Published in final edited form as:

J Addict Med. 2013 ; 7(6): . doi:10.1097/ADM.0b013e31829e9b36.

Increased incidence of cardiovascular conditions among older adults with pathological gambling features in a prospective study

Dr. Corey E. Pilver, Ph.D. and **Dr. Marc N. Potenza, M.D., Ph.D.**

Department of Biostatistics, Yale School of Public Health, New Haven, CT (Dr. Pilver).

Departments of Psychiatry, Neurobiology, and Yale Child Study Center, Yale University School of Medicine, New Haven, CT (Dr. Potenza)

Abstract

Objectives—To evaluate the prospective associations between at-risk/problem/pathological gambling (ARPG) and incident medical conditions among older adults.

Methods—Secondary data analysis of the National Epidemiologic Survey of Alcohol and Related Conditions (NESARC), Waves 1 and 2, collected from 2001–2002 and 2004–2005, respectively. Participants are adults aged 55 years and older ($n=10,231$) who were selected from a nationally representative community sample of adults residing in the United States. Past-year DSM-IV diagnostic criteria for pathological gambling at Wave 1 were evaluated with the Alcohol Use Disorder and Associated Disabilities Interview Schedule—Diagnostic and Statistical Manual of Mental Disorders—Fourth Edition. Physical-health conditions were assessed at Wave 1 and Wave 2. Logistic regression modeling was conducted on groups categorized as ARPG (participants endorsing one or more inclusionary criteria for pathological gambling) and non-ARPG (non-gambling/low-frequency gambling or gambling without endorsement of pathological gambling criteria).

Results—Relative to non-ARPG, ARPG is prospectively associated with elevated incidences of arteriosclerosis and any heart condition, independently of Wave-1 socio-demographic characteristics, psychiatric comorbidity, substance use, and body mass index.

Conclusions—Older adults who demonstrate risky or problematic levels of gambling may be at particular risk for the onset of some physical-health conditions. ARPG individuals should be monitored more closely for the development of these conditions and encouraged to adopt activities that confer health benefits. Efforts should be made to educate older adults and their caretakers on the adverse incident physical-health conditions associated with ARPG.

Corresponding author: Marc N. Potenza, Connecticut Mental Health Center, Room S-104, 34 Park St., New Haven, CT 06519, Tel: 203-974-7356, Fax: 203-974-7366, Marc.Potenza@yale.edu.

Conflicts of Interest: The authors report no conflicts of interest with respect to content of the manuscript. The authors disclose the following for past-12-month activities. Dr. Potenza reports no conflicts of interest related to the content of this manuscript. He has consulted for Lundbeck and Ironwood pharmaceuticals; received research support from the National Institutes of Health (NIH), Mohegan Sun Casino, and National Center for Responsible Gambling; has participated in surveys, mailings, or telephone consultations related to drug addiction, impulse-control disorders, or other health topics; has consulted for law offices on issues related to addictions or impulse-control disorders; has consulted to gambling agencies and entities on responsible gambling efforts; has provided clinical care in the Connecticut Department of Mental Health and Addiction Services Problem Gambling Services Program; has performed grant reviews for the NIH and other agencies; has guest edited journal sections; has given academic lectures in grand rounds, Continuing Medical Education events, and other clinical or scientific venues; and has generated books or book chapters for publishers of mental health texts. Dr. Pilver reports no financial or other potential conflicts of interest related to the subject of this article.

Disclaimer: The funding agencies did not provide input or comment on the content of the manuscript, and the content of the manuscript reflects the contributions and thoughts of the authors and do not necessarily reflect the views of the funding agencies.

Keywords

At-risk/problem/pathological gambling; physical illness; older adults; addiction; aging

Introduction

Most older adults gamble (Gerstein et al., 1999) and do so without developing problems. However, approximately 0.1% to 1.9% of older adults meet criteria for pathological gambling (PG) (Gerstein et al., 1999; Pietrzak et al., 2007; Shaffer et al., 1999a; Welte et al., 2001). DSM-IV PG is diagnosed when an individual acknowledges five or more inclusionary criteria (Association, 2000). From a public health perspective, many individuals acknowledge one to four inclusionary criteria, and even the acknowledgement of one or two criteria has been associated with elevated odds for specific psychiatric and medical conditions (Desai et al., 2007; Desai and Potenza, 2008).

While non-problematic (or recreational) gambling has been associated with positive mental and physical-health outcomes, particularly amongst older adults (Desai et al., 2004; Footitt and Anderson, 2012), cross-sectional studies link more severe or problem gambling to poorer physical health among older adults. For example, older-adult (aged 65 years and older) past-year recreational gamblers (individuals acknowledging zero to two PG criteria) and past-year problem/pathological gamblers (PPG; individuals acknowledging three or more PG criteria) were more likely than past-year low-frequency gamblers/non-gamblers to report at least one chronic physical-health condition, such as arthritis or heart disease (Desai et al., 2007). In another study, older adults with lifetime PPG demonstrated elevated odds for angina and arthritis, relative to older-adult (aged 60+) lifetime non-gamblers (Pietrzak et al., 2007).

Cross-sectional data do not permit assessment of temporal relationships between gambling problems and physical-health conditions; thus, statements regarding directionality cannot be made. Some data suggest that physical illnesses may predate the onset of gambling problems; other data suggest gambling problems may predate the onset of physical illnesses. These studies are reviewed below. Physical illnesses may predate and contribute to the development of gambling problems. Gambling is a social and recreational activity compatible with physical limitations of many older adults, and in the possible setting of limited options for recreation, gambling may represent an outlet for entertainment and socialization that may come to dominate leisure time. For instance, older adults who are wheelchair-bound, use oxygen tanks, or are otherwise unable to participate in physically demanding activities report feeling safe and independent while gambling at casinos (Glicksman, 2012; Martin et al., 2011). Thus, limitations experienced by some older adults could potentially facilitate an increased reliance on gambling as a leisure activity that could lead to problem gambling. In support of this explanation, older adults who reported gambling as a substantial part of their recreational activities were more likely than others to show PG features (Preston et al., 2007).

Alternatively, gambling may predate and contribute to the development of physical illness. Stress associated with gambling wins and losses may exacerbate cardiovascular conditions such as angina and tachycardia (Potenza et al., 2002). Gamblers who lack time for sustained physical activity (as a result of time spent in gambling and other largely sedentary activities) might be expected to have poorer physical health over time, compared to individuals devoting more time to more demanding physical activities. Additionally, gamblers' elevated consumption of alcohol and tobacco may elevate risks for hypertension, cardiovascular events, liver disease and cirrhosis (Rehm et al., 2003; U.S. Department of Health and

Human Services, 2004). Lastly, the unique environmental context of casino gambling may contribute to the development of deleterious physical-health conditions among older adults, specifically conditions related to smoking and exposure to secondhand smoke (i.e. cancers and cardiovascular conditions (CDC, 2012a, b)). Casino gambling is popular among older adults, with 36% of adults aged 50–64 years and 28% of adults aged 65 years and over having visited a casino in 2012 (AGA, 2013a). Although state and local governments have increasingly enacted smoking bans for workplaces, restaurants, and/or bars (beginning with California in 1995), casinos have often been exempted (American Nonsmokers' Rights, 2013a). Presently, only 8 of 23 states operating commercial casinos are 100% smoke-free (AGA, 2013b; American Nonsmokers' Rights, 2013b); furthermore, all tribal casinos are exempt from these policies. Thus, as casinos represent some of the last venues for smoking in public, they may be particularly attractive to smokers. The prevalence of smoking among casino employees is higher than in the general population (Shaffer et al., 1999b), smokers report greater cigarette consumption on gambling days compared to non-gambling days (Sullivan and Beer, 2013), and problem-gambling severity is associated with smoking levels among casino gamblers (Fong et al., 2011). Additionally, non-smokers experience elevated exposure to secondhand smoke in the context of casino gambling (Repace, 2009), casino patrons and workers demonstrate elevated health risks related to secondhand smoke (Achutan et al., 2009; American Nonsmokers' Rights, 2013c), and exposure to secondhand smoke in casinos exceeds levels associated with risk for cardiovascular illness after only two hours of exposure (Repace et al., 2011). An association between gambling and physical-health problems may result from confounding or mediating factors associated with both. By controlling for these factors in statistical models, independent relationships between gambling and physical-health conditions may be understood.

Here, we evaluated whether features of PG are associated with the onset of physical-health conditions. This extends prior work (Desai et al., 2007; Pietrzak et al., 2007) by examining longitudinal relationships between PG features and incident physical-health conditions among older adults in the general population. We hypothesized that older adults with PG features (at-risk/problem/pathological gambling [ARPG] operationalized as one or more inclusionary criteria for PG) would be more likely than participants who were either non-gamblers/low frequency gamblers or gamblers not acknowledging PG features (non-ARPG) to report incident physical-health conditions at a three-year follow-up assessment.

METHODS

Sample

We utilized data from the National Epidemiologic Survey of Alcohol and Related Conditions (NESARC), a longitudinal study conducted by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) and the US Census Bureau. Extensive details on NESARC methodology have been published (Grant and Kaplan, 2005; Grant et al., 2003). Briefly, NESARC data were collected in 2001–2002 (Wave 1) and 2004–2005 (Wave 2). Wave-1 data included 43,093 participants (81% response); Wave-2 data included 34,653 participants (87% response; 70% cumulative response) (Ruan et al., 2008). The average time between interviews was 36.6 months. Eligible participants were selected through a multistage, clustered sampling strategy and included non-institutionalized adults (aged 18 years and older at Wave 1) who resided in the United States and lived in households, dormitories, group homes, and shelters. There was oversampling of ethnic minorities and young adults. The oversampling, clustered sampling strategy, and probability of non-response are accounted for by a NESARC weighting variable.

From the 34,653 individuals completing Waves 1 and 2, we excluded 647 participants who did not provide valid data for the Wave-1 gambling module. Older adults were defined as

individuals who were 55 years or older at Wave 1, as previously (Pilver et al., 2013; Potenza et al., 2006). Consequently, we excluded 23,775 participants aged 18–54 years, yielding a final sample that included 10,231 participants. Given our focus on incidence, only those individuals without a lifetime history of the outcome of interest at Wave 1 were included in each analysis; consequently, the analytical sample varied as function of the outcome under study.

Survey Instrument

Axis-I and Axis-II psychiatric disorders were assessed at each wave using the Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS-IV), which was administered by trained, lay interviewers (Grant et al., 1995). The AUDADIS-IV is a structured diagnostic instrument yielding DSM-IV diagnoses (American Psychiatric Association, 1994). AUDADIS-IV diagnoses are reliable in clinical and general population samples (Grant et al., 1995; Ruan et al., 2008). Participants were fully informed about the purpose of the survey, potential use of the data, and data protection procedures prior to giving consent. The U.S. Census Bureau and Office of Management and Budget reviewed and approved the ethics of the NESARC. Analyses of de-identified, publicly available NESARC data were exempted from further Institutional-Review-Board review.

Measures

Dependent variables—Incident physical-health conditions: Outcomes were binary, and considered incident at Wave 2 given that the analytic sample was restricted to individuals with no past-year history of the condition at Wave 1. At both waves, participants reported the presence or absence (in the past year) of eleven doctor-diagnosed conditions. Outcomes included individual conditions of arteriosclerosis, hypertension, and arthritis and combined categories of any liver condition (cirrhosis and/or any other liver disease), any heart condition (angina, tachycardia, myocardial infarction, and/or any other heart disease), and any stomach condition (stomach ulcer and/or gastritis).

Independent variable—ARPG status was assessed at Wave 1; participants who endorsed gambling at least five times in any one year of their lifetime were assessed for the ten inclusionary criteria for PG. DSM-IV PG requires endorsement of five or more of criteria (American, 1994). As previously (Cunningham-Williams et al., 1998; Kessler et al., 2008; Pilver et al., 2013; Potenza et al., 2011; Rahman et al., 2012; Slutske et al., 2000), ARPG status was characterized as a binary variable: low-frequency gambling/non-gambling (did not gamble more than five times in any one year in one's lifetime) and low-risk gambling (gambled more than five times in any year with no past-year PG criteria) were characterized as non-ARPG; ARPG was defined by having gambled more than five times in any year and acknowledging one or more past-year PG criteria).

Socio-demographic covariates—Assessed at Wave 1, these included: age (continuous, ranging from 55–90 years), gender, race/ethnicity (white, black, Hispanic, Other), education (less than high-school, high-school graduate, some college, college and higher), employment status (full-time, part-time, other), household income (less than \$20K, \$20K to less than \$35K, \$35K to less than \$70K, \$70K and above), and marital status (married/living-as-married, not married).

Baseline psychiatric comorbidity—Binary variables indicated the presence or absence of past-year psychiatric disorders at Wave 1; these included: any past-year mood disorder (major depressive disorder, dysthymia, mania, hypomania) and any past-year anxiety disorder (panic disorder with or without agoraphobia, agoraphobia, social phobia, specific phobia, and generalized anxiety disorder). A binary variable indicated the presence or

absence of any Axis-II disorders (lifetime) at Wave 1; these included: avoidant, dependent, obsessive-compulsive, paranoid, schizoid, and histrionic personality disorders.

Substance use—Three categorical variables indicated current (past-year), former (lifetime but not past-year), and lifetime non-use of tobacco products (cigarettes, cigars, pipe, snuff, and chewing tobacco), alcohol (coolers, beer, wine, and liquor), and drugs (substances in the following classes: sedatives, tranquilizers, opiates (other than heroin or methadone), stimulants, hallucinogens, cannabis, cocaine, inhalants/solvents, heroin, and other drugs).

Body mass index (BMI)—BMI, assessed at Wave 1, is a continuous variable ranging from 14.4 to 65.8. BMI is based on height (inches) and weight (pounds), calculated as: $(\text{weight} \times 703) / \text{height}^2$. BMI scores less than 18.5 are considered underweight; 18.5 to 24.9 fall within the normal range; 25.0 to 29.9 are considered overweight; and greater than 30.0 is considered obese.

Analytic approach

We utilized SAS 9.1 (SAS, 2002) and SUDAAN 10.1 (SUDAAN, 2008) for data management and analyses, respectively. The NESARC weighting variable was included at all stages of analyses. Descriptive statistics were performed with PROC CROSSTAB for categorical variables and PROC DESCRIPT for continuous variables; bivariate associations were evaluated with the Wald Chi-Square test. Using PROC CROSSTAB, we calculated the three-year cumulative incidence of each outcome according to ARPG status, among individuals with no Wave-1 history of that outcome. Results are presented as unweighted Ns and weighted percentages. To determine the direction and magnitude of these associations, we constructed two binary logistic regression models using PROC RLOGIST. The first model was unadjusted; the second model was adjusted for Wave-1 socio-demographic covariates, psychiatric comorbidity, substance use, and BMI. We present odds ratios (ORs) and associated 95% confidence intervals (CIs). A 95% CI that does not include 1.0 is significant at $\alpha = 0.05$.

RESULTS

Prevalence of gambling behaviors and features

Among older adults at Wave 1, 67.3% ($n=7,045$) were non-gamblers or low-frequency gamblers, 28.8% ($n=2,917$) were low-risk gamblers (endorsed no past-year PG features), 2.4% ($n=231$) were at-risk gamblers (endorsed 1 to 2 past-year PG features), 0.4% ($n=30$) were problem gamblers (endorsed 3 to 4 past-year PG features). Consistent with prior low prevalence estimates observed in older adults (Gerstein et al., 1999; Shaffer et al., 1999a; Welte et al., 2001), 0.1% ($n=8$) met criteria for PG. The prevalence of ARPG was 2.8% ($n=269$).

Baseline characteristics and past-year ARPG

ARPG status was associated with current age, any mood disorder, any axis-II disorder, alcohol use, tobacco use, and drug use (Table 1). Relative to non-ARPG individuals, ARPG individuals were younger, and were more likely to be male, have a past-year history of any mood disorder at Wave 1, have a lifetime history of any axis-II disorder, and be a current user of alcohol, tobacco, and drugs.

ARPG and incident physical-health conditions

In bivariate analyses, ARPG was negatively associated with any liver condition; the incidence of any liver condition was higher among non-ARPG individuals compared to ARPG individuals (Table 2).

In unadjusted logistic regression modeling (model 1), ARPG individuals were 36% more likely than non-ARPG individuals to develop arteriosclerosis (OR=2.36; $p=.0059$). In model 2, this association remained significant (OR=2.30; $p=.0035$) following adjustment for Wave-1 socio-demographic characteristics, psychiatric comorbidity, substance use, and BMI. In contrast, the association between ARPG status and incidence of any heart condition, which was initially not statistically significant (OR=1.41; $p=.10$), was strengthened and gained statistical significance in model 2 (OR=1.53; $p=.044$) after adjustment for Wave-1 socio-demographic characteristics, psychiatric comorbidity, substance use, and BMI. Finally, the bivariate association found for ARPG status and the incidence of any liver condition was not statistically significant in unadjusted and adjusted logistic regression modeling (Table 3).

DISCUSSION

This study is a novel examination of the prospective relationship between past-year ARPG status and incident physical-health conditions among older adults in the general population. As hypothesized, ARPG status was associated with elevated odds for some physical-health conditions; specifically, incident arteriosclerosis and heart conditions. Moreover, these relationships were observed independently of Wave-1 socio-demographic characteristics, psychiatric comorbidity, substance use, and BMI. Although the mechanisms that may link ARPG to the development of arteriosclerosis and heart conditions among older adults cannot be identified from these data, results suggest that ARPG may confer risk for these illnesses beyond established risk factors for arteriosclerosis and heart conditions such as smoking, alcohol consumption, and obesity (Solberg and Strong, 1983). It is possible that chronic stress associated with ARPG may contribute to the development of these health issues, as gambling has been associated with biological measures of stress responsiveness, such as elevated heart rates and cortisol levels, particularly amongst problem gamblers (Krueger et al., 2005; Meyer et al., 2000; Meyer et al., 2004). However, alternate explanations exist. For example, older adults who frequent gambling venues may also have greater exposure to secondhand smoke (Repace, 2009), which was not assessed but may represent a risk factor for cardiovascular conditions. Because gambling is a sedentary activity, ARPG individuals may spend less leisure time engaged in physical activity compared to non-ARPG individuals, although this possibility warrants direct examination. Such possible differences in health behaviors may contribute to the elevated incidence of cardiovascular conditions among ARPG individuals as compared to non-ARPG individuals. However, the NESARC lacks information on Wave-1 physical activity and secondhand smoke exposure; thus, these relationships could not be explored with these data.

ARPG was negatively associated with the incidence of any liver condition (cirrhosis and/or any other liver disease) in bivariate analysis; however, this association failed to remain significant in logistic regression modeling. Given the very low incidence of incident liver disorders in the sample, the study may have been underpowered to detect an association; furthermore, the direction and magnitude of this association is relatively unstable. Consequently, future research should directly examine the potential role of ARPG status in the development of liver conditions among older adults, using a larger sample or a different study design (e.g., a nested case-control design). If an association between ARPG status and incident liver conditions among older adults were identified, the nature of this association

(positive or negative) would have implications for screening, prevention, and treatment of both gambling problems and liver conditions.

The results raise questions and suggest important implications for older adult care, particularly since many senior centers, assisted-living facilities, and nursing homes offer gambling activities or sponsor casino trips as part of their recreational programming (McNeilly and Burke, 2001). Our findings suggest that ARPG is associated with incident cardiovascular illness and thus should be considered by older adults and those who contribute to their care. While all older adults should be monitored for the development of physical-health conditions, older-adult gamblers who endorse any features of PG may represent a particularly high-risk population in need of greater attention with respect to not only potential gambling-related sequelae, but also possible cardiovascular conditions. Such individuals should be educated about the physical-health risks associated with risky or problematic gambling and encouraged to consider the health implications and participate in health-promoting activities. Additional research (e.g., into the types and frequencies of gambling participation) may help better understand the nature of the observed prospective associations such that persons responsible for recreational programming of community-dwelling older adults, as well as those who reside in facilities, may modify their recommendations and policies accordingly. Monitoring for ARPG and intervening early might help to ensure not only better mental health, but also better physical health.

While this study has numerous strengths, multiple limitations exist. First, ARPG status was assessed at Wave 1 but not at Wave 2; therefore, we could not evaluate whether physical-health conditions were related to the onset of gambling problems in older adults or whether incident physical conditions related to changes in ARPG status. Second, the characterization of gambling groups (ARPG and non-ARPG) are not based on validated DSM-IV thresholds; instead, these are based on approaches adopted in prior work (Cunningham-Williams et al., 1998; Kessler et al., 2008; Pilver et al., 2013; Potenza et al., 2011; Rahman et al., 2012; Slutske et al., 2000). While considerations of subsyndromal levels of gambling behaviors are encouraged from a public health perspective, additional investigations of clinical groups are warranted. Third, we employ a relatively liberal definition of ‘older’ adults, albeit one used in prior work (Petry, 2002; Pilver et al., 2013; Potenza et al., 2006). Relatedly, this broad characterization of older adults does not consider potential intra-group variability. Future studies might examine older adults in more precise terms (i.e., the young old, old, and oldest old) (Suzman et al., 1992). Although self-reports of doctor-diagnosed conditions have been found to be reliable (Kehoe et al., 1994), this source of information is a potential limitation. Additionally, participants who failed to seek medical assistance for their symptoms may have had physical-health conditions that were undetected and undiagnosed. This would lead to misclassification of participants as non-cases at the Wave-1 and/or Wave-2 assessments, which might have biased findings. Finally, the baseline assessment of these medical conditions refers to the past-year only (rather than lifetime) and may potentially contribute to misclassification, in which participants are incorrectly included in the baseline population at risk for an incident disorder. An example of this is someone who was hypertensive prior to the year before the Wave-1 interview, received medication, and therefore reported being free from hypertension in the past-year at Wave-1. Similarly, the Wave-2 assessment probes for diagnoses in the prior year (rather than during the entire period between interviews); thus, cases that occurred and were resolved in the interval between the Wave-1 and Wave-2 assessments, but prior to the year before Wave-2, would be misclassified as non-cases.

The strengths of this study include the use of a large, nationally representative dataset to investigate a novel research question. Additionally, the AUDADIS-IV is a valid and reliable tool for assessing psychiatric disorders. The use of a past-year measure of ARPG status,

rather than a lifetime measure, is also advantageous given that it is less vulnerable to recall bias and of greater temporal proximity to the period of possible incidence.

CONCLUSIONS

ARPG is prospectively associated with elevated incidences of arteriosclerosis and any heart condition in older adults, relative to a non-ARPG older-adult group. These findings suggest that ARPG may represent an important risk factor to the cardiovascular health of older adults. Future studies should investigate specific mechanisms that may link ARPG to the development of cardiovascular conditions (and other physical-health conditions) in older adults; ideal studies would utilize prospective designs, collect biological measures of stress responsiveness, assess health behaviors such as leisure-time physical activity, employ more detailed assessments of specific gambling behaviors (e.g., gambling types, frequencies), and examine relevant environmental factors such as exposure to secondhand smoke. Furthermore, research should differentiate among pathological, problem, and at-risk gambling, and different generations of “older” adults. Older adults who demonstrate more risky or problematic levels of gambling should be more closely monitored for the development of physical-health conditions. Additionally, older adult patients seeking medical care for cardiovascular conditions should be screened by their physicians for gambling problems, using easily administered brief screening tools such as the Brief Bio-social Gambling Screen (Gebauer et al., 2010) or the EIGHT (Early Intervention Gambling Health Test) Gambling Screen; Sullivan, 1999). Finally, efforts should be made to educate older adults and their caretakers on the potential physical-health risks associated with ARPG.

Acknowledgments

Source of Funding: This research was funded in part by NIMH training grant T-32-MH01 4235-37, NIH grants from NIAAA (RL1 AA017539), the Connecticut State Department of Mental Health and Addictions Services, the Connecticut Mental Health Center, an unrestricted research gift from the Mohegan Sun casino, and the Yale Gambling Center of Research Excellence Award grant from the National Center for Responsible Gaming.

References

1. Achutan, C.; West, C.; Mueller, C.; Boudreau, Y.; Mead, K. [Accessed on May 22, 2013.] Environmental and biological assessment of environmental tobacco smoke exposure among casino dealers. National Institute for Occupational Health and Safety. 2009. Available at: <http://www.cdc.gov/niosh/hhe/reports/pdfs/2005-0201-3080.pdf>
2. American Gaming Association (AGA). State of the States: The AGA Survey of Casino Entertainment. American Gaming Association; 2013a. Available at: http://www.americangaming.org/sites/default/files/uploads/docs/aga_sos2013_fnl.pdf [Accessed on May 22, 2013.]
3. American Gaming Association (AGA). State Information. American Gaming Association; 2013b. Available at: <http://www.americangaming.org/industry-resources/state-information> [Accessed on May 22, 2013.]
4. American Nonsmokers' Rights. Overview List--How many smokefree laws?. American Nonsmokers' Rights Foundation; 2013a. Available at: <http://www.no-smoke.org/pdf/mediaordlist.pdf> [Accessed on May 22, 2013.]
5. American Nonsmokers' Rights. US 100% Smokefree Gambling. American Nonsmokers' Rights Foundation; 2013b. Available at: <http://www.no-smoke.org/pdf/100smokefreecasinos.pdf> [Accessed on May 22, 2013.]
6. American Nonsmokers' Rights. Secondhand Smoke and Gaming Facilities. American Nonsmokers' Rights Foundation; 2013c. Available at: <http://www.no-smoke.org/document.php?id=316> [Accessed on May 22, 2013.]

7. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4. Washington DC: American Psychiatric Press; 1994. (DSM-IV)
8. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4. Washington DC: American Psychiatric Press; 2000. Text revision (DSM-IV-TR)
9. Centers for Disease Control and Prevention (CDC). Smoking and Tobacco Use: Health Effects of Cigarette Smoking. Centers for Disease Control and Prevention; 2012a. Available at: http://www.cdc.gov/tobacco/data_statistics/fact_sheets/health_effects/effects_cig_smoking [Accessed on May 22 2013.]
10. Centers for Disease Control and Prevention (CDC). Smoking and Tobacco Use: Health Effects of Secondhand Smoke. Centers for Disease Control and Prevention; 2012b. Available at: http://www.cdc.gov/tobacco/data_statistics/fact_sheets/secondhand_smoke/health_effects/ [Accessed on May 22 2013.]
11. Cunningham-Williams RM, Cottler LB, Compton WM, Spitznagel EL. Taking chances: Problem gamblers and mental health disorders - results from the St. Louis Epidemiologic Catchment Area Study. *Am J Public Health*. 1998; 88:1093–1096. [PubMed: 9663161]
12. Desai RA, Desai MM, Potenza MN. Gambling, health and age: data from the National Epidemiologic Survey on Alcohol and Related Conditions. *Psychol Addict Behav*. 2007; 21:431–440. [PubMed: 18072825]
13. Desai RA, Maciejewski PK, Dausey DJ, Caldarone BJ, Potenza MN. Health correlates of recreational gambling in older adults. *Am J Psychiatry*. 2004; 161:1672–1679. [PubMed: 15337659]
14. Desai RA, Potenza MN. Gender differences in the associations between past-year gambling problems and psychiatric disorders. *Soc Psychiatry Psychiatr Epidemiol*. 2008; 43:173–183. [PubMed: 18080792]
15. Fong TW, Campos MD, Brecht ML, Davis A, Marco A, Pecanha V, Rosenthal RJ. Problem and pathological gambling in a sample of casino patrons. *J Gambl Stud*. 2011; 27:35–47. [PubMed: 20549549]
16. Footitt J, Anderson D. Associations between perception of wellness and health-related quality of life, comorbidities, modifiable lifestyle factors and demographics in older Australians. *Australas J Ageing*. 2012; 31:22–27. [PubMed: 22417150]
17. Gebauer L, LaBrie R, Shaffer HJ. 2010 Optimizing DSM-IV-TR classification accuracy: a brief biosocial screen for detecting current gambling disorders among gamblers in the general household population. *Can J Psychiatry*. 2010; 55:82–90. [PubMed: 20181303]
18. Gerstein, D.; Murphy, S.; Toce, M.; Hoffman, J.; Palmer, A.; Johnson, R.; Larison, C.; Chuchro, L.; Bard, A.; Engelman, L.; Hill, MA.; Buie, T.; Volberg, R.; Harwood, H.; Tucker, A.; Christiansen, E.; Cummings, W.; Sinclair, S. Gambling impact and behavior study: Report to the national gambling impact study commission. Chicago: 1999.
19. Glicksman, E. [Accessed March 19, 2013.] When seniors gamble: Harmless fun or bad bet? [myOptumHealth.com website]. 2012. Available at: <http://wn.wsaz.com/story/11867314/when-seniors-gamble-harmless-fun-or-a-bad-bet>
20. Grant BF, Harford TC, Dawson DA, Chou PS, Pickering RP. The Alcohol Use Disorder and Associated Disabilities Interview schedule (AUDADIS): reliability of alcohol and drug modules in a general population sample. *Drug Alcohol Depend*. 1995; 39:37–44. [PubMed: 7587973]
21. Grant, BF.; Kaplan, KD. Source and accuracy statement: The wave 2 national epidemiologic survey on alcohol and related conditions (NESARC). Rockville, MD: 2005.
22. Grant, BF.; Moore, TC.; Shepard, J.; Kaplan, K. Source and accuracy statement for wave 1 of the 2001–2002 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). Bethesda, MD: 2003.
23. Kehoe R, Wu SY, Leske MC, Chylack LT. Comparing self-reported and physician-reported medical history. *Am J Epidemiol*. 1994; 139:813–818. [PubMed: 8178794]
24. Kessler RC, Hwang I, LaBrie R, Petukhova M, Sampson NA, Winters KC, Shaffer HJ. DSM-IV pathological gambling in the National Comorbidity Survey Replication. *Psychol Med*. 2008; 38:1351–1360. [PubMed: 18257941]

25. Krueger TH, Schedlowski M, Meyer G. Cortisol and heart rate measures during casino gambling in relation to impulsivity. *Neuropsychobiology*. 2005; 52:206–211. [PubMed: 16244502]
26. Martin F, Lichtenberg PA, Templin TN. A longitudinal study: casino gambling attitudes, motivations, and gambling patterns among urban elders. *J Gambl Stud*. 2011; 27:287–297. [PubMed: 20549548]
27. McNeilly DP, Burke WJ. Gambling as a social activity of older adults. *Int J Aging Hum Dev*. 2001; 52:19–28. [PubMed: 11310572]
28. Meyer G, Hauffa BP, Schedlowski M, Pawlak C, Stadler MA, Exton MS. Casino gambling increases heart rate and salivary cortisol in regular gamblers. *Biol Psychiatry*. 2000; 48:948–953. [PubMed: 11074233]
29. Meyer G, Schwertfeger J, Exton MS, Janssen OE, Knapp W, Stadler MA, Schedlowski M, Krüger TH. Neuroendocrine response to casino gambling in problem gamblers. *Psychoneuroendocrinology*. 2004; 29:1272–1280. [PubMed: 15288706]
30. Petry NM. A comparison of young, middle-aged, and older adult treatment-seeking pathological gamblers. *Gerontologist*. 2002; 42:92–99. [PubMed: 11815703]
31. Pietrzak RH, Morasco BJ, Blanco C, Grant BF, Petry NM. Gambling level and psychiatric and medical disorders in older adults: results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Am J Geriatr Psychiatry*. 2007; 15:301–313. [PubMed: 17095749]
32. Pilver CE, Libby DJ, Hoff RA, Potenza MN. Problem gambling severity and the incidence of Axis I psychopathology among older adults in the general population. *J Psychiatr Res*. 2013; 47:534–541. [PubMed: 23333039]
33. Potenza MN, Fiellin DA, Heninger GR, Rounsaville BJ, Mazure CM. Gambling: an addictive behavior with health and primary care implications. *J Gen Intern Med*. 2002; 17:721–732. [PubMed: 12220370]
34. Potenza MN, Steinberg MA, Wu R, Rounsaville BJ, O'malley SS. Characteristics of Older Adult Problem Gamblers Calling a Gambling Helpline. *J Gambl Stud*. 2006; 22:241–254. [PubMed: 16835811]
35. Potenza MN, Wareham JD, Steinberg MA, Rugle L, Cavallo DA, Krishnan-Sarin S, Desai RA. Correlates of at-risk/problem internet gambling in adolescents. *J Am Acad Child Adolesc Psychiatry*. 2011; 50:150–159. [PubMed: 21241952]
36. Preston FW, Shapiro PD, Keene JR. Successful Aging and Gambling: Predictors of Gambling Risk Among Older Adults in Las Vegas. *American Behavioral Scientist*. 2007; 51:102–121.
37. Rahman AS, Pilver CE, Desai RA, Steinberg MA, Rugle L, Krishnan-Sarin S, Potenza MN. The relationship between age of gambling onset and adolescent problematic gambling severity. *J Psychiatr Res*. 2012; 46:675–683. [PubMed: 22410208]
38. Rehm J, Gmel G, Sempos CT, Trevisan M. Alcohol-related morbidity and mortality. *Alcohol Res Health*. 2003; 27:39–51. [PubMed: 15301399]
39. Repace JL. Secondhand smoke in Pennsylvania casinos: a study of nonsmokers' exposure, dose, and risk. *Am J Public Health*. 2009; 99:1478–1485. [PubMed: 19542036]
40. Repace JL, Jiang RT, Acevedo-Bolton V, Cheng KC, Klepeis NE, Ott WR, Hildemann LM. Fine particle air pollution and secondhand smoke exposures and risks inside 66 US casinos. *Environ Res*. 2011; 111:473–484. [PubMed: 21440253]
41. Ruan WJ, Goldstein RB, Chou SP, Smith SM, Saha TD, Pickering RP, Dawson DA, Huang B, Stinson FS, Grant BF. 2008 The alcohol use disorder and associated disabilities interview schedule-IV (AUDADIS-IV): reliability of new psychiatric diagnostic modules and risk factors in a general population sample. *Drug Alcohol Depend*. 2008; 92:27–36. [PubMed: 17706375]
42. SAS [computer program]. Version 9. Cary: SAS Institute; 2002.
43. Shaffer HJ, Hall MN, Vander Bilt J. Estimating the prevalence of disordered gambling behavior in the United States and Canada: a research synthesis. *Am J Public Health*. 1999a; 89:1369–1376. [PubMed: 10474555]
44. Shaffer HJ, Vander Bilt J, Hall MN. Gambling, drinking, smoking and other health risk activities among casino employees. *Am J Ind Med*. 1999b; 36:365–378. [PubMed: 10470001]

45. Slutske WS, Eisen S, True WR, Lyons MJ, Goldberg J, Tsuang M. Common genetic vulnerability for pathological gambling and alcohol dependence in men. *Arch Gen Psychiatry*. 2000; 57:666–673. [PubMed: 10891037]
46. Solberg LA, Strong JP. Risk factors and atherosclerotic lesions. A review of autopsy studies. *Arteriosclerosis*. 1983; 3:187–198. [PubMed: 6342587]
47. SUDAAN [computer program]. Version 10. Research Triangle Park: RTI International; 2008.
48. Sullivan, S. Development of the “EIGHT” Problem Gambling Screen. Auckland Medical School; Auckland, New Zealand: 1999. Available at: http://www.acts.co.nz/Eight_Screen.php [Accessed May 28, 2013.]
49. Sullivan S, Beer H. Smoking and problem gambling in New Zealand: problem gamblers’ rates of smoking increase when they gamble. *Health Promotion Journal of Australia*. 2013; 14:192–195.
50. Suzman, RM.; Willis, DP.; Manton, KG. *The Oldest Old*. New York: Oxford University Press; 1992.
51. U.S. Department of Health and Human Services. U.S. Department of Health and Human Services, Center for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. *The Health Consequences of Smoking: A report of the Surgeon General*. Atlanta: 2004. Available at: http://www.cdc.gov/tobacco/data_statistics/sgr/2004/complete_report/index.htm [Accessed May 22, 2013.]
52. Welte J, Barnes G, Wieczorek W, Tidwell MC, Parker J. Alcohol and gambling pathology among U.S. adults: prevalence, demographic patterns and comorbidity. *J Stud Alcohol*. 2001; 62:706–712. [PubMed: 11702810]

Table 1

At-risk/problem/pathological gambling status and Wave-1 study characteristics

Study characteristics	Non-ARPG N=9962; 97.2% ARPG N=269; 2.8%			
	N or Mean	% or SE	N or Mean	% or SE
Current Age	67.51	0.11	64.66	0.57
Gender				
Male	3934	44.13	130	55.45
Female	6028	55.87	139	44.55
Race/ethnicity				
White	6681	80.34	179	75.63
Black	1761	8.42	53	10.23
Other	326	5.00	14	9.63
Hispanic	1194	6.23	23	4.50
Marital status				
Married/living as married	4817	33.36	141	68.23
Not married	5145	66.64	128	31.77
Education				
Less than high school	2517	21.22	65	24.05
High school	3161	33.04	89	35.32
Beyond high school	4284	45.74	115	40.62
Employment				
Full time	2275	23.95	78	29.25
Part time	871	9.12	33	12.17
Other	6816	66.93	158	58.58
Household income				
<\$20,000	3829	29.67	81	21.79
\$20,000 to <\$35,000	2259	22.83	63	22.02
\$35,000 to <\$70,000	2527	29.24	80	33.96
\$70,000	1347	18.25	45	22.23
Any mood disorder	539	4.74	30	9.74
Any anxiety disorder	874	8.18	35	13.15

Study characteristics	Non-ARPG N=9962; 97.2% ARPG N=269; 2.8%				p
	N or Mean	% or SE	N or Mean	% or SE	
Any axis II disorder	961	9.61	77	22.35	.0002
Alcohol use					.0001
Current use	4954	53.32	181	69.99	
Former use	2653	24.98	69	20.46	
Lifetime non-use	2355	21.71	19	9.55	
Tobacco use					<.0001
Current use	1740	17.81	118	44.69	
Former use	3448	36.46	88	31.65	
Lifetime non-use	4774	45.73	63	23.66	
Drug use					.0267
Current use	160	1.53	9	2.65	
Former use	557	5.59	33	11.13	
Lifetime non-use	9245	92.88	227	86.22	
Body Mass Index	27.17	0.07	27.67	0.37	.1758

Notes: ARPG=at-risk/problem/pathological gambling; N are unweighted; % are weighted percentages reflecting prevalence
 Bolded *p*-values indicate statistically significant findings.

^aIndicates past-year prevalence at Wave 1

Table 2
Bivariate associations between at-risk/problem/pathological gambling status and incident physical-health conditions

Incident medical conditions	Non-ARPG		ARPG		p
	N	%	N	%	
Arteriosclerosis	9253	3.87	250	8.68	.06
Hypertension	5525	23.61	148	19.45	.30
Any heart condition	8296	11.05	219	14.89	.14
Any liver condition	9773	0.71	261	0.21	.02
Any stomach condition	8916	6.71	242	6.12	.52
Arthritis	5802	24.37	153	18.27	.12

Notes: ARPG=at-risk/problem/pathological gambling

N are unweighted population at risk; % are weighted percentages reflecting incidence

Bolded *p*-values indicate statistically significant findings.

Table 3

Unadjusted and adjusted logistic regression modeling: A-risk/problem/pathological gambling status and incident medical conditions

Incident medical conditions	Model 1 ^a		Model 2 ^b	
	ARPG vs. Non-ARPG		ARPG vs. Non-ARPG	
	OR	95% CI	OR	95% CI
Arteriosclerosis	2.36	1.29–4.31	2.30	1.33–3.98
Hypertension	0.78	0.48–1.28	0.93	0.50–1.37
Any heart condition	1.41	0.94–2.11	1.53	1.01–2.32
Any liver condition	0.29	0.05–1.54	0.26	0.05–1.49
Any stomach condition	0.91	0.53–1.54	0.92	0.53–1.62
Arthritis	0.69	0.42–1.14	0.79	0.47–1.30

Notes: ARPG=at-risk/problem/pathological gambling

Bolded ORs and 95% CIs indicate statistically significant findings.

^aUnadjusted model

^bAdjusted for age, race, education, marital status, work, income, gender, any Axis-II disorder, any past-year mood disorder at Wave 1, any past-year anxiety disorder at Wave 1, tobacco use status, alcohol use status, drug use status, and body mass index at Wave 1.