – pathological gambling represents 5 out of 10 DSM-IV criteria in any 1 year. Past-year and lifetime prevalence obtained. Problem/pathological gambling represents meeting 3 or more DSM-IV criteria. 4 groups: recreational (0 criteria), at-risk gambling (1–2 criteria), problem gambling (3–4 criteria) and pathological gambling (≥5 criteria)	Past-year Axis I and lifetime Axis II disorders, SF-12 measures of past-year mental and physical health, and past-year occurrences of life events (representing psychosocial problems) such as work relationships, termination of steady relationship, financial issues and legal difficulties	4.3% lifetime pathological-gambling prevalence (5+ DSM-IV criteria) and 7.2% problem/pathological gambling (3+ DSM-IV criteria). Lifetime pathological-gambling criteria associated with Axis II disorders but not Axis I diagnoses
Moghaddam et al. (2015)	13,578 individuals who provided information on gambling behavior, lifetime suicidal ideation and/or attempts. Aim: to examine suicidal and gambling behavior with a derived subgroup of a nationally representative sample	AUDADIS-IV – 5 gambling groups: non-gambling (never gambled ≥5 times in any one year), low-risk gambling (gambled ≥5 times in any one year but have not met any DSM-IV pathological-gambling criteria), at-risk gambling (met 12 pathological-gambling criteria), problem gambling (met 3–4 criteria), and pathological gambling (met 5–10 criteria)	Lifetime suicidal behaviors, lifetime suicidal ideation, and lifetime suicidal attempts	Non-gambling (25.8%), low-risk (24.5%) and at-risk gambling (28.4%) had similar prevalence rates of suicidal ideation. 36.7% rate of suicidal ideation among problem-gambling group and 49.2% among pathological-gambling group. For suicide attempts, rates were as follows: 7.9% non-gambling, 6.6% low-risk, and 7.9% at-risk gambling. Problem gambling (17.2%) and pathological gambling (18.3%) associated with higher rates of suicide attempts
Sharma and Sacco (2015)	34,653 participants who completed both Wave 1 and Wave 2 data. Aim: to examine associations between pathological gambling and adverse childhood experiences	AUDADIS-IV – 4 groups: 0 = non-gambling, never gambled >5 times per year in lifetime; 1 = non-problem gambling, endorsed <2 pathological-gambling criteria; 2 = problem gambling, endorsed 2–4 DSM-IV pathological-gambling criteria; 3 = pathological-gambling endorsed ≥5 pathological-gambling criteria	Adverse childhood experiences: physical, sexual, emotional abuse, physical neglect and family violence. Covariates: sociodemographics, lifetime substance-use, and mood and anxiety disorders	Adverse childhood experiences rates were higher among problem-gambling and pathological-gambling groups than non-gambling group. Physical abuse: 4.40% among non-gambling group, 4.84% among non-problem-gambling group, 6.95% among problem-gambling group, 12.21% among pathological-gambling group. Sexual abuse: 10.41% among non-gambling group, 9.56% among non-problem-gambling group, 15.50% among problem-gambling group, 15.44% among pathological-gambling group

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Table 1. (Continued)

Article	Sample (N and other characteristics)	Instrument and diagnostic/subdiagnostic assessments	Other variables investigated	Main findings
Wilson, Salas-Wright, Vaughn, and Maynard (2015)	11,153 Wave 1 participants who answered “yes” to “Have you ever gambled at least 5 times in any one year of your life?” Aim: to utilize data from Wave 1 and 2 to examine gambling prevalence rates across gender and world regions	AUDADIS-IV; Only items with prevalence of greater than 1.5% were included in statistical analyses	– Wave 2 Immigrant status: first-generation, second-generation, third-generation and non-immigrant – Socio-demographic controls: age, gender, ethnicity/race, household income, education level, marital status, region of the U. S., urbanicity	Gambling prevalence lower among first-generation immigrants (19.05%) relative to native-born Americans (29%), second-generation (29.93%) and third-generation (33.22%) immigrants. Pathological-gambling prevalence lower among first-generation immigrants (2.79%) relative to native-born Americans (4.73%), second-generation (4.71%) and third-generation (5.18 %) immigrants. Second-generation immigrants and non-immigrants with higher likelihood of meeting criteria for problem/pathological gambling
Kong, Smith, Pilver, Hoff, and Potenza (2016)	43,093 from Wave 1 (2001–2002); Aim: to investigate association between problem-gambling severity and psychiatric disorders among American-Indian/Alaska-Native individuals	AUDADIS-IV – 3 groups: Non-gambling/low frequency, low-risk gambling, and at-risk/problem/pathological gambling (see Barry et al., 2011b)	Sociodemographics – age, gender, race, education level, marital status, employment status; Axis I and Axis II diagnoses	American-Indian/Alaska-Native as compared with other respondents were least likely to report non-gambling/low-frequency gambling (American-Indian/Alaska-Native 66.5%, white 70.5%, black 72.8%, other race 72.3%) and most likely to report low-risk gambling (American-Indian/Alaska-Native 30.1%, white 26.5%, black 23.4%, other race 24.7%). Stronger associations between at-risk/problem/pathological gambling and past-year Axis I disorders among American-Indian/Alaska-Native than other groups
Cowlishaw, Hakes, and Dowling (2016)	3,007 adults reporting treatment for mood/anxiety disorders. Predominantly female (73.2%), white/non-Hispanic (65.5%). Aim: to evaluate prevalence and clinical correlates of problem/pathological gambling among a sample of individuals seeking treatment for affective disorders	AUDADIS-IV to derive estimates of at-risk gambling (1–2 criteria) and problem/pathological gambling (3+ criteria)	Past-year substance usage (i.e., drinking frequency, heavy drinking, marijuana and other drugs use); mental and physical health (SF-12); health-service utilization; occurrences of psychosocial difficulties	Among individuals seeking treatment for affective disorders, rates of lifetime and past-year problem/pathological gambling were 3.1% and 1.4%, respectively. Meanwhile, 8.9% showed at-risk gambling features. Lifetime pathological gambling statistically predicted higher interpersonal and financial difficulties, marijuana use (not alcohol use) and healthcare utilization; and poorer mental or physical health
Sanacora et al. (2016)	43,093 from Wave 1 (2001–2002). Aim: to investigate potential moderation effect of income on relationship between pathological gambling and psychopathology	AUDADIS-IV to derive 4 problem-gambling-severity groups – Non-gambling/low frequency, low-risk gambling, at-risk gambling and problem/pathological gambling (see Desai & Potenza, 2008)	Independent or primary past-year psychopathology diagnoses (Desai & Potenza, 2008). Annual income (moderator) in 2 groups – lower (annual household income <\$24,000) and middle/higher (>\$24,000) income	Greater problem-gambling severity statistically predicted increased odds of multiple psychiatric disorders for both income groups. Stronger association between problem/pathological gambling and alcohol abuse/dependence for middle/higher income than lower-income group

Ronzitti, Kraus, Hoff, Clerici, and Potenza (2018)	43,093 from Wave 1 (2001–2002). Aim: to examine the extent to which stress moderated the relationships between problem-gambling severity and psychopathologies	AUDADIS-IV; Problem-gambling measured at Wave 1. The sample was divided into four problem-gambling severity groups with five episodes of gambling in a single year in their lifetime; low-risk gambling with <5 episodes of gambling in a single year and no criteria for pathological gambling in the past year; at-risk gambling with one or two criteria for pathological gambling in the past year; and problem/pathological gambling with > three criteria for pathological gambling in the past year	AUDADIS-IV assessed gambling and other psychiatric disorders in the NESARC. From the 12 items on the AUDADIS-IV related to past-12-month stressful events, a median split was used to create two categories: a low past-year stress group (i.e., 0 or 1 event), and a high past-year stress group (i.e., two or more events)	Stress moderated problem-gambling-severity relationships with Cluster B disorders. A stronger relationship was observed between problem-gambling severity and psychopathology in the low-stress versus high-stress groups
Ronzitti et al. (2018)	13,543 from Wave 1 (2001–2002) with mood symptomatology. Aim: to examine relationships between problem-gambling severity and personality disorders among individuals with differing levels of suicidality	AUDADIS-IV; Problem-gambling measured at Wave 1. The sample was divided into four problem-gambling severity groups with five episodes of gambling in a single year in their lifetime; low-risk gambling with < five episodes of gambling in a single year and no criteria for pathological gambling in the past year; at-risk gambling with one or two criteria for pathological gambling in the past year; and problem/pathological gambling with > three criteria for pathological gambling in the past year	NESARC wave-1 survey investigated features of antisocial, avoidant, dependent, histrionic, obsessive–compulsive, paranoid, and schizoid personality. Two questions were used to assess lifetime major depressive episode (yes/no). Based on three questions the sample was classified into three suicidality groups: (a) history of suicide attempt; (b) history of suicide ideation, without any history of suicide attempt; and (c) no history of suicidal behaviors	At-risk or problem/pathological gambling groups showed higher rates of a wide range of personality disorders compared to non-gambling group. At-risk and problem/pathological gambling groups had higher odds for any personality disorder than the group with no history of suicidality, particularly for cluster-B personality disorders
Nicholson, Mackenzie, Afifi, Keough, and Sareen (2019)	43,093 from Wave 1 (2001–2002). 34,635 from Wave 2 (2004 and 2005). Aim: to examine whether changes in gambling-related diagnostic criteria from DSM-IV to DSM-5 correspond to changes in prevalence of comorbid psychiatric disorders	AUDADIS-IV; Pathological gambling assessed at Wave 1 according to DSM-IV criteria in the past year	AUDADIS-IV assessed gambling and other psychiatric disorders in the NESARC	Prevalence for any comorbid disorder among gambling-related diagnoses was similar from DSM-IV (56.7%) to DSM-5 (53.7%). Comorbidity between gambling disorder using DSM-5 criteria and alcohol-use (25.3%) and cannabis-use (37.7%) disorders remained high
Roberts et al. (2018)	Waves 1 and 2 (N = 25,631) of the NESARC. Aim: to investigate the associations between intimate partner violence and gambling problems and Axis I and II disorders	AUDADIS-IV; Pathological-gambling-related measures at Wave 1 according to DSM-IV criteria in the past year. Problem/pathological gambling was defined by having three or more DSM-IV criteria and at-risk gambling with 1–2 criteria of pathological gambling	Physical intimate partner violence victimization and perpetration in the past 12 months were assessed at Wave 2 using items from the Conflict Tactics Scale (CTS-R)	Problem/pathological gambling was associated with increased odds of both intimate partner violence perpetration for males (OR = 2.62) and females (OR = 2.87), and with intimate partner violence victimization for females only (OR = 2.97)

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Table 1. (Continued)

Article	Sample (N and other characteristics)	Instrument and diagnostic/subdiagnostic assessments	Other variables investigated	Main findings
Bernardi et al. (2019)	43,093 from Wave 1 (2001–2002). Aim: to examine predictors of pathological gambling remission status during the past 12 months	AUDADIS-IV; Pathological-gambling-related measures at Wave 1 according to DSM-IV criteria in the past year. Problem/pathological gambling was defined by having three or more DSM-IV symptoms. Gambling remission was defined as having a lifetime history of problematic gambling or pathological gambling but not endorsing any pathological gambling DSM-IV criteria	AUDADIS-IV assessed psychiatric disorders in the NESARC. Family history of depression, substance-use disorders, and antisocial personality disorder were included	Rates of past 12-month remission were 45.24% for problem gambling (3–4 DSM-IV criteria) and 36.72% for pathological gambling (>5 DSM-IV criteria). Survival analyses estimated an 85.6% cumulative probability of remission from pathological gambling, with a median time of 19 years
Ronzitti, Kraus, Hoff, Clerici, and Potenza (2019)	13,543 from Wave 1 (2001–2002) with mood symptomatology. Aim: to examine the relationship between different levels of problem-gambling severity and DSM-IV Axis I psychiatric disorders according to suicidality level	AUDADIS-IV; Pathological-gambling-related measures at Wave 1 according to DSM-IV criteria in the past year. The sample was divided into four problem-gambling severity groups with five episodes of gambling in a single year in their lifetime; low-risk gambling with < five episodes of gambling in a single year and no criteria for pathological gambling in the past year; at-risk gambling with one or two criteria for pathological gambling in the past year; and problem/pathological gambling with > three criteria for pathological gambling in the past year	AUDADIS-IV assessed psychiatric disorders in the NESARC. Two questions were used to assess lifetime major depressive episode (yes/no). Based on three questions the sample was classified into three suicidality history groups: (a) history of suicide attempt; (b) history of suicide ideation, without any history of suicide attempt; and (c) no history of suicidal behaviors	The relationships between Axis I psychiatric disorders and problem-gambling severity were mostly not moderated by suicidal ideation or attempt except for panic disorder in which a stronger relationship was observed in the relationship between low-risk gambling (vs low-frequency/non-gambling) in the group with suicide attempts as compared with that without attempt or ideation
Hammond et al. (2019)	43,093 from Wave 1 (2001–2002). Aim: to examine how cannabis use moderated associations between problem-gambling severity and psychopathology	AUDADIS-IV; Pathological-gambling-related measures at Wave 1 according to DSM-IV criteria in the past year. The sample was divided into four problem-gambling severity groups with five episodes of gambling in a single year in their lifetime; low-risk gambling with < five episodes of gambling in a single year and no criteria for pathological gambling in the past year; at-risk gambling with one or two criteria for pathological gambling in the past year; and problem/pathological gambling with > three criteria for pathological gambling in the past year	AUDADIS-IV assessed psychiatric disorders in the NESARC	Among both the group with lifetime cannabis use and that which never used cannabis, greater problem-gambling severity was associated with more psychopathology across mood, anxiety, substance-use and Axis II disorders. Cannabis use moderated the relationships between problem-gambling severity and psychiatric disorders, with cannabis use appearing to account for some of the variance in the associations between greater problem-gambling severity and specific forms of mental illness

Table 2. Summary table of (eight) studies that investigated problem-gambling severity in the context of other main psychopathology variables

Article	Sample (N and other characteristics)	Main variables investigated	Main findings
Blanco et al. (2008)	43,093 from Wave 1 (2001–2002); 81% response rate. Aim: to present nationally representative lifetime prevalence correlated and comorbidity of shoplifting among US adults	Main variable: shoplifting (embedded in the section on antisocial personality disorder). Diagnoses of mood, anxiety, and disorders, and personality disorders	0.56% past-year pathological gambling prevalence among shoplifters and 0.11% pathological gambling prevalence among non-shoplifters. Strongest links with shoplifting behavior were deficits in impulse control such as pathological gambling, antisocial personality disorder, substance-use disorders, and bipolar disorder
Pulay et al. (2008)	43,093 from Wave 1 (2001–2002); 81% response rate. Aim: to present lifetime prevalence and population estimates of violent behavior among individuals with psychopathology	Information on violent behavior collected before age 15 and since age 15 years. Diagnoses of mood, anxiety, substance-use, and personality disorders	28.78% prevalence of violent behavior among pathological-gambling group with comorbid disorders, but 0% prevalence of violent behavior among individuals with solely pathological-gambling diagnoses. Odds of violent behavior increases with pathological gambling, substance-use disorders, major depressive disorder, anxiety disorders, and personality disorders
Vaughn et al. (2009)	43,093 from Wave 1 (2001–2002); 81% response rate. Aim: to investigate sociodemographic, psychiatric, and behavioral correlates of cruelty to animals	Cruelty to animals assessed as an embedded item in the section on antisocial personality disorder. Diagnoses of mood, anxiety, substance-use, and personality disorders	3.02% lifetime pathological gambling prevalence among individuals with history of cruelty to animals and 0.39% pathological-gambling prevalence among individuals without history of cruelty to animals. Strong associations between cruelty to animals and lifetime alcohol-use disorders, pathological gambling, conduct disorder, specific personality disorders and family history of antisocial behavior, and cruelty to animals
Blanco et al. (2010)	43,093 from Wave 1 (2001–2002). Aim: to examine national prevalence, sociodemographic, psychiatric correlates and mental health service utilization rates of individuals with fire-setting behaviors	Fire-setting behavior assessed in the section on antisocial personality disorder, mental health service utilization, mood disorders, anxiety disorders, substance-use disorders, and personality disorders	1.6% lifetime prevalence of pathological gambling among fire-setting individuals as compared to 0.1% prevalence of pathological gambling among non-fire-setting individuals. Strongest links with fire setting were disorders related to impulse-control deficits such as pathological gambling, antisocial personality disorder, drug dependence and bipolar disorder
Schneier et al. (2010)	43,093 from Wave 1 (2001–2002). Aim: to estimate national prevalence and clinical impact of comorbid social anxiety disorder, and alcohol-use disorders (alcohol abuse and dependence)	Diagnoses of social anxiety disorder, alcohol-use disorders, other psychiatric disorders, and sociodemographics	1.4% pathological-gambling prevalence among comorbid social anxiety disorder and alcohol-use disorder group as compared to 0.1% pathological-gambling prevalence among group with neither social anxiety disorder nor alcohol-use disorders. Among respondents with social anxiety disorder, alcohol-use disorder presence was strongly associated with more substance-use disorders, pathological gambling, and antisocial personality disorder
Wu et al. (2011)	43,093 from Wave 1 (2001–2002). Aim: to investigate patterns of substance use and psychiatric correlates among individuals with prescription opioid, heroin and non-opioid drug use in a nationally representative sample	Substance use (heroin, opioid analgesics), psychiatric disorders (mood, anxiety and personality disorders), substance abuse treatment utilization, quality of life, and sociodemographics	Prevalence of pathological gambling was 5.4% among individuals with heroin-other-opioid use, 2.2% among those with other-opioid use only, 0% among those with heroin use only and 0.7% among those with non-opioid drug use. Non-opioid drug use associated with reduced odds of substance-use disorders and other psychopathology (mood, anxiety, pathological gambling, and personality disorder) as compared with those with other-opioid use only
Chou and Cheung (2013)	8,205 respondents 65 years or older from Wave 1 NESARC data. Aim: to estimate prevalence of DSM-IV major depressive disorder, its clinical characteristics (onset, course and treatment) and evaluate comorbid psychopathology	Diagnoses of major depressive disorder, anxiety disorders, substance-use disorders, and sociodemographics	0.12% pathological-gambling prevalence among respondents with past-year major depressive disorder within this sample of individuals aged 65 years or older. Pathological gambling, anxiety disorders and substance-use disorders were strongly associated with major depressive disorder
Moghaddam et al. (2014)	701 American Indians and Alaska Natives from Wave 1 NESARC. Aim: to examine comorbidity of lifetime nicotine dependence with both current and lifetime psychiatric and substance-use disorders	Lifetime presence/absence of nicotine dependence, substance-use disorders, mood disorders, anxiety disorders, personality disorders, and pathological gambling	0.6% lifetime pathological gambling prevalence rates overall and 1.9% pathological gambling prevalence among individuals with nicotine dependence but 0% prevalence among individuals without nicotine dependence

was conducted at Wave 1 with the psychometrically validated AUDADIS-IV instrument, which is an extensive semi-structured diagnostic interview conducted by trained lay interviewers to assess lifetime and past-year psychiatric disorders and related measures (Grant & Dawson, 2006). Other psychiatric disorders assessed in the AUDADIS-IV included: (a) five mood disorders/features – major depressive disorder, bipolar I and II disorders, dysthymia, and hypomania; (b) four/five anxiety disorders – panic disorder with and without agoraphobia, social phobia, specific phobia, and generalized anxiety; and (c) seven personality disorders – avoidant, dependent, obsessive-compulsive, paranoid, schizoid, histrionic, and antisocial disorders.

There are several distinctions between Waves 1 and 2 estimates – Wave 1 data captured respondents' lifetime and past-year experiences, whereas Wave 2 focused on prior-to-past-year (since Wave 1) and past-year psychopathology experiences. Additional assessments in Wave 2 included: (a) classifications for several psychiatric disorders – posttraumatic stress disorder, attention-deficit hyperactivity disorder, and narcissistic, borderline, and schizotypal personality disorders; (b) psychosocial indicators – sexual orientation, adverse childhood events, childhood and partner abuse, social integration, and acculturation; and (c) perceived experiences of discrimination.

Definitions of problem-gambling-related behaviors have changed over time in accordance with empirical findings and progression of DSM and non-DSM efforts like the Research Domain Criteria movement – with both categorical and continuum conceptualizations of problem-gambling severity (from non-gambling/low frequency gambling to pathological gambling). Although several different thresholds and definitions have been utilized (see Table 1), pathological gambling in DSM-IV was defined by meeting 5 or more of 10 criteria, whereby 15 symptom items operationalized the 10 pathological-gambling criteria in the assessment used in the NESARC (Blanco et al., 2006; Petry et al., 2005). Meanwhile, meeting three to four criteria has been termed by some authors as experiencing problem gambling – defined by some as excessive gambling linked with impaired inter- and intra-personal functioning but not meeting the minimum threshold of pathological-gambling criteria in DSM-IV (Loo, Raylu, & Oei, 2008). The gate-keeping question in the AUDADIS-IV was “Have you gambled 5 or more times in any one year of your life?” and respondents who answered “No” to this question were classified as *low-frequency/non-gambling*, while past-year *recreational gambling* involved answering “Yes” but met no more than two pathological-gambling criteria in the previous year (Desai et al., 2007; Pietrzak et al., 2007). Some authors have further separated recreational gambling into low-risk and at-risk groups, with the former meeting no criteria and the latter 1–2 criteria for pathological gambling (Desai & Potenza, 2008; Grant, Desai, & Potenza, 2009). Some studies combined problem gambling and pathological gambling into a single group to increase statistical power and labeled it as problem/pathological gambling, where respondents met three or more pathological-gambling criteria (Barry, Pilver, Hoff, & Potenza, 2013; Barry, Stefanovics, Desai, & Potenza, 2011a, 2011b; Desai & Potenza, 2008;

Giddens, Stefanovics, Pilver, Desai, & Potenza, 2012; Grant et al., 2009). Most studies distinguished between lifetime gambling and past-year pathological gambling, and presented weighted prevalence estimates for the population of interest.

Psychometric developments and measurement analyses with NESARC data

There were five gambling-related NESARC studies that developed research questions on model testing, symptom patterns, differential item functioning, and/or scale development (i.e., Boudreau et al., 2009; Gebauer, LaBrie, & Shaffer, 2010; Nelson, Gebauer, LaBrie, & Shaffer, 2009; Sacco, Torres, Cunningham-Williams, Woods, & Unick, 2011; Strong & Kahler, 2007). Nationally representative data are an important resource from which symptom classifications and assessment perspectives can be reviewed in a reliable manner. Strong and Kahler (2007) evaluated the DSM-IV pathological-gambling criteria – using 11,153 lifetime gambling Wave 1 data points – for its unidimensionality and symptom patterns. Factor analysis results revealed that pathological gambling symptoms fit a unidimensional Rasch model, which confirms the validity of using a total pathological gambling score to represent symptom patterns variations in problem-gambling severity. Extending these findings, Sacco et al. (2011) explored the presence of differential item functioning in DSM-IV pathological-gambling criteria stratified by age, gender, and ethnicity/race using Multiple-Indicator Multiple-Cause modeling and found evidence for differential item functioning for these sociodemographic variables. Specifically, women and Asians were less likely than reference groups (male, Caucasian, ages 25–29 years) to endorse *preoccupation*, and women were more likely to report *gambling to escape*, while young adults were less likely to report *gambling to escape* (see Table 1 for additional details).

Utilizing a similar sampling method and 658 out of 3,008 AUDADIS-IV questions, Boudreau et al. (2009) investigated the presence of shadow symptoms (e.g., anxiety and phobias) among individuals with and without past-year pathological gambling behavior. Findings suggested that shadow symptoms were associated with pathological gambling diagnoses, providing support for a need to develop treatment around multi-faceted symptomology instead of categorical diagnostic classification (see Table 1 for additional details). Following from this study, Nelson et al. (2009) found that pathological gambling symptom patterns changed as symptom count increased and differed between timeframes. *Preoccupation*, *chasing losses*, *tolerance*, and *gambling to escape* were the top four most endorsed criteria, whereas *illegal acts* were both rare, unstable, and arguably the least useful discriminant criteria (Nelson et al., 2009). As *preoccupation* is both prevalent and stable across timeframes, it is a useful gateway question in clinical settings. Building on this symptom analysis research, Gebauer et al. (2010) validated a 3-item brief biosocial gambling screen applicable for use among community populations and treatment-seeking groups. The Brief Biosocial Gambling Screen, which is an alternative to the Lie/Bet Questionnaire, showed high sensitivity and specificity, with an item from

each of the three theoretical addiction syndrome domains – neuroadaptation, psychosocial characteristics, and negative social consequences of gambling.

Prevalence of pathological gambling

The lifetime pathological gambling prevalence estimate among NESARC Wave 1 respondents was 0.42% (0.64% men and 0.23% women), $N = 43,093$ (Petry et al., 2005). Past-year pathological gambling prevalence was 0.16% (Blanco et al., 2015), but when restricted to sample of lifetime gamblers, past-year pathological gambling rates were 1.92% among men and 1.05% among women (Blanco et al., 2006). Morasco et al. (2006) reported lifetime prevalence rates of 0.42% for pathological gambling, with 25.84% exhibiting at-risk gambling and 72.84% exhibiting low-risk gambling among gamblers. Past-year problem/pathological gambling rates were reported to be 0.70% in men and 0.40% in women (Desai & Potenza, 2008). Among 33,231 complete data from Waves 1 and 2, problem/pathological gambling rate was 0.60% with 0.82% prevalence among males and 0.40% among females (Chou & Affi, 2011). When categorized according to immigrant status, pathological gambling prevalence rate was highest for third-generation immigrants (5.18%), followed by native-born Americans (4.73%) and second-generation immigrants (4.71%), while pathological gambling prevalence was lowest for first-generation immigrants at 2.79% (Wilson et al., 2015).

Adults aged 40–64 years reported weighted prevalence estimates of 0.30% for problem/pathological gambling and 30.80% for recreational gambling, while older individuals aged more than 64 years reported similar rates – problem/pathological gambling (0.30%) and recreational gambling (28.70%; Desai et al., 2007). Comparable estimates were found in another study (Table 1), which suggested that recreational gambling was relatively common among older adults (Pietrzak et al., 2007). Further evaluations on Wave 1 pathological gambling and Wave 2 psychopathology revealed that baseline prevalence rates among older adults aged 55 years or more were 2.80% for at-risk/problem/pathological gambling and 29.90% for low-risk gambling (Pilver et al., 2013b). Respondents with past-year major depressive disorder aged 65 years or older reported a modest pathological gambling prevalence of 0.12% (Chou & Cheung, 2013).

As pathological gambling rarely exists in isolation, prevalence estimates for gambling groups (non-gambling/low frequency, low-risk, at-risk, and problem/pathological gambling) among nicotine-dependent individuals were 59.70%, 31.60%, 4.90%, and 1.9%, respectively (Grant et al., 2009). In a sample of 701 American Indians, pathological gambling prevalence was higher among individuals with (1.90%) than without (0%) nicotine dependence (Moghaddam, Dickerson, Yoon, & Westermeyer, 2014). Meanwhile, problem/pathological gambling rate was higher at 8.30% among individuals with alcohol abuse and/or dependence, and lower at 2.30% among non-alcohol-use-disorder group (Brewer, Potenza, & Desai, 2010). Analyses of 402 patients who reported past-year treatment of substance-use problems revealed prevalence estimates of 4.30% of lifetime

pathological gambling and 7.20% of problem gambling (Cowlshaw & Hakes, 2015). Hammond et al. (2019) also found that cannabis use moderated the relationships between problem-gambling severity and psychiatric disorders, with cannabis use appearing to account for some of the variance in the associations between greater problem-gambling severity and specific forms of mental illness.

Meanwhile, data from 3,007 treatment-seeking individuals with affective disorders showed comparably lower rates – 3.1% lifetime pathological gambling and 1.4% past-year problem gambling (Cowlshaw et al., 2016). Pathological gambling prevalence was higher among individuals (1.40%) with comorbid social anxiety disorder and an alcohol-use disorder, as compared with individuals (0.10%) who were diagnosed neither with social anxiety disorder nor an alcohol-use disorder (Schneier et al., 2010). In another study on specific drug use, pathological gambling prevalence was highest among heroin-other-opioid-using individuals (5.40%) and other-opioid-only-using individuals (2.20%), as compared with heroin-using (0%) and non-opioid-using (0.70%) individuals (Wu, Woody, Yang, & Blazer, 2011). Nicholson et al. (2019) recently reanalyzed Wave 1 data to examine whether changes in gambling-related diagnostic criteria from DSM-IV to DSM-5 would correspond to changes in prevalence of psychiatric disorders among those with pathological gambling versus gambling disorder. Prevalence rates for any comorbid disorders among individuals with pathological gambling versus gambling disorder remained similar (56.7% vs. 53.7%) and the highest co-occurring substance-use disorders were alcohol (25.3%) and cannabis (37.7%).

The AUDADIS-IV captured information on antisocial-personality disorder that provided an avenue to estimate pathological-gambling prevalence among individuals with the presence of specific antisocial-personality disorder behaviors. Past-year pathological-gambling prevalence was reportedly higher among shoplifters (0.56%), as compared with non-shoplifters at 0.11% (Blanco et al., 2008). Similarly, lifetime pathological gambling prevalence was evident among individuals who reported animal cruelty behavior (3.02% with vs. 0.39% without) and fire-setting behavior (1.60% with vs. 0.10% without) (Blanco et al., 2010; Vaughn et al., 2009). In addition, violent behavior was more prevalent among individuals with pathological gambling with comorbid disorders (28.78%), such as alcohol-use and mood disorders, than among those with solely pathological gambling (0%) (Pulay et al., 2008). In addition, Ronzitti et al. (2018) found that at-risk/problem/pathological gambling had a higher odds ratio for any personality disorder in the group with no history of suicidality, particularly for cluster-B personality disorders.

Prevalence for problem/pathological gambling was higher for a group with moderate/severe pain interference (0.79%) than for a group with no/low pain interference (0.48%), while similar prevalence patterns were observed for low-risk-gambling or at-risk-gambling groups (Barry et al., 2013). Both problem gambling and pathological gambling groups as compared with non-gambling or low-risk gambling groups had significantly higher prevalence estimates of suicidal ideation (36.70%, 49.20%) and attempts (17.20%, 18.30%), respectively (Moghaddam,

Yoon, Dickerson, Kim, & Westermeyer, 2015). Furthermore, adverse childhood experiences rates were higher for problem-gambling and pathological-gambling groups than for a non-gambling group (Sharma & Sacco, 2015). Specifically, rates of physical and sexual abuse were 6.95% and 15.50% among individuals with problem gambling and 12.21% and 15.44% among those with pathological gambling, respectively.

Gambling subtypes and model testing

Six studies included in this systematic review utilized NESARC data to evaluate theoretical models of pathological gambling, identify gambling subtypes, or distinguish between individuals with early- versus later-onset pathological gambling. Individuals with early-onset pathological gambling were more likely than those with later-onset pathological gambling to be male, be never married, have incomes below \$70,000, belong to younger cohorts and have Cluster B personality disorders, and were less likely to have mood disorders (Vizcaino, Fernandez-Navarro, Petry, Rubio, & Blanco, 2014). Bernardi et al. (2019) examined predictors of pathological gambling remission during the past 12 months and found that an 85.6% cumulative probability of remission from pathological gambling with a median time of 19 years. Carragher and McWilliams (2011), through latent class analysis on 11,104 lifetime gamblers, empirically derived three typology of gamblers – groups with no, moderate, and pervasive gambling problems – based on endorsements of past-year DSM-IV pathological-gambling criteria. While the first group (no gambling problems) showed very low endorsement probabilities across all criteria, the second group (moderate) endorsed primarily preoccupation, tolerance, and chasing criteria, and the third group (pervasive) endorsed most criteria. Also using latent class analysis, but this time with 581 individuals with problem/pathological gambling, Nower et al. (2013) derived three problem-gambling subtypes/classes based on etiological and clinical characteristics in a Pathways Model. Individuals in Class 1 (50.76%) showed lowest overall psychiatric disorders, while those in Class 2 (20.06%) showed high probability of endorsing past-year substance-use disorders and mood disorders. Finally, those in Class 3 had the highest probability of personality disorders, substance-use disorders, and separation/divorce, among other concerns (see Table 1 for additional details).

In the first attempt of examining model fit using NESARC Wave 1 data, findings from confirmatory factor analysis showed that pathological gambling loaded highest on the externalizing factor of Krueger's (1999) three-factor model of common mental disorders (Oleski, Cox, Clara, & Hills, 2011). The externalizing factor composed of pathological gambling, substance dependence, and antisocial-personality disorder for both genders. Blanco et al. (2015) developed a pathological gambling etiological model based on a modified Kendler's developmental model for major depression, and found it can be used to statistically predict lifetime and past-year pathological gambling through possible risk factors in several developmental levels. Factors statistically predictive of lifetime

gambling included family history of substance-use disorders or depression, impulsivity, childhood-onset anxiety, and independent stressful life events. Meanwhile, lifetime history of pathological gambling, personality disorder, and past-year nicotine dependence statistically predicted past-year pathological gambling. Future model development and comparisons between national data sets will be interesting avenues for theoretical advancement.

Sociodemographics and potential risk factors

Most articles examined elements of sociodemographics and potential risk factors among specified research questions. One of the earliest investigations on gender-related differences by ethnicity found that Black women were more likely than Black men to report pathological gambling, but Hispanic men were more likely than Hispanic women to report subclinical pathological gambling, while no gender differences were observed among White individuals (Blanco et al., 2006). Further analyses by age among individuals with subclinical pathological gambling revealed that more men were in the 18- to 29-year age group, while more women were in the 65 years or more age group. Stronger associations between pathological gambling and psychiatric disorders – mood, anxiety and personality disorders – were evident among women as compared with men (Petry et al., 2005), and among American Indian/Alaskan Native adults (Kong et al., 2016). Problem/pathological gambling prevalence rates were 0.70% among men and 0.40% among women (Desai & Potenza, 2008). The “telescoping” phenomenon, whereby women show a later onset but quicker duration for the development of gambling problems, was suggested in several studies (Pilver et al., 2013a; Vizcaino et al., 2014). Longitudinal analyses of Wave 1 and 2 data revealed that pathological gambling was linked with an increased 3-year incidence of nicotine dependence among females and alcohol dependence among males (Pilver et al., 2013a). In general, men were more likely than women to engage in gambling activities (Wilson et al., 2015).

The sample of lifetime gamblers was racially 76.8% White, 20.1% Black, and 14.2% Hispanic (Strong & Kahler, 2007). In a sample of individuals who engaged in gambling ($n = 11,153$), Black (2.2%) and Native American/Asian (2.3%) individuals reported significantly higher percentages of problem/pathological gambling than White individuals (1.2%; Alegria et al., 2009). Similarly, in this sample, lifetime conditional prevalence of problem/pathological gambling was higher among Black (9.0%) and Native Americans/Asian (8.2%) adults than White (4.0%) adults. However, in a sample selection of 31,830 white and Hispanic adults, White individuals (0.5%) were more likely to exhibit problem/pathological gambling as compared to Hispanic individuals (0.4%; Barry et al., 2011b). Racial comparisons based on a sample of 32,316 White and Black adults revealed that problem/pathological gambling rates were higher for Black (0.96%) than White (0.45%) individuals (Barry et al., 2011a). American Indian/Alaskan Native as compared with other Americans (using the total 43,093 Wave 1 sample) were least likely to report

non-/low-frequency gambling (American Indian/Alaskan Native: 66.5%, White: 70.5%, Black: 72.8%, and other race: 72.3%) and most likely to report low-risk gambling (American Indian/Alaskan Native: 30.1%, White: 26.5%, Black: 23.4%, and other race: 24.7%; [Kong et al., 2016](#)). It is important to note that percentages vary according to specified sample parameters of each study based on the NESARC data.

Descriptive results were provided in most studies in relation to age, and a few focused on pathological gambling among older adults. Prevalence estimates based on a sample of 25,485 individuals 40 years and above revealed that problem/pathological gambling rates are similar (0.30%) for both the younger group (40–64 years) and older group (more than 64 years; [Desai et al., 2007](#)). Problem/pathological gambling in the younger group was linked to poorer subjective health, nicotine dependence, alcohol abuse/dependence, obesity, and one or more chronic conditions, while similar non-significant patterns were seen among the older group. Another study that sampled 10,563 older adults aged 60 or more years found that individuals with problem/pathological gambling as compared to those with recreational gambling (i.e., met 0-2 DSM-IV criteria) had higher rates of alcohol, nicotine, mood, anxiety, personality disorders and obesity, and lower rates of arteriosclerosis or cirrhosis ([Pietrzak et al., 2007](#)). Recreational gambling was relatively common among older adults as 30% reported ever gambling more than 5 times per year, whereas pathological gambling was rare as 0.30% of older adults met lifetime pathological-gambling and 0.10% met past-year pathological-gambling diagnostic criteria. Younger gamblers demonstrate loss chasing at lower levels of problem-gambling severity than older gamblers ([Strong & Kahler, 2007](#)).

Psychiatric comorbidities

Twelve articles provided results on psychiatric comorbidities with pathological gambling, while eight studies investigated comorbidities amid other central variables. Individuals with problem/pathological gambling were more likely to report lifetime psychiatric disorders ([Pietrzak et al., 2007](#)), and this pattern was evident across racial/ethnic groups ([Barry et al., 2011a, 2011b](#)). Furthermore, past-year problem/pathological gambling was linked to increased odds of the incidence of some Axis I disorders at 3-year follow-up, and these relationships remained significant after adjusting for the effects of covariates ([Chou & Afifi, 2011](#)). Associations between problem-gambling severity and psychiatric disorders are largely not modified by pain interference ([Barry et al., 2013](#)). Anxiety disorders accounted for some of the variance in the association between problem-gambling severity and psychopathology, particularly internalizing disorders, tobacco smoking, and multiple personality disorders ([Giddens et al., 2012](#)). Anxiety-by-gambling interactions indicate stronger associations between problem-gambling severity and psychiatric disorders among individuals without anxiety disorders than with anxiety disorders, suggesting that some of the variance in the relationships between problem-gambling severity and psychopathology are accounted for by anxiety disorders.

Among respondents with social-anxiety disorder, alcohol-use disorders were linked to substance-use disorders, pathological gambling, and antisocial-personality disorder ([Schneier et al., 2010](#)).

Problem/pathological gambling was found to be associated with elevated odds for most Axis I and II disorders among a non-alcohol-use-disorder group, with alcohol-use disorders moderating the relationships between problem-gambling severity and psychopathologies ([Brewer et al., 2010](#)). Longitudinal analyses at 3 years after initial intake interview indicated that individuals reporting any gambling behavior at baseline as compared to non-gamblers were at increased risk of mood, anxiety, or substance-use disorders ([Parhami, Mojtabai, Rosenthal, Afifi, & Fong, 2014](#)). Income level moderated the relationship between problem/pathological gambling and alcohol-use disorders, as a middle/higher-income as compared to a lower-income group evidenced stronger associations between problem-gambling severity and alcohol-use disorders ([Sanacora, Whiting, Pilver, Hoff, & Potenza, 2016](#)). Gender-related differences were evident in motivations for gambling and smoking, whereby psychosocial stress and negative mood states were identified to be potential triggers of substance-use disorders and problem/pathological gambling ([Pilver et al., 2013a](#)). Impulse-control deficits and increased odds of pathological gambling were linked to a spectrum of antisocial-personality disorder behaviors, such as shoplifting behavior ([Blanco et al., 2008](#)), violent behavior ([Pulay et al., 2008](#)), cruelty to animals ([Vaughn et al., 2009](#)), and fire-setting ([Blanco et al., 2010](#)).

Findings from the NESARC on psychiatric comorbidities of pathological gambling have identified common links between pathological gambling and substance-use disorders, alcohol-use disorders, antisocial-personality disorders, and mood disorders. Differences between genders were reported in the etiology and presenting problems associated with problem/pathological-gambling. Future research and clinical practice would benefit from carefully identifying comorbid psychopathology and assessing cluster symptoms of related disorders.

Physical health and chronic medical conditions findings

Four articles presented findings on physical health and medical conditions in relation to problem/pathological gambling. Higher problem-gambling severity was associated with current obesity status and poorer appraisal of physical health ([Morasco et al., 2006](#)). In the same study, at-risk/problem/pathological gambling was associated with a greater likelihood of utilizing medical services such as the emergency department and being admitted for severe injuries. Another study reported significant associations between recreational gambling and health, with recreational gambling among older adults associated with both negative measures like obesity and positive measures like better physical and mental functioning ([Desai et al., 2007](#)).

Prevalence of problem/pathological gambling was higher for individuals with moderate/severe pain interference (0.79%) than for those with no/low pain interference (no/low pain interference; 0.48%; [Barry et al., 2013](#)). Prospective evaluations of Wave 1 and 2 NESARC data found

that the at-risk/problem/pathological-gambling group had a 36% increased likelihood of developing arteriosclerosis as compared to the non-at-risk/problem/pathological-gambling group (Pilver & Potenza, 2013). In contrast, the incidence of any liver condition was higher in the non-at-risk/problem/pathological-gambling group than in the at-risk/problem/pathological-gambling group; however, this finding did not survive adjustment for covariates.

DISCUSSION

This systematic review provides a comprehensive synthesis of gambling-related NESARC findings in 51 published articles. Although all studies utilized the same NESARC Wave 1 and/or Wave 2 data, there were variations in terminologies (e.g., pathological gambling, problem/pathological gambling, and at-risk/problem/pathological gambling), thresholds employed, and gambling groups used in describing the problem-gambling-severity continuum – all of which contribute to challenges in comparative analyses between papers. The studies, however, provide important findings related to prevalence estimates of pathological gambling in subgroups and in the general population and information on psychiatric comorbidities, sociodemographic correlates, and gambling typologies. Lifetime rates of pathological gambling (0.42%) based on the US NESARC data resembled rates reported in other countries, specifically New Zealand and Sweden. The results from the US NCS-R study also yielded a similar prevalence rate of 0.6% for pathological gambling in the general population (Kessler et al., 2008). Although rates of pathological gambling appear low, variability is noted across subgroups, and this comprehensive review of NESARC studies sheds light on some health and psychological correlates of pathological gambling and subdiagnostic at-risk/problem gambling found in the US population. Moreover, systematic review of all gambling-related NESARC publications permits comparative evaluation, reflection, and formulation of strategic areas for future directions, specifically public health campaigns aimed at reducing the occurrence of problem gambling among vulnerable groups.

A key strength of the NESARC studies is the utilization of the psychometrically valid and reliable AUDADIS-IV. Good reliability indicators for alcohol consumption and psychiatric disorders suggest that it is a useful measurement tool in varied research contexts, especially in population studies – the target sample for which it was developed (Grant, Dawson, et al., 2003). With the passage of the DSM-5, pathological gambling was renamed gambling disorder and moved from an impulse-control disorder to addictive disorder and subsequently grouped with substance-use disorders. The diagnostic criteria of gambling disorder remained similar except for the elimination of the illegal-acts criterion and the lowering of the threshold from five to four diagnostic criteria (Petry, Blanco, Jin, & Grant, 2014). Because gambling disorder occurs at a low base rate in the general population and as one means of improving statistical power in some studies, problem gambling and pathological gambling have often been combined into one category – problem/pathological gambling. Careful formulation of subsequent versions of the AUDADIS provides an additional

benefit of allowing prospective longitudinal and comparative analyses between Wave 1 and Wave 2 data for most psychiatric disorders, with an exception of pathological gambling. Although there were other additional assessments in Wave 2 as compared with Wave 1, pathological gambling measurements were omitted from Wave 2 data collection, which limits the possibility of performing longitudinal prospective analyses on gambling constructs using NESARC data, particularly with respect to incident pathological gambling or documenting changes in rates of problem-gambling severity among specific groups over time. Longitudinal data examining both risk and protective factors associated with gambling disorder are needed, particularly given the expansion of gambling, particularly sports gambling but also casino and other forms, occurring in the USA. Given the wealth of knowledge gained from the NESARC specific to gambling disorder, a new longitudinal prospective study is needed to tackle many unanswered questions around the prevalence, severity, and course of gambling disorder in the USA.

The results reported from the NESARC on potential risk factors and sociodemographic correlates of pathological gambling resonate with prior findings. Elevated odds of pathological gambling was associated with being male, Black, aged between 45 and 64 years and widowed/separated/divorced. Gender-related differences varied when the sample was stratified into racial/ethnic groups, whereby higher prevalence of pathological gambling was reported among Hispanic men and Black women, while no differences were observed among White men/women (Blanco et al., 2006). Positive associations were evident between pathological gambling and other psychopathology – substance dependence, mood disorders, personality disorders (particularly antisocial-personality disorder), comorbid diagnoses (stronger among females), and suicidal attempts (Moghaddam et al., 2015). Furthermore, higher income increases the positive association between problem-gambling severity and alcohol dependence. Wave 1 problem/pathological gambling prospectively increased likelihood of predicting Wave 2 incidence of mood disorders, generalized anxiety disorder, posttraumatic stress disorder, and alcohol abuse/dependence (Chou & Afifi, 2011).

Recreational gambling among older adults (>65 years) was linked with better self-reported physical and mental health, despite increased odds of negative health measures such as obesity (Desai et al., 2007). Older adults with presenting at-risk/problem and pathological gambling should be closely observed for physical health conditions. Treatment-seeking rates among individuals with pathological gambling were low in the entire population with no differences reported between those with early- and later-onset pathological gambling. These findings were generally consistent with national data sets worldwide with specific variations (intricate to US demographics) in prospective analyses, ethnicity differences, and recreational gambling among older adults.

The US NESARC data structure has provided some avenues for testing theoretical models and analyzing symptom patterns, which were main aims of selected studies reported here. While investigations on prevalence, descriptive estimates, and behavioral correlates are important outputs from national data sets, it is beneficial to examine empirically

and test theoretically driven models of pathological-gambling etiology using these nationally representative data. Analyses of NESARC data validated the use of a total pathological-gambling score to consider problem-gambling severity and revealed group differences in symptom endorsements (see Sacco et al., 2011). Careful adaptation of observed data on latent structures of proposed models such as the pathways model (Nower et al., 2013; Valleur et al., 2015) and cognitive-behavioral model of gambling behavior (Raylu, Oei, Loo, & Tsai, 2016) provide further evidence that may help generate future evolutions of theoretical frameworks, which further guide treatment formulations and prevention initiatives for vulnerable subgroups. The results on potential risk factors for early- versus later-onset pathological gambling (Vizcaino et al., 2014) and etiological or ecological determinants of gambling subtypes (Blanco et al., 2015; Carragher & McWilliams, 2011) may enable future identification of at-risk groups for early intervention, inform assessment of possible behavioral addictions at intake interviews, and highlight key areas of focus in population studies. Scientific prediction of future behavior based on potential risk factors should be used with caution to reduce occurrences of false positives or negatives in case assessments. Future research, not covered in NESARC, is needed to identify protective factors against the development of problem/pathological gambling. Since the NESARC study was initially conducted, additional research has been focused on identifying protective factors for youth and other vulnerable groups to reduce early onset of gambling disorder (Dowling et al., 2017), yet our understanding of specific protective factors for vulnerable groups (e.g., youth, ethnic minorities, and military veterans) remains limited. In these efforts, not only should DSM-5 criteria for gambling disorder be considered, but also the criteria for gambling disorder and hazardous gambling or betting in the 11th edition of the International Classification of Diseases, with the latter perhaps particularly well suited for promoting public health through identification and targeting of potentially vulnerable groups (World Health Organization, 2018).

The 51 NESARC studies published on problem/pathological gambling provide a wide array of empirical findings that may help guide future research. It would have been ideal if Wave 2 had included gambling-related measures. This would have allowed for longitudinal analyses of development and/or recovery, while answering questions in relation to telescoping effects, natural recovery, and pathway and other models of transitions. Although eight studies in this review provided some prospective analyses using both Wave 1 and 2 data sets, there were no comparative analyses on gambling-related outcomes, given the absence of gambling-related measures in Wave 2. In addition, oversampling of individuals of Black or Hispanic backgrounds and young adults at the design-phase of the survey may have provided an overrepresentation of these cohorts in outcome analyses. In studies employing the NESARC-generated weights, analyses could statistically adjust for oversampling to be representative of the US population, which presents itself as an important alternative to stratified random sampling of US households given important questions that could be addressed as the result of oversampling.

In conclusion, the first review of gambling-related NESARC findings revealed that pathological gambling rarely exists in isolation and is commonly associated with substance-use, mood, anxiety, and personality disorders. This confirms, in a nationally representative data set, past findings from other cross-sectional investigations. Gender, racial/ethnic, and sociodemographic variability were identified across comorbidities, which may facilitate early identification of at-risk groups for prevention efforts. As rates of adverse childhood experiences and suicidal attempts were higher among individuals with problem and pathological gambling, further investigations and assessments are important to clarify the underlying mechanisms of these associations. It is noteworthy that first-generation immigrants show better health outcomes and lower pathological-gambling prevalence as compared to second- and third-generation immigrants in the US population (i.e., the immigrant paradox), which is in contrast to past research that highlighted higher rates of pathological gambling among migrant populations (Petry, Armentano, Kuoch, Norinth, & Smith, 2003). The finding highlights the importance of stratifying generational immigrant status in measuring prevalence or outcome indicators. Although recreational gambling among older adults is relatively common, lifetime and past-year diagnoses of pathological gambling were rare. Future research among older adults and treatment-seeking individuals are potential avenues for further investigation stemming from NESARC findings.

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Conflict of interest: MNP has consulted for Rivermend Health, Opiant Therapeutics, Game Day Data, and the Addiction Policy Forum; has received research support from Mohegan Sun Casino and the National Center for Responsible Gaming; has participated in surveys, mailings, or telephone consultations related to drug addiction, impulse-control disorders or other health topics; has consulted for gambling and legal entities on issues related to impulse-control/addictive disorders; provides clinical care in a problem gambling services program; has performed grant reviews for the National Institutes of Health and other agencies; has edited journals and journal sections; has given academic lectures in grand rounds, CME events and other clinical or scientific venues; and has generated books or book chapters for publishers of mental health texts. The other authors have no conflict of interest.

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