



The Relationship Between Gambling Disorder, Physical and Mental Health, and Substance Use in Maryland

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Abstract

The Prevention and Etiology of Gambling Addiction Study in the U.S. (PEGASUS) was a prospective cohort study, conducted in Maryland from 2015 to 2022, that sought to measure the comorbidities and impact of gambling behavior. In-person and telephone study visits collected data about gambling history, chronic health conditions, mental health, and substance use. The study used the South Oaks Gambling Screen (SOGS) to categorize participants as having or not having a history of probable pathological gambling (PPG). The analysis included data from 1,195 participants who were each followed for up to four years. The study intentionally over-sampled gamblers, resulting in a sample in which 34.2% of participants met the study criteria for lifetime history of PPG. Of the 22 chronic health conditions with sufficient numbers for analysis, 17 showed statistically significant relationships with PPG, with mental health disorders standing out as having particularly strong associations. Alcohol and drug use problems, along with smoking, were also significantly more common among participants with PPG compared to those without PPG. The physical health conditions that showed the strongest associations with PPG were restless leg syndrome, high blood pressure, seizures and epilepsy, and stroke. This analysis demonstrated which physical health, mental health, and substance use characteristics were most commonly comorbid with Gambling Disorder, which may inform public health policymakers and healthcare professionals as they target screenings for and interventions against problematic gambling.

Keywords Gambling disorder · Comorbidities · Physical and mental health · Substance use disorders

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Introduction

Legalized gambling has rapidly expanded across the United States. Maryland exemplifies this trend, legalizing various forms of gambling since 2008. Maryland voters approved commercial casino gaming in that year, added table games in 2012, and legalized sports betting in late 2021, with mobile sports betting coming online in November 2022 (State of the States 2023: The AGA Survey of the Commercial Casino Industry, 2023).

As legalized gambling opportunities have expanded, opportunities for developing a problem gambling behavior may be on the rise. In 1989, a statewide prevalence survey indicated that 89% of Maryland residents had engaged in gambling at some point in their lives (Volberg & Steadman, 1989), a figure that has stayed consistent in statewide prevalence studies fielded 2010, 2017, 2020, and 2022 (Shinogle et al., 2011; Tracy et al., 2019; Tracy & Schluterman, 2021; Tracy & Brown, 2023). The population-level lifetime prevalence of disordered gambling ranged from 1.7 to 8.4% in those surveys, indicating that tens to hundreds of thousands of Maryland residents have suffered from a gambling problem in their lives. In 2022, the MGM National Harbor resort, located in the Maryland suburbs near Washington, D.C., generated more gaming revenue than any other commercial casino outside of Nevada for that year, and the Baltimore-Washington, D.C., area was the third largest commercial casino gaming market in the United States. (State of the States 2023: The AGA Survey of the Commercial Casino Industry, 2023). Gambling behavior in Maryland mirrors global socio-demographic trends, with higher prevalence among males, racial minorities, and individuals with lower levels of education (Tracy & Brown, 2023). The risk created by expansion of gambling opportunities translating into rates of Gambling Disorder will be the subject of future gambling prevalence studies.

Apart from the societal and financial burdens associated with gambling, individuals demonstrating problem gambling behavior may experience poorer physical health compared to their counterparts (Afifi et al., 2010; Erickson et al., 2005; Morasco, Vom Eigen et al., 2006; Blanck et al., 2021; Lancet Public Health Commission on Gambling, 2024). Nevertheless, certain research suggests that this correlation might be influenced by sociodemographic elements and substance use (Grant & Chamberlain, 2020; McGrath & Barrett, 2009). Pathological gambling is associated with obesity, chronic medical conditions, unhealthy lifestyle behaviors, worse quality of life, and the use of costly forms of medical care (Black et al., 2013). Gambling disorder is associated with poorer physical health in older adults (Erickson et al., 2005). Pathological and problem gamblers reported more health-related concerns than recreational gamblers and nongamblers on indices of physical functioning (Morasco, Vom Eigen et al., 2006). Pathological gamblers had a higher likelihood of being diagnosed with tachycardia, angina, cirrhosis, and other liver diseases and are more likely to utilize emergency medical services (Morasco et al., 2006).

Understanding the relationships among problem gambling behavior, substance use, and health outcomes could provide vital information for both policymakers and healthcare providers as they consider interventions. The current analysis uses data from a recently completed seven-year prospective cohort study of Maryland adults to identify medical comorbidities with Gambling Disorder.

Methods

Study Design

The Prevention and Etiology of Gambling Addiction Study in the U.S. (PEGASUS) was a prospective cohort study conducted from 2015 to 2022, designed to identify the socio-demographic patterns, impacts, and comorbidities of Gambling Disorder among community-dwelling adults living in Maryland. The methods have been described previously (Day et al., 2020). The Institutional Review Board of the University of Maryland, Baltimore approved all study activities.

The recruiting strategy targeted likely gamblers, and it utilized online advertisements on social media, print advertisements (including at gambling venues), and flyers distributed at community meetings of Gamblers Anonymous. Potential participants who saw these advertisements could then self-enroll in the study. As such, the design produced an intentional oversample of gamblers, giving this analysis a large enough number of gamblers that it was possible to examine health factors associated with problematic gambling behavior.

Data were originally collected via in-person interviews. This changed in March 2020 due to the COVID-19 pandemic, during which the study transitioned to telephone data collection. The study instruments included questions on socio-demographics, health status and functioning, and gambling history, as well as assessments of mental health and gambling behaviors. Participants completed up to four annual follow-up visits.

Materials and Methods

Probable pathological gambling (PPG), defined based on self-reported behavior, was assessed using the South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987). A SOGS score of 5 or more out of 20 in at least one year was used to define those that met criteria for PPG (Lesieur & Blume, 1987). This analysis considers only SOGS data from the second through fifth years of data collection, during which time the SOGS was administered consistently with comparable results across years. The version of the SOGS used in PEGASUS yielded lifetime history (rather than current or past year) of Gambling Disorder. The SOGS has been validated for use with the DSM-IV and DSM-5 (Goodie et al., 2013).

Self-reported chronic conditions were assessed at enrollment and annually thereafter. If a participant reported a diagnosis of a particular chronic condition in at least one year, they were classified as having the condition. The following 29 chronic conditions were measured in this way: diabetes, cancer, seizures/epilepsy, migraines, thyroid disease, stroke, attention deficit/hyperactivity disorder (ADHD/ADD), learning disability, restless leg syndrome, head injury, kidney disease, asthma, arthritis, anemia, gout, back problem, heart problem, high blood pressure, vitamin B12 deficiency, birth trauma, depression, anxiety, other mental illness, multiple sclerosis, Parkinson's disease, Huntington's disease, narcolepsy, brain tumor, and lead poisoning.

Mental health conditions were assessed using validated scales, at enrollment and all follow-up visits. The four mental health conditions evaluated in this analysis are:

- Anxiety, using the Beck Anxiety Inventory (BAI; Beck et al., 1988).

- A participant was defined as having anxiety if they ever had a score of 16 (“moderate anxiety”) or higher, out of 63. Reference period: past week.
- Depression, using the Beck Depression Inventory (BDI; Beck et al., 1988).
 - A participant was defined as having symptoms of depression if they ever had a score of 20 (“moderate depression”) or higher, out of 63. Reference period: past two weeks.
- Alcohol use, was assessed using the Brief Michigan Alcohol Screening Test (BMAST; Pokorny et al., 1972).
 - The BMAST assesses the presence and severity of alcohol problems in adults. It identifies individuals who may be at risk for alcohol use disorder or who are already experiencing problems related to their drinking. Participants that obtained a score of 6 (“likely alcohol abuse”) or higher, out of 29 at any study visit were defined as having a problems with alcohol. Reference period: lifetime.qa.
- Drug use, using the Drug Abuse Screening Test (DAST; Skinner, 1982).
 - The DAST identifies the presence and severity of drug-related problems in adults and older youth. It assesses consequences related to drug abuse, such as health, social, legal, and financial problems. Participants that received a score of 11 (“substantial substance abuse”) or higher, out of 20 at any study visit were defined as having a drug-related problems. Reference period: past 12 months.

For anxiety and depression, the PEGASUS collected both self-reported diagnoses and self-report measures. These data were collected independently of one another— for example, a participant was free to report a previous diagnosis of depression but not achieve a score of “moderately or severely depressed” on the BDI, and vice versa. Throughout the analysis, these assessments of depression and anxiety are presented alongside the self-reported chronic conditions. For the analysis of the total number of chronic conditions, the diagnosis of anxiety and depression are used instead of scale-assessed anxiety and depression; this approach allowed for consistency with other chronic conditions, which all reflected self-reported history of diagnosis. The analysis considered a participant to be a current smoker if they reported that they currently smoked “some days” or “every day,” as opposed to “not at all.”

Sample Composition and Data Analysis

The study enrollment data were used for socio-demographic information. The data represented here for health and gambling behavior were collected during four annual follow-up visits. Data were summarized over the four years, with primary study variables collapsed per participant, as noted in the definitions above, so that the final dataset included one row of data per participant. Bivariate analyses used Chi-square tests for categorical variables and Student’s *t*-tests for comparing means across two groups. Logistic regression was used to

obtain unadjusted odds ratios and show the raw associations between health conditions and PPG. Multivariable analysis also used linear regression models, adjusting for age, race, education, current smoking status, and alcohol and drug use problems, to calculate the difference in the mean number of chronic conditions between participants with and without PPG.

Results

The middle age group (aged 40–64 years old) had the highest occurrence of PPG, with 2.59 times the odds of PPG compared to the youngest age group (Fig. 1). Black non-Hispanics had a significantly higher occurrence of PPG compared to other race-ethnicity groups. The odds of PPG were higher among participants who reported lower incomes or lower levels of education. PPG occurrence did not vary significantly by gender.

Figure 2 lists the unadjusted associations between PPG and individual chronic conditions. Anxiety and depression are each displayed twice, reflecting both a history of professional diagnosis and within-study assessments via the BAI and BDI, respectively. PPG was significantly associated with 17 of the 22 individual chronic conditions that had adequate cell sizes to analyze and display. The chronic conditions that had insufficient cell sizes to display were multiple sclerosis, birth trauma, lead poisoning, Huntington's disease, Parkinson's disease, narcolepsy, and brain tumor.

Mental health conditions (e.g. depression, anxiety, and other mental illness) each yielded associations with PPG that were among the strongest measured by this study. Physical health measures that demonstrated high-magnitude associations included restless leg syndrome, high blood pressure, seizures and epilepsy, and stroke.

Table 1 Self-reported sample characteristics

Characteristics	<i>n</i>	% of sample
Age 18–39 years	526	44.0%
Age 40–64 years	602	50.4%
Age 65+ years	67	5.6%
White Non-Hispanic	446	40.3%
Black Non-Hispanic	562	48.6%
Hispanic	48	4.2%
Mixed/other race	81	7.0%
Male	552	46.2%
Female	643	53.8%
Income <\$25K	488	43.6%
Income \$25K–\$49,999	279	24.9%
Income \$50K+	353	31.5%
High school grad or less	283	25.3%
At least some college	838	74.8%
Not married	907	80.7%
Married	217	19.3%
Gambled during study period or 1 year prior	1074	89.9%
Did not gamble	121	10.1%
Probable pathological gambling (PPG; lifetime)	409	34.2%
No PPG (lifetime)	786	65.8%

n = 1,195

Probable pathological gambling (PPG), via the South Oaks Gambling Screen

The final analytic sample for the current analysis included 4,509 person-year observations for 1,195 participants, of whom 89.9% reported that they had gambled during the study period or in the year prior to enrollment (Table 1). The SOGS assessment determined that 34.2% of the respondents had experienced PPG behavior at some point in their lifetime

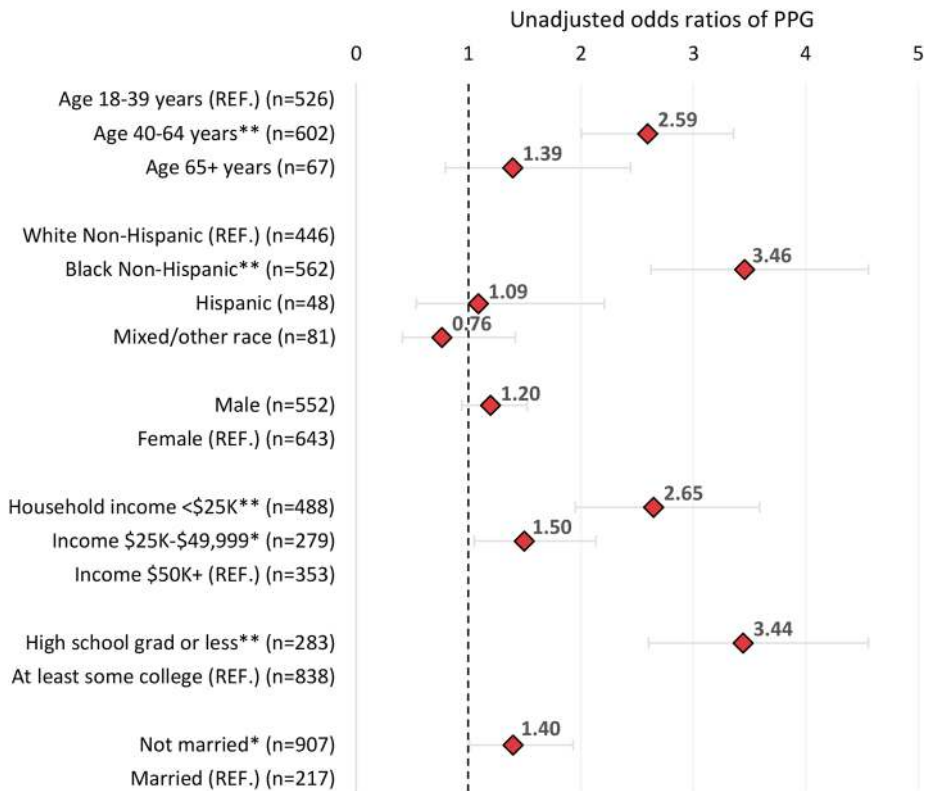


Fig. 1 Sample characteristics and associations with probable pathological gambling (PPG) $n=1,195$. PPG: probable pathological gambling, via the South Oaks Gambling Screen. Ref: reference group for each characteristic. Chi-square tests to detect significantly different proportions with PPG: * $p<0.05$; ** $p<0.001$. Bars represent 95% confidence intervals of the odds ratios

PPG was strongly associated with substance use, including lifetime alcohol use problems, current smoking, and recent drug use problems (Fig. 3). Substance use variables were among the strongest correlates of PPG.

Fig. 4 displays the distributions of the number of chronic conditions (out of a possible 29 individual conditions) reported by participants who did and did not have PPG. Among all participants, the mean and median numbers of chronic conditions reported were 3.9 and 3, respectively. Those with PPG reported a significantly higher mean number of chronic conditions (4.9 conditions) than those without PPG (3.4 conditions; $p<0.001$). The median numbers of chronic conditions reported by the PPG and non-PPG groups were 5 and 3, respectively

This mean difference of +1.5 conditions between those with and without PPG was reduced but remained significant after adjustment for socio-demographic and substance use factors (Fig. 5). After adjusting for age, race, education, and current smoking status in a linear regression model, participants with PPG reported an average of 0.8 more chronic conditions than did those without PPG. Upon further adjustment for alcohol and drug use

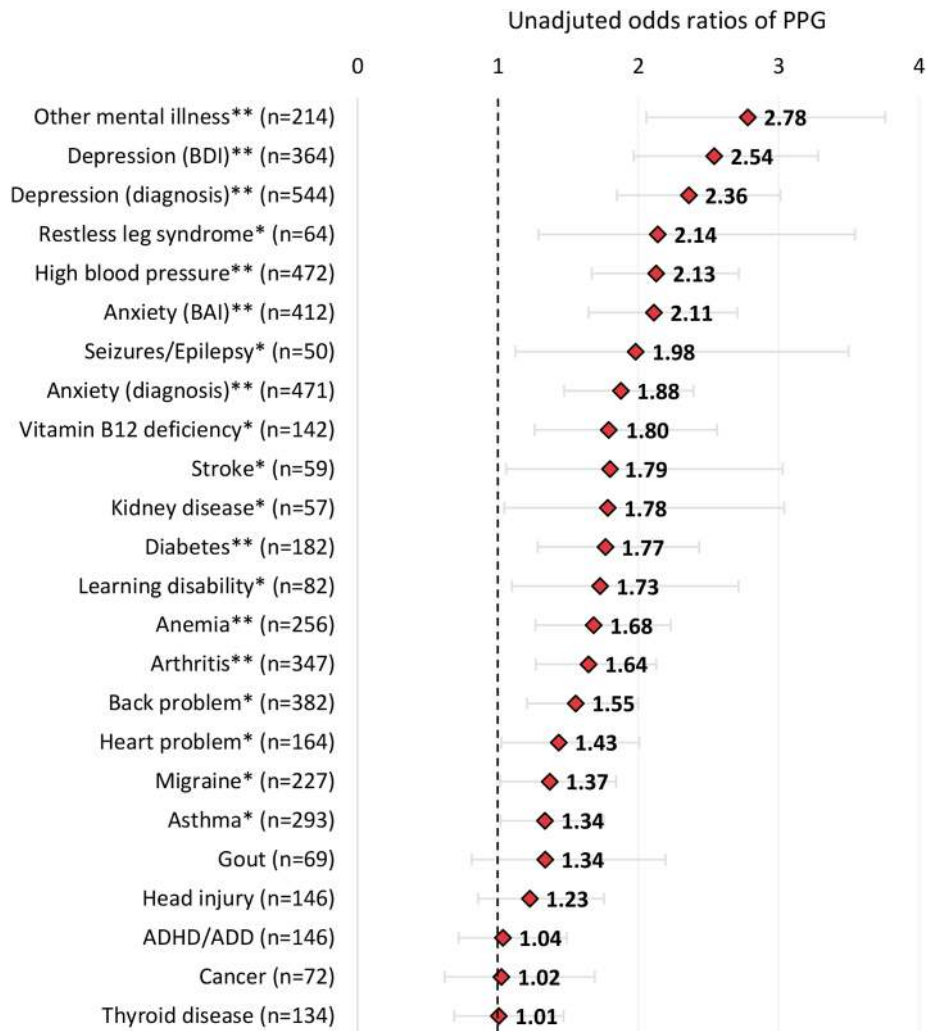


Fig. 2 Associations between specific diagnosed chronic health conditions and probable pathological gambling (PPG) $n = 1,195$ Outcome: lifetime probable pathological gambling (PPG), via the South Oaks Gambling Screen. Reference group: those without each listed chronic condition. Displayed n 's refer to the number of participants who reported that they had ever been diagnosed with each chronic condition, except for Beck Anxiety Inventory (BAI) and Beck Depression Inventory (BDI), which were administered during the study. ADHD/ADD: attention deficit disorder/attention deficit hyperactivity disorder Chi-square tests to detect significantly different proportions with PPG, comparing participants with and without each condition: * $p < 0.05$; ** $p < 0.001$. Bars represent 95% confidence intervals of the odds ratios

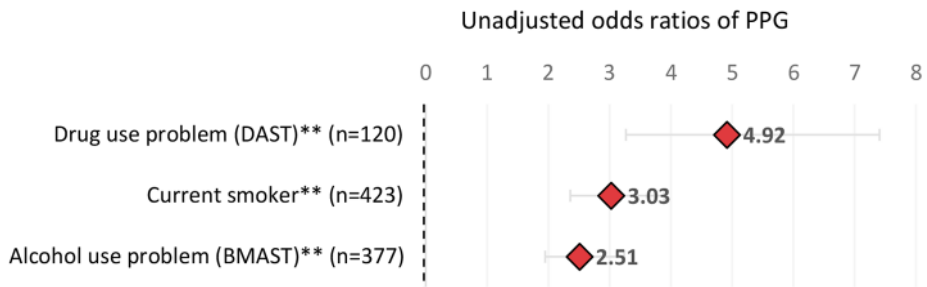


Fig. 3 Associations between substance use and probable pathological gambling (PPG) $n=1,195$ Outcome: lifetime probable pathological gambling (PPG), via the South Oaks Gambling Screen. Reference group: those who did not meet criteria for use problems for that substance. BMAST: Brief Michigan Alcohol Screening Test, indicating likely alcohol use problems at any point during the participant's lifetime. DAST: Drug Abuse Screening Test, indicating substantial substance use problems within the past 12 months. Chi-square tests to detect significantly different proportions with PPG, comparing participants with and without each condition: ** $p<0.001$. Bars represent 95% confidence intervals of the odds ratios

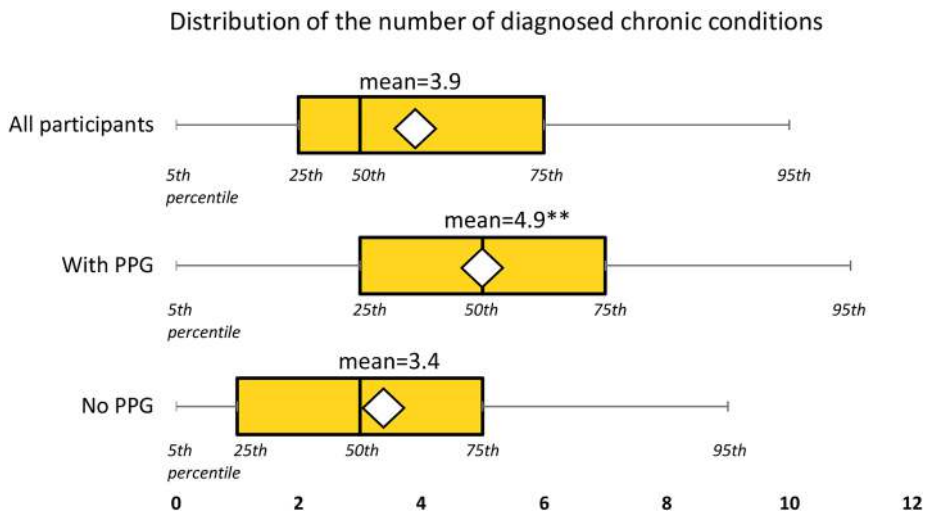


Fig. 4 Distribution of chronic conditions among participants who did and did not meet criteria for probable pathological gambling (PPG) $n=1,195$ PPG: probable pathological gambling (lifetime; South Oaks Gambling Screen). ** T -test to detect significant difference in the mean number of chronic conditions ($p<0.001$), comparing participants with and without each PPG. Bars represent the indicated percentiles. The analysis included 29 individual chronic conditions: the 22 conditions shown in Fig. 2, plus birth trauma, lead poisoning, Huntington's disease, Parkinson's disease, narcolepsy, multiple sclerosis, and brain tumor. For anxiety and depression, this measure includes professionally diagnosed conditions only (not the results of the Beck Anxiety Inventory and Beck Depression Inventory conducted during the current study)

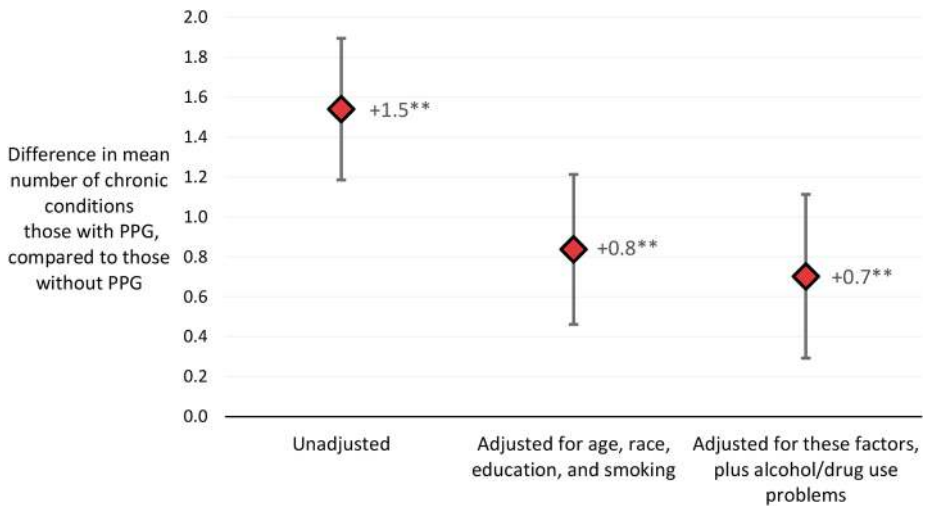


Fig. 5 Relative mean numbers of chronic conditions among participants who met criteria for probable pathological gambling (PPG) $n = 1,195$ PPG: probable pathological gambling (lifetime; South Oaks Gambling Screen). **Linear regression to detect significant difference in the mean number of chronic conditions ($p < 0.001$), comparing those with and without PPG. A positive value indicates that participants with PPG had more mean chronic conditions than participants without PPG. Bars represent 95% confidence intervals of the mean differences. The analysis included 29 individual chronic conditions: the 22 conditions shown in Fig. 2, plus birth trauma, lead poisoning, Huntington's disease, Parkinson's disease, narcolepsy, multiple sclerosis, and brain tumor. For anxiety and depression, this measure includes professionally diagnosed conditions only (not the results of the Beck Anxiety Inventory and Beck Depression Inventory conducted during the current study)

problems, this mean difference was 0.7 conditions. All three of these linear regression coefficients were statistically significant, at a level of $p < 0.001$.

Discussion

We sought to identify comorbidities of problem gambling behavior. Many chronic health conditions were associated with probable pathological gambling (PPG) in this sample. The study was not designed to establish a causal relationship between poor health and gambling problems, nor determine the direction that such a causal relationship would take. However, the co-occurrence itself may have implications for public health policy and for healthcare providers. In particular, participants with a history of substance use or symptoms of depression or anxiety had higher odds than their peers of having PPG.

Participants with PPG tended to have higher rates of use of alcohol, tobacco, and substances than did their peers, mirroring findings of other studies (Grant & Chamberlain, 2020; McGrath & Barrett, 2009). One potential explanation for these findings would be that gambling is another, consequential form of self-soothing behavior for individuals with depression and anxiety. Substance rehabilitation programs typically stress to participants that they should not engage in other potentially addictive behaviors, and this analysis suggests that gambling may be included among the potentially addictive behaviors to be avoided.

While substance use partially explained the association between poor health and PPG, our findings indicate that other chronic health conditions also significantly co-occur with problem gambling behavior, independent of substance use. Symptoms of depression and anxiety stood out as having particularly strong associations with PPG. Furthermore, healthcare encounters, particularly those involving mental health, could serve as an opportunity for healthcare professionals to screen for and address problematic gambling behaviors.

This study has several limitations, including cohort retention and selection bias due to loss of follow-up. The remedy used in this analysis against loss to follow-up was to collapse multiple years of data for each participant, so that the final analytic sample was one row per enrollee, without over-representing participants who remained in the study for more follow-up visits. The exclusion of individuals with incomplete SOGS may have introduced bias into the analysis, although a comparison of the analysis sample with the full cohort did not show statistically significant differences. While the existence of co-occurrent health issues among people with problematic gambling behavior is well-supported by this study and others (Afifi et al., 2010; Erickson et al., 2005; Morasco, Vom Eigen et al., 2006), another potential limitation is that gambling behavior and substance use were ascertained through self-report, which is subject to recall error and could reflect a social desirability bias.

This study ascertained PPG status using the SOGS, with a sensitive cut point of 5. This cut point corresponds with the scale's use as a screening tool (Lesieur & Blume, 1987), and as such it may produce false positives compared to diagnostic tools (Goodie et al., 2013). A more specific tool than the SOGS—or the SOGS with a higher, more specific cut point—may be used by a medical professional to diagnose a patient with Gambling Disorder (Goodie et al., 2013). The results should therefore be interpreted in the context that PPG status was judged using a sensitive screening tool, whereas chronic conditions were judged using self-report of actual, specific diagnoses by medical providers.

The sample of this study was not population-based; instead, it was an intentional over-sample of participants who engaged in gambling so that the analysis could examine their comorbidities, risk factors, and behavioral health tendencies. Other studies have been designed and conducted to produce population-level estimates of Gambling Disorder, including Maryland prevalence studies in 2010, 2017, 2020, and 2022 (Shinogle et al., 2011; Tracy et al., 2019; Tracy & Schluterman, 2021; Tracy & Brown, 2023). The occurrence of current gambling participation (89.9%) and PPG (34.2%) in this sample was far higher than in the 2022 Maryland Gambling Prevalence Study (31.5% and 1.6%, respectively; Tracy & Brown, 2023). Therefore, the proportions of PPG observed in this study should not be interpreted as prevalence estimates, either on the whole population level or within subgroups.

This study does, however, highlight subgroups within the population who may benefit from increased attention on their gambling behavior—specifically, members of the community who are experiencing substance use problems, mental health conditions, or certain chronic health conditions—especially as new opportunities for gambling are legalized.

Declarations

Competing Interests The authors have no relevant financial or non-financial interests to disclose, and no competing interests to declare that are relevant to the content of this article.

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