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IMPACTS OF CASINO GAMBLING AVAILABILITY IN PLAINVILLE, MASSACHUSETTS: A REPEATED CROSS-SECTIONAL ANALYSIS

A Thesis Presented

by

DANIELLE MARIE VENNE

Submitted to the Graduate School of the
University of Massachusetts Amherst in partial fulfillment
of the requirements for the degree of

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Epidemiology

IMPACTS OF CASINO AVAILABILITY IN PLAINVILLE, MA: A REPEATED CROSS-SECTIONAL ANALYSIS

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ABSTRACT

IMPACTS OF CASINO AVAILABILITY IN PLAINVILLE, MA: A REPEATED CROSS-SECTIONAL ANALYSIS

MAY 2018

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The impacts of the introduction of casino gambling in Plainville, MA and surrounding communities are of interest in developing informed policy. Problem gambling is a public health issue as associated harms include physical and mental illness, impaired relationships with one's close social network, impacts on school or work, financial difficulties and illegal behavior. The results of surveys prior to and after the introduction of the casino were used to evaluate potential differences in the prevalence of at-risk and problem gambling, associations amongst health and gambling behavior covariates with at-risk and problem gambling status by year, and changes of covariate relationships with at-risk and problem gambling between years (2014 Total n = 1,090; 2016 Total n = 999; Total N = 2,089). No change in prevalence of at-risk and problem gambling was observed. A borderline significant higher rate in casino gambling between survey years was observed for at-risk and problem gamblers. Future research should aim to explore the influence of gambling availability on vulnerable subgroups of the population to create fully informed policy.

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CHAPTER I

INTRODUCTION

A. Problem gambling as a public health issue

Problem gambling is a public health issue as associated harms include physical and mental illness, impaired relationships with one's close social network, impacts on school or work, financial difficulties and illegal behavior (1, 2, 3). The 'problem gambling' continuum encompasses a range of behaviors and impacts with individuals at different points on the continuum that classifies non-gamblers, recreational, at-risk, problem and pathological gamblers (4). At-risk and problem gamblers may bet more money or spend more time gambling than planned, chase losses, or borrow money to gamble; problem gamblers additionally experience a loss of control over their gambling habits (4).

In 2016, Welte et al. conducted a telephone survey of adults in the United States and estimated that the prevalence of problem gambling in the United States was between 0.5% and 7.6%, with an average of 2.3% during the years 2011-2013 (5). In the state of Massachusetts, the impacts of the introduction of multiple casino venues are prospectively monitored through the Social and Economic Impacts of Gambling in Massachusetts (SEIGMA) study. A general population survey carried out in Massachusetts in 2013-2014 found a prevalence rate of 2.0% in the adult population and an additional rate of 8.4% at-risk gambling (4).

In 2016, Welte et al. reported that "males, people aged 31-40, Blacks, and those with the least education have the highest average problem gambling symptoms" in the United States (5). Risk factors for problem gambling in the SEIGMA baseline general

population survey include poorer physical health, tobacco use, binge drinking, illicit drug use, drug or alcohol problems, behavioral addictions, mental health problems, and a less happy childhood when compared to recreational gamblers (4, 6). Risk factors for at-risk gambling when compared to recreational gambling are poorer physical health, tobacco use, binge drinking, behavioral addictions, and mental health problems (4,6). The identification of risk factors for problem gambling is vital to inform policy making and planning for services.

The concepts of gambling exposure and availability relate to the legality of different gambling formats and accessibility of participation for a population, where changes in availability can influence gambling exposure (1, 7-20). The prevalence of problem gambling is thought to be influenced by changes in gambling availability (1, 7-20). Adaptation is an extension of the availability hypothesis in which in addition to the proposal that problem gambling prevalence increases as availability and gambling exposure increase, a stabilization of problem gambling prevalence occurs over time (1, 7, 9, 10, 14-16, 20, 21). Although several studies have provided support for these hypotheses, additional questions regarding risk factors for vulnerable demographic groups such as measures of health, substance use and gambling behaviors, and whether they experience similar changes in response to gaming availability changes remain (7, 19, 20).

B. Outcome

1. Problem Gambling

Activities referred to as forms of gambling throughout this manuscript will relate to "betting money or material goods on an event with an uncertain outcome in the hope of winning additional money and/or material goods" (4, 6, 20). Problem gambling refers to the "continuum of gambling and gambling participation, in which individuals who do not gambler (non-gamblers) are located at one end, and individuals who experience problems with their gambling (problem gamblers) are located at the opposite end" (4). In this context, "gambling problems are considered to be dynamic in which individuals can move throughout points of the continuum over their lifetime" (4). The Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders defines disordered gambling as "persistent and recurrent problematic gambling behavior leading to clinically significant impairment or distress" (22). In the medical community, 'disordered' and 'pathological gambling' are often used in the context of diagnosis and treatment, whereas 'problem gambling' is the term preferred by public health professionals (4, 22).

The concept of gambling harm associated with problem gambling is broadly understood as negative impacts of gambling participation, with greater harms associated with increasing frequency of participation and monetary risks (4, 23). Problem gambling and health issues tend to be associated; however, it is unclear whether or not associations between covariates and problem gambling indicate a causal relationship in the development of problem gambling, are confounding factors influenced by problem gambling, or occur simultaneously with problem gambling due to precursors not yet identified (24-43). Therefore, development of additional insight into the etiology of

problem gambling is necessary to distinguish the relationship between health issues and problem gambling.

2. Physical Health

Potential explanations for the association between physical health and problem gambling are complicated, as different studies suggest contradictory explanations regarding the onset of physical illness and problem gambling, due to the use of cross-sectional data, and a primary focus on older adults. (26, 27, 30, 37-41). Explanations for physical health issues predating problem gambling include that gambling is compatible with the mobility limitations older adults tend to have, and becomes popular if alternative activities are limited (38, 40). Hypotheses for why gambling may predate physical health issues are that the combination of stress associated with wins and losses, mismanaging time for physical activity with gambling, and use of substances available at the casino lead to hypertension, cardiovascular issues, liver diseases, or cirrhosis (38, 41).

3. Mental Health and Substance Use Behaviors

Anxiety, depression and substance use disorders are associated with problem gambling (8, 25, 27, 28-36, 41-43) In 2008, Kessler et al. reported results from the US National Comorbidity Survey Replication, that included associations between problem gambling and “prior anxiety, mood, impulse-control, and substance use disorders” (31). Earlier in 2007, Petry discussed the co-occurrence of substance use disorders and problem gambling, and reported that the National Epidemiologic Survey of Alcohol and Related Conditions observed that “alcohol dependence was five times greater in

pathological gamblers than non-pathological gamblers" (3). Similar to physical health, it is unknown if these mental health issues are risk factors for developing problem gambling, or are a resulting harm of problem gambling (31).

C. Exposure

1. Gambling availability

It is widely assumed that problem gambling prevalence is influenced by gambling availability, or the accessibility of gambling formats to a population (20). Availability of gambling has been operationalized in a variety of different ways through different research designs, including pre/post, repeated cross-sectional, cross-sectional and longitudinal designs, as well as considering gambling regulations and proximity to gambling establishments as proxies of availability (7-21).The use of varied methods to evaluate availability is both the result and cause of a lack of standard within a relatively young field of research (7-21). This is problematic because when considered together, the use of different methods has produced seemingly contradictory findings (7-21).

The approach described in this manuscript, or a pre/post repeated cross-sectional design, for the assessment of gambling availability can be utilized when data are collected prior and subsequent to the establishment of a gambling facility, thereby permitting comparison of survey responses from before and after the introduction of the establishment (1, 9, 12). For example, Room et al. utilized a pre/post longitudinal design to investigate the impacts of casino introduction in Niagara Falls, Ontario through surveys of the same participants before or around introduction of the casino and after, and found increases in rates of 18 problem indicators (12).

Based on a single cross-sectional survey design, the National Gambling Impact Study Commission found in 1999 that the presence of a casino within 50 miles of residence was associated with higher problem gambling prevalence and participation (8). Also related to proximity, Shaffer et al. used a single cross-sectional survey design in 2004 to create a regional exposure model that incorporated measures of dose, potency and duration of gambling exposure, and found that counties in Nevada with the highest regional exposure had the greatest prevalence of problem gambling in the state (15). Also using proximity, in 2004 Welte et al. utilized national data and mapped participants' addresses relative to gambling establishments to determine proximity to gambling for each respondent, and reported that the presence of a casino within 10 miles of a participant's home was associated with higher rates of problem gambling (19). Pearce et al. used neighborhoods of residence rather than specific addresses to assess availability, and found that those who lived in neighborhoods closest to the casino were more likely to be gamblers or problem gamblers than those who lived farther from the establishment (11).

Changes in gaming regulations have also been used to operationalize availability (18). In 2016, Welte et al. compared the total number of types of legal gambling and the sum of years all forms of gambling were legally available statewide through a database containing responses from two surveys collected during 1999-2000 and 2011-2013, and found higher rates of problem gambling, gambling frequency and past-year gambling as the number of gambling forms increased (18). The same study found that higher rates of problem gambling were associated with longer periods of gambling exposure (18).

Conflicting results regarding problem gambling status and the relationship to gambling availability are present amongst all three types of availability assessment approaches (1,9). For example, Govoni et al. surveyed respondents before and after the introduction of a casino, but reported that the sample was not representative of the population with statistically insignificant changes in problem gambling prevalence (9). Similarly, in a longitudinal study published by Jacques et al. residents were classified into exposure categories by the distance of their residence from the new casino, and were interviewed both before and one year after the casino's introduction (1). Although there was an increase in gambling frequency for exposed residents, there was no change in problem gambling status for either group of residents (1).

In another study, Abbott et al. assessed changes in gambling over 5 years in Victoria, Australia and found that while there were increases in availability, gambling participation rates declined and problem gambling status did not change (7). Additionally, in 2002, Rush et al. found that proximity to a gambling venue defined by postal codes, provincial, and health region boundaries was not a strong predictor of problem gambling status through a nationally representative Canadian survey (13). Similarly, although Sevigny et al. found an association between proximity and gambling participation, there was not an association between proximity and problem gambling within their analyses of two combined datasets that categorized participants' distance from a casino (14). While the variety of ways gambling availability has been assessed attempt to address at least one aspect of the construct, the different ways that availability has been conceptualized has led researchers to different conclusions about the relationship between gambling

behavior and problem gambling prevalence, for both general and various subpopulations (7-21).

D. Rationale for Relationship

Exposure theory proposes that exposure to gambling increases gambling involvement and problem gambling prevalence (10). In addition to asserting that there is a close connection between gambling participation and problem gambling prevalence, the total consumption model assumes that gambling participation in the population follows a curve representative of participation rates overall, and that even small changes in the distribution of gambling participation can change the overall proportion of problematic gambling participation (10, 15, 20, 44, 45). The availability hypothesis is an application of exposure theory in which "exposure to gambling venues increases gambling involvement and problem gambling prevalence" (10, 15, 20, 44, 45). The adaptation hypothesis was developed to explain findings inconsistent with the availability hypothesis, where weak relationships were observed between problem gambling prevalence and availability (10, 15, 20, 44, 45). The adaptation hypothesis proposes that while initial increases in exposure lead to increases in rates of problem gambling, over time populations adapt and further harms do not occur, despite increased exposure (10, 15, 20, 44, 45). The complex nature of relationships between problem gambling prevalence, gambling participation, and availability is further complicated by the lack of standardization in the measurement of availability, resulting in difficulties comparing study results (1, 10, 15, 19, 20, 44, 45).

E. Conclusion

In summary, the construct of availability, its measurement, theoretical underpinnings, relationships with gambling participation, problem gambling prevalence, and various health issues are of interest in the present analyses. The introduction of Plainridge Park Casino in Plainville, MA, a slot parlor with a horse racing track, provides an opportunity for a natural experiment in which availability is relatively easy to determine based on the presence of casino operation, with the year 2014 representing a pre-exposure assessment and 2016 representing a post-exposure assessment.

Our utilization of a repeated cross-sectional study design as a measure of availability allows for assessment of problem gambling prevalence between years, and relationships among covariates with problem gambling status and availability. Information pertaining to the relevance of the availability and adaptation hypotheses, risk factors for problem gambling, and demographic subpopulations vulnerable to changes in gambling availability will aid in the development of thorough policy and effective directing of treatment and prevention services funding.

CHAPTER II

METHODS

A. Study Design

1. Study Population

a. Sampling Frame

For this study, we used data from the SEIGMA targeted 2014 and 2016 surveys in Plainville and surrounding communities. The sampling frame for this study was residents of Massachusetts aged 18 and over who lived in Plainville and surrounding areas, who spoke English or Spanish, and did not live in group quarters, were incarcerated or homeless at the time of the survey. Participants were selected using address-based sampling to assure representation of households with varying access to landline telephone service. In 2014, a total of 4,800 households were contacted, and 1,093 individuals agreed to participate; in 2016, a total of 4,800 households were contacted and 1,012 individuals agreed to participate, yielding a response rate for 2014 of 22.8% and 21.1% for 2016. Both surveys exceeded the target response rate of 21% or 1,000 surveys per exposure assessment. Missing data for problem gambling status disqualified responses for this set of analyses. The final unweighted total of responses in 2014 was equal to 1090, and 999 in 2016. The final weighted total of responses in 2014 was equal to 294,142.5 and 295,484.47 in 2016.

b. Weighting Procedure

Weighting was applied to both surveys to align respondents to the known Plainville, MA population established by the 2014 and 2016 American Community Survey PUMS data. The procedure involved various adjustments. Beginning with the

sampling weight for the selected addresses, adjustment for unknown eligibility of addresses was followed by adjustment for non-response, and household size. Raking on the variables of age, gender, race, and education from the corresponding survey year PUMS data was used to align the sample from each survey with the distribution of these variables in the population.

2. Questionnaire Content

Responses to the survey were obtained via an online self-administered questionnaire, self-administered paper questionnaire or telephone interview. Questionnaire content solicited information about recreation, physical and mental health, alcohol and drug use, gambling attitudes, gambling behavior, gambling motivations, importance of gambling as a recreational activity, awareness of problem gambling services, gambling-related problems, and demographics. Prior to launching analyses, the data were inspected, cleaned and back-coded.

a. Measurement of Outcome: Problem Gambling Status

The Problem and Pathological Gambling Measure (PPGM) was used to assess problem gambling. Reliability of other tools such as the Canadian Problem Gambling Index, the South Oaks Gambling Screen (SOGS) and various DSM-IV based measurement scales is “well-established by consistent evidence of internal consistency and test-retest reliability” (4, 46-52, Figure 1). Limitations of these assessments include weak correspondence between identification of problem gamblers in surveys and clinical interviews and variation in the accuracy of the measures across gender, age, race and ethnicity subgroups (46-52).

The PPGM was chosen as the primary measurement tool because it "performed better and did not vary by age, gender, or race (51, 52). The PPGM has 14 questions divided into Problem, Impaired Control, and Other Issues sections, utilizes a 12-month timeframe, and divides problem gambling status into a continuum of non-gambling, recreational, at-risk, problem, and pathological gambling (51,52). Unlike other measures available to assess problem gambling, the PPGM assesses all harms of problem gambling (financial, mental health, health, relationship, work/school, legal) and allows respondents to indicate whether or not someone else in their life believes they have a problem related to gambling regardless of whether or not they themselves believe that they do (51, 52).

In the PPGM tool, Non-gamblers are classified as having not gambled in the past 12 months, Recreational gamblers have gambled in the past 12 months but received a total PPGM score of 0 (4). Criteria for At-Risk Gamblers includes a total score of at least 1 or more, and inability to meet criteria for more severe categories or a gambling frequency and expenditure greater than the PG median (4). Problem Gambler criteria include having gambled at least once a month in the past 12 months, impaired control score greater than 1, a problem score greater than 1, a total score between 2 and 4, or a total score greater than 3 and a gambling frequency and expenditure greater than or equal to the PG median (4). Pathological gambler criteria include having gambled at least once in the past 12 months, impaired control score greater than 1, a problem score greater than 1 and a total problem score of greater than 5 (4). The PPGM is the only problem gambling instrument to identify false negatives and false positives, as a person must have gambled at least once a month in the past year or be classified as a problem gambler

despite reporting sub-threshold symptomatology, if their gambling expenditure and frequency are equal to those of unambiguously defined problem gamblers (51, 52).

Between 2007 and 2010, Williams and Volberg (2010, 2014) validated the PPGM through a study that used two samples from previous studies. The first study included 7,272 gamblers and evaluated the impact of administration modality and survey description on obtained problem gambling prevalence rates while the second study included 12, 521 individuals ages 15 and older from 105 countries who completed an online survey in 2007 (51, 52). In both studies the participants who gambled were administered the SOGS, CPGI, NODS and PPGM (51, 52). Over several months a psychologist and psychiatrist with experience in treating addictions were trained in the rating procedure and then a summary profile was reviewed by each of the clinicians, and each participant was given a rating by both clinicians and a joint rating (51, 52). If the clinicians disagreed the profile was reviewed until a consensus was reached (51, 52).

Across the two samples, the PPGM had a Cronbach's alpha of .81 and a one-month test-retest reliability of .78. (total score) and .68 (five categories) (4, 51, 52). In terms of concurrent validity, the PPGM has the following Kendall-tau associations with the other instruments: .70 (CPGI), .69 (SOGS), and .78 (NODS) (4, 51, 52). The PPGM also had a Kendall tau association of .41 with gambling frequency and .20 with gambling next expenditure (4, 51, 52).

b. Measurement of Exposure: Gambling Availability

Our analyses defined exposure based solely on the use of a pre/post design to assess availability, and used the PPGM to assess problem gambling status. This instance is unique as previous studies have not done so with a clean baseline, referring to the

operation of the casino starting after the 'pre-exposure' assessment, and have used the SOGS to assess problem gambling status (1, 9, 12). Therefore, our results are not subject to exposure misclassification, and are unlikely to have experienced misclassification of outcome (1, 9, 12).

Assessment of availability in previous studies through changes in gambling regulations over time allows time trends related to gambling regulatory changes to be observed (7). However, this approach is more useful in comparing gambling regulations amongst jurisdictions, rather than assessing the impact of the introduction of a single gambling format or gambling establishment (7). The use of proximity to a gambling establishment can be used to examine whether distance rather than presence of a gambling establishment is associated with changes in gambling behavior and problem gambling status (8, 11, 13, 14, 17). In this approach, pre/post designs can assess distance and presence, whereas the use of a single cross-sectional design can only be used to assess distance (1, 8, 11-14, 17). Therefore, we believe the use of a pre/post design to assess the impacts of the introduction of the Plainridge Park Casino in Plainville, MA is most appropriate to assess the local impact of casino introduction.

c. Measurement of Covariates

In the demographics section of the survey, participants were asked to report their gender, date of birth, what level of education they had received, and identify themselves as being either White, Hispanic, Black, Asian, another unlisted race, or having multiple ethnicities. Questions about mental and physical health, and alcohol, drug and tobacco use were assessed in our survey using measures from the Behavioral Risk Factor Surveillance Survey, funded jointly by the federal and state governments and completed

annually to “collect information on emerging public health issues, health conditions, risk factors and behaviors” (53).

Questions in our survey typically asked participants to recall a time when they did or did not participate in the specified behavior, for example, “have you experienced depression or anxiety within the past 30 days?” and respond with a ‘yes’ or ‘no’. One of our physical health variables asked participants to report their overall health status as ‘excellent’, ‘very good’, ‘good’, ‘fair’ or ‘poor’. A separate question was asked of participants to understand if had a functional limitation, which asked if they use a cane, wheelchair, special bed or special telephone for a health problem. Tobacco use was separated by frequency of use within the past month or year for various products, mainly cigarettes and non-cigarettes. Participants were also asked whether or not they had smoked more than 100 cigarettes in their lifetime. Alcohol use was assessed in a similar way to current tobacco use. Binge drinking asked participants who drank on average how many drinks they would have on occasions when they drank, and how many days within the past week to month or year, that they drank. Respondents were also asked if they had used marijuana, hallucinogens, cocaine, opium or any other drug not intended for medical use during the past 12 months.

Information on participation in various gambling activities was asked in a ‘yes’ or ‘no’ format for each gambling activity to assess past-year gambling participation. If respondents indicated they had participated at some time in the past year, they were directed to another question to indicate if they had participated in that activity during the past year, month or week. Total number of gambling activities was computed from respondents’ answers to questions to past-year gambling participation in different

gambling activities. Gambling expenditure was assessed with a question that asked an estimate for how much money they had spent/won gambling in the past year, if they indicated they participated in a gambling form in the past year. Participants who indicated they gambled during the past year were asked how many times within the past year they had visited a casino outside of Massachusetts.

B. Data Analysis Plan

1. Aims

1) To evaluate whether there is a difference in prevalence of problem and at-risk gambling comparing samples representing pre- and post-slot parlor introduction

2a) Determine relationships of covariates with at-risk and problem gambling overall

2b) Determine relationships of covariates with gambling availability

3) To compare the relationships of covariates (mental and physical health, and drug, alcohol and tobacco use) with at-risk and problem gambling for both the 2014 and 2016 surveys in order to determine whether the relationships varied between pre- and post-slot parlor availability.

2. Variable Operationalization

The demographic variables of gender, age, race, and education level were analyzed categorically. When categorized, age grouped respondents who were 18-24, 25-34, 35-54, and 55+. Age was also analyzed continuously. Race grouped respondents who identified as White and non-White. This was done due to small cell sizes of individual subgroups that reported being Hispanic, Black, Asian, another unlisted ethnicity or multi-

racial. The overall composition of the sample was also mostly White. Education classified respondents with less than or equivalent to a high school degree separately from those with some college or a Bachelor's degree, and those who have a graduate, professional or doctoral degree.

Past-year gambling participation was characterized into 'yes' or 'no' for the gambling activities of participation in any game, any form of lottery, traditional lottery, daily lottery, instant tickets, raffle, sports betting, bingo, horse racing, private betting, casino and online gambling. Gambling frequency was determined for participation in any form of lottery, traditional lottery, instant tickets, daily lottery, raffle, sports betting, bingo, horse racing private betting, and casino gambling. Gambling frequency variables were classified into 'never', 'at least yearly', and 'at least monthly or weekly'. The number of gambling activities participated in during the past year summed the activities with a 'yes' response from all of the past-year gambling variables. Total past-year gambling expenditure represented the total amount of gains/losses accrued in gambling activities during the past year. The problem and pathological gambling variable classified respondents as 'non-gamblers', 'recreational gamblers', and 'at-risk or problem gamblers'. The combination of 'at-risk' and 'problem gamblers' into one group in our analyses was done to increase cell size, as the 'problem gambler' group was small. Participants who responded 'no' to all but one of the 10 gambling activities, were assumed to have not participated in that activity as well, and were classified as a 'non-gambler'.

Physical health was measured by responses to a question that asked respondents to classify their overall health into 'excellent, very good to good' versus 'fair to poor'.

Responses to multiple questions assessing functional limitation were classified into 'yes' or 'no'. A depression and anxiety variable was created to assess experiences within the past year, and classified results as either a 'yes' or 'no'. The variable for having smoked 100 or more cigarettes in one's lifetime was analyzed without creation of a new variable, as was illegal drug use. Variables were created for current alcohol use that classified responses from alcohol consumption questions into 'never', 'in the past year but not past 30 days' and 'within the past 30 days'. A 'yes' or 'no' variable was created from the variables that created binge drinking for each gender, and responses to alcohol use regarding average number of drinks on occasions when drinking, and number of days per week or month drinking, were used to create a binge drinking variable representative of both genders.

3. Statistical Methods

a. Aim 1: Evaluate association of slot-parlor availability with at risk and problem gambling

To assess Specific Aim 1, we described and compared the 2014 (pre-slot parlor availability) and 2016 (post-slot parlor availability) populations. Summary statistics in the form of frequency, weighted frequency, column percent, mean, and confidence intervals were calculated for variables in each year and are displayed in Tables 1 and 2. Respondents were classified as a non, recreational, and at-risk or problem gambler based on classification by the Problem and Pathological Gambling Measure (PPGM). For categorical variables, a chi-square test was used to compare weighted frequency of participants in each survey year, accompanied by a p-value that indicates significant

difference between the 2014 and 2016 surveys. ANOVAs and t-tests were used for continuous variables, and are also accompanied by a p-value.

b. Aim 2a: Determine relationships of covariates with at-risk and problem gambling overall

Aim 2 analyses described responses to the 2014 and 2016 surveys by problem gambling status. Frequency, weighted frequency, column percentages, means, and confidence intervals of covariates were calculated where appropriate for display in Tables 3 and 4 to describe variables in each survey year by non, recreational and at-risk or problem gambling status. Chi-square, t-test, and ANOVA testing were used to produce p-values.

c. Aim 2b: Determine relationships of covariates with gambling availability

In order to determine covariates that vary between pre- and post-slot parlor samples, we performed statistical tests comparing means using ANOVA and t-tests, and proportions using chi-square or Fisher's exact test as appropriate to produce p-values to compare variables by availability. Results are displayed in Tables 1 and 2.

d. Aim 3: Determine relationships of covariates with problem gambling status by year

Tables 5 and 6, as well as Tables 7 and 8 display responses to the 2014 and 2016 surveys, respectively, by problem gambling status. Frequency, weighted frequency, column percentages, means, and confidence intervals were calculated by chi-square tests, t-test and ANOVA where appropriate to determine factors that varied between pre- and post-slot parlor availability.

CHAPTER III

RESULTS

A. Problem Gambling, Gambling Behaviors and Health Covariates by Survey Year

Tables 1 and 2 display responses from each survey year. There were no significant differences between the prevalence of at-risk and problem gambling between 2014 and 2016. Similarly, there were no significant differences in the demographic composition of the sample. In both surveys, most respondents had a bachelor's degree or some college, followed by less than or equivalent to a high school education, then a professional, graduate or doctoral degree. Most respondents were aged 35-54 years, followed by the 55+ age group, those aged 25-34, and those ages 18-24. Respondents were mostly White in both surveys.

There were no statistically significant differences in past-year participation between 2014 and 2016 for most gambling activities. However, borderline significant were observed as a lower rate of past-year private betting from 13.7% in 2014 to 9% in 2016, and as a higher rate of past-year participation for casino gambling from 23.3% in 2014 to 28.4% in 2016. Non-statistically significant changes were observed between 2014 and 2016 for frequency of participation in any form of lottery, traditional lottery, instant, sports betting, and horse racing. Borderline statistically significant higher rates were observed in yearly casino gaming from 20.6% in 2014 to 25.8% in 2016. There were no observed differences between the 2014 and 2016 survey years for average number of gambling activities participated in, average number of times gambled at a casino in the past year, and total gambling expenditure.

A statistically significant higher proportion of participants reported good to excellent health, from 88.7% in 2014 to 93.0% in 2016. A borderline statistically significant higher rate of reported binge drinking was observed from 2014 to 2016. There were no statistically significant differences observed between the 2014 and 2016 surveys for functional limitation, depression and anxiety, having smoked 100+ cigarettes in a lifetime, current tobacco use, alcohol use, or illegal drug use within the past year.

B. Gambling Behaviors and Health Covariates by Problem Gambling Status

Results in Tables 3 and 4 represent respondents from both survey years, by at-risk and problem gambling status. At-risk and problem gamblers were significantly more likely to be male than female. Similar proportions of at-risk and problem gamblers had less than a high school diploma or equivalent, or some college or a Bachelor's degree. Most recreational gamblers had some college or a bachelor's degree, followed by less than high school or equivalent to a high school diploma, and a graduate, professional or doctoral degree. Both recreational and at-risk and problem gamblers were aged 35-54, followed by those aged 55+, and those aged 25-34. There were no significant differences amongst problem gambling status and race, as both recreational gamblers and at-risk and problem gamblers were mostly White.

Non-gamblers had the greatest prevalence of a functional limitation. Recreational gamblers had the highest proportion of respondents who reported good to excellent health and at-risk and problem gamblers had the highest reported fair to poor health. The proportion of at-risk and problem gamblers who reported experiencing depression and anxiety was statistically significantly greater than recreational gamblers. More at-risk and

problem gamblers than non-gamblers reported having smoked at least 100+ cigarettes in their lifetime. A significantly greater proportion of at-risk and problem gamblers reported that they currently used tobacco compared to non-gamblers and recreational gamblers. Recreational gamblers were more likely to report that they had consumed alcohol in the past 30 days compared to non-gamblers and at-risk and problem gamblers. At-risk and problem gamblers reported engaging in binge drinking significantly more than recreational gamblers and non-gamblers. Finally, illegal drug use was reported more by at-risk and problem gamblers than by non-gamblers and recreational gamblers.

At-risk and problem gamblers participated in the past year significantly more than recreational gamblers in instant lottery games, daily lottery games, sports betting, bingo, horse racing, private betting, casino, and online gambling. At-risk and problem gamblers also gambled significantly more frequently than recreational gamblers on a weekly basis for any form of lottery, traditional lottery, instant games, sports betting, horse racing, private betting, and casino games. At risk and problem gamblers participated in a significantly greater number of gambling activities when compared to recreational gamblers, gambled more at casinos outside of Massachusetts in the past year, and lost more money gambling than recreational gamblers.

C. Gambling Behaviors and Health Covariates by Survey Year and Problem Gambling Status

1. Gambling Behaviors and Health Covariates by Problem Gambling Status in 2014

Tables 5 and 6 represent survey responses from 2014 by at-risk and problem gambling status. There were significantly more male at-risk and problem gamblers than

female at-risk and problem gamblers in the 2014 survey. Borderline statistically significant differences in education existed between at-risk and problem gamblers and recreational gamblers in 2014 with 54.4% of at-risk and problem gamblers having a high school education or less, compared to 34.5% of recreational gamblers with a high school education or less. No statistically significant differences by race or age were found.

There were borderline significantly more at-risk and problem gamblers who reported experiencing depression or anxiety in the past year than recreational and non-gamblers. A borderline significantly higher proportion of at-risk and problem gamblers reported current tobacco use than recreational and non-gamblers. At-risk and problem gamblers also reported more binge drinking in the past 30 days than recreational and non-gamblers. There was also significantly more illegal drug use amongst at-risk and recreational gamblers compared with recreational and non-gamblers. Borderline or non-significant differences were found for general health, having a functional limitation, having smoked 100+ cigarettes in one's lifetime, current tobacco use, and current alcohol use.

At-risk and problem gamblers participated in instant lottery games, daily lottery games, bingo, horse racing, private betting, casino games, and online games more than recreational gamblers at least once in the past year. At-risk and problem gamblers also gambled significantly more often on a weekly or monthly basis more than recreational gamblers on any type of lottery game, traditional lottery, instant lottery, sports betting, horse racing, private betting and casino games. At-risk and problem gamblers also engaged in significantly more gambling activities, were more likely to have visited a

casino outside of Massachusetts in the past year, and had greater gambling expenditure than recreational gamblers.

2. Gambling Behaviors and Health Covariates by Problem Gambling Status in 2016

Tables 7 and 8 represent responses to the 2016 survey by at-risk and problem gambling status. In 2016, there were significantly more male at-risk and problem gamblers than female at-risk and problem gamblers. When compared to non-gamblers and recreational gamblers, at-risk and problem gamblers were significantly more male. Significantly more at-risk and problem gamblers were between the ages of 25-34 than their recreational gambler counterparts. Generally, although at-risk and problem gamblers were mostly White, there was a larger proportion of non-White at-risk and problem gamblers than recreational gamblers.

The proportion of respondents who reported having smoked at least 100 cigarettes in one's lifetime was greater for at-risk and problem gamblers than recreational gamblers and non-gamblers. Although not statistically significant, at-risk and problem gamblers reported more current tobacco use than recreational and non-gamblers. At-risk and problem gamblers reported alcohol use within the past 30 days borderline significantly more than non-gamblers. At-risk and problem gamblers reported binge drinking within the past 30 days more than recreational gamblers and non-gamblers with borderline significance. At-risk and problem gamblers also reported with borderline significance using illegal drugs within the past 12 months more than recreational gamblers. Non-significant results were found for general health and functional limitation.

At-risk and problem gamblers were more likely to report having played instant lottery games and daily lottery games, and engaged in sports betting horse racing, private betting, casino gambling, and online gambling at least once in the past year compared with recreational gamblers. Additionally, at-risk and problem gamblers reported monthly or weekly participation in any form of lottery, traditional lottery, instant games, sports betting, horse racing, private betting, and casino games more than recreational gamblers in the past year. On average at-risk and problem gamblers participated in significantly more gambling activities, gambled at casinos outside of Massachusetts more in the past year, and had greater gambling expenditures.

3. Changes in Gambling Behaviors and Health Covariates Between Survey Years

Comparisons were made between results in Tables 5 and 6, and Tables 7 and 8 to compare the 2014 and 2016 survey years by at-risk and problem gambling status, respectively. Between 2014 and 2016 there was a non-significant higher percentage of male at-risk and problem gamblers from 65.6% to 73.9%. In 2016 there was a significant difference in the percentage of at-risk and problem gamblers who were aged 25-34 compared with participants in other age groups, whereas in 2014 no such significant difference in the distribution of age existed. Additionally, there was a non-significant higher proportion of non-White survey respondents who were at-risk and problem gamblers from 5.2% in 2014 to 19.7% in 2016.

There was a non-significant higher rate of at-risk and problem gamblers who reported they smoked 100+ cigarettes in their lifetimes from 44.7% in 2014 to 52.5% in 2016, as well as a higher rate of alcohol use in the past 30 days from 65.3% to 75.9%. A

non-significant lower rate of illegal drug use among at-risk and problem gamblers was observed from 35.7% in 2016 to 23.3% in 2016.

There was a non-significant higher rate among at-risk and problem gamblers in past-year horse racing from 15.8% to 29.1%. A borderline significant higher rate in past-year casino gambling from 53.5% to 76.5%, and a statistically non-significant higher rate in weekly and monthly casino gambling from 11.8% to 20.4% was observed amongst at-risk and problem gamblers between pre- and post- survey years.

CHAPTER IV

DISCUSSION

A. Summary of Results

1. At-risk and Problem Gambling Prevalence

Despite the introduction of the Plainridge Park Casino the prevalence of at-risk and problem gambling did not change from 2014 to 2016. A potential explanation for this finding is the presence of nearby casinos in the state of Rhode Island, specifically the Twin River Casino in Pawtucket, and the casino at Roger Williams Park in Providence, which appear to have caused the sampling frame to have experienced exposure to gambling availability prior to the introduction of the Plainridge Park Casino. Therefore, our findings are supportive of the adaptation hypothesis, which suggests that initial increases in exposure lead to increases in rates of problem gambling, while over time populations adapt and further harms do not occur.

In past studies, results have been consistent with the availability and adaptation hypotheses in a variety of studies (7-21). In relation to other pre-post designs, our results are consistent (1, 9, 12). Beyond reasons due to the nature of study design, the general notion that there is no standardized way to assess gambling availability may have contributed to the lack of consistent results, as researchers have tended to choose different assessment methods and outcome variables (7-21). Therefore, it remains to be established whether repeated cross-sectional pre and post assessment of a jurisdiction is an accurate approach to measuring the gambling availability construct (7-21). However, we are not concerned about misclassification of availability as defined in our study, as a clean baseline assessment was conducted.

Given the above, we feel comfortable with the application of the adaptation hypothesis to the results observed as explanations of the potential mechanisms of adaptation can be reasonably applied to the Plainville and surrounding communities' experience over time. Possible reasons for why problem gambling prevalence in a population decreases with time include increased public awareness of gambling harms, decreased participation after the novelty of the additional gambling accessibility has gone down, more effort by government and industry to provide gambling more safely, expansion of treatment services, an aging population, movement of problem gamblers out of the sampling frame due to associated personal or financial crises, incarceration or suicide (20).

Additional reference has been made in the literature to the influence of community host factors on the duration of an individual's experience with problem gambling (7, 19, 20). For example, Abbott has described 'vulnerable communities' in terms of community resources, community deprivation, weak neighborhood linkages, and availability of social service resources to members of the community (7). Abbott suggests that communities with greater resources have individuals that experience problem gambling for shorter durations of time, which would effectively decrease problem gambling prevalence, as problem gambling is a dynamic continuum (7).

Based on comparisons with other towns and cities in Massachusetts, Plainville has relatively high community resources and therefore would be less vulnerable to experiencing high rates of at-risk and problem gambling (Dr. Rachel Volberg, University of Massachusetts Amherst, 2018). For example, the host profile for Plainville completed by the SEIGMA economic team in 2015 indicated that Plainville has higher median

incomes, education levels and real estate values (53). In contrast, Springfield would be considered a vulnerable community, as the rate of poverty is 29.4% in Springfield versus 11.4% statewide, and as Springfield has lower than average levels of education (54). Considering the demographic composition of our samples in each year, it is clear that our study population is similar to a less vulnerable community. Therefore, it is logical that no change would be observed in problem gambling prevalence for the general population.

2. At-risk and Problem Gambling Characteristics

Without regard to survey year, at-risk and problem gamblers were generally male, aged 35-54 and White. At-risk and problem gamblers also gambled more than recreational gamblers, in both past-year and frequency-based gambling participation variables, and number of gambling formats which is consistent with literature that cites these risk factors for at-risk and problem gambling (4,5).

Physical health was of initial interest to our analyses, and although at-risk and problem gamblers had the greatest proportions of respondents who reported having ‘fair to poor’ health, this difference was not statistically significant, nor was having a functional limitation. This is consistent with previous literature that has observed associations between problem gambling and physical health limited to the older adult population (26, 27, 30, 37-41). Further analyses are necessary to evaluate the relationship between at-risk and problem gambling status with age and our proxy variables for physical health.

Our findings that the proportion of respondents who experienced anxiety or depression during the past year was significantly greater for at-risk and problem gamblers

than recreational gamblers, and the proportion of at-risk and problem gamblers having smoked more than 100 cigarettes in their lifetime was greater than non-gamblers, but not recreational gamblers, are consistent with previous literature associating mental health and substance use issues with problem gambling (22-43). At-risk and problem gamblers also reported engaging in binge drinking significantly more than recreational and non-gamblers, which is consistent with previous literature citing a relationship between the two (26, 31, 34, 35, 36, 41, 42, 43). Significantly more at-risk and problem gamblers reported current tobacco use within the past 30 days and illegal drug use than non-gamblers and recreational gamblers, which is also discussed in the problem gambling literature (3, 8, 32). However, a non-significant lower rate of illegal drug use was observed between survey years, which cannot be explained by any statewide policy change, but could be related to media coverage of security and public safety changes related to the casino's introduction. Although this cannot be evaluated in the current study, it is one possible explanation of the observed change in behavior (Dr. Rachel Volberg, University of Massachusetts Amherst, 2018).

3. Vulnerable Subpopulations

Non-significant to borderline significant higher rates of past-year casino gambling and monthly or weekly casino gambling amongst at-risk and problem gamblers were observed between years, indicating that although problem gambling prevalence did not change, behaviors amongst this group of the population did. There was also a borderline significant higher percentage of male at-risk and problem gamblers, and a significant difference in the distribution of age within at-risk and problem gamblers, suggesting that

the 2016 at-risk and problem gamblers were younger than this group in the prior survey. Also not significant, the proportion of at-risk and problem gamblers who were non-White was higher in 2016. Demographics, covariates and gambling behaviors should be taken into account in further analyses targeted to understanding problem gambling experiences in vulnerable subpopulations. While we have plans to conduct sensitivity analyses outside of this manuscript, efforts by the Massachusetts Gaming Commission to study vulnerable groups identified in the baseline general population survey conducted in 2013 and 2014 by the SEIGMA team are currently underway as well.

B. Limitations

A number of considerations are important to as potential limitations to inferences from this study. Selection bias occurs when participants are selected into the study differentially, based on exposure status, resulting in a sample that is not representative of the population. As availability was determined by survey year, for selection bias to have occurred in this context, participants would have to have been selected into the study differentially by year. Some evidence to the contrary was observed in comparing characteristics of the two samples; as shown in the results (Table 1), there were no notable differences in the 2014 and 2016 samples overall. Non- or differential misclassification of the exposure (i.e., pre vs. post completion of the Plainville site casino) is also not an issue with our results as exposure was determined by survey year, and not assessed individually. Despite the potential of at-risk and problem gamblers inaccurately reporting responses to items in the problem gambling instrument to preserve their self-image or appear healthier to researchers, misclassification of outcome is also of

limited likely impact, as previous studies determined that our measurement tool for problem gambling status, the PPGM, when validated along with other measurement tools, had very high accuracy, with a sensitivity of 99.7% and specificity of 98.9% (4, 51,52, Figure 1).

It is also unlikely that confounding had a substantial influence on these results. A covariate must be associated with outcome (i.e., at-risk and problem gambling) and exposure (i.e., availability) but not as a result of the exposure (i.e., an intermediate) to act as a confounder of the relation of interest. Despite observing a number of variables related to outcome status, in our data we observed very few covariates to be related to exposure (i.e., vary by survey years). Although information collected on covariates was broad, information was specific enough to be able to detect potential confounders, had they been present.

Potential effect modifiers to the relationship between availability and problem gambling status were of main interest in these analyses as displayed in Tables 5 and 6, and Tables 7 and 8. We plan to test statistical interaction models beyond these present analyses at a later date.

Generalizability is a consideration for our results for a number of reasons. First, respondents were limited to adults who lived in households, which excluded people who live in group quarters, were incarcerated at the time of the survey or homeless from the sampling frame. Second, questionnaires were only available in English and Spanish, which excluded respondents who did not read or write in these languages. However, as confirmed by the census, both of these groups constituted a small proportion of the population in the targeted survey area. Third, it is possible that our sample may not be

representative of the population for demographics of primary interest for their relation to problem gambling, such as race, as relevant cell sizes for this variable were small and cannot be generalized to the group. Finally, because our findings regarding the association of interest as evaluated by comparison of pre- with post-completion of the casino may have been impacted by the presence of other nearby casinos, it is unclear whether our results will apply in areas without pre-existing nearby gambling establishments.

Small cell sizes also present a threat to validity, as they result in low power to detect statistically significant changes. Additionally, the use of a cross-sectional design with two different samples of participants, eliminates potential conclusions about causality for covariate relationships one could support with other study designs.

C. Implications and Future Directions

In conclusion, our analyses present results of a natural experiment considering the construct of gambling availability through the use of a repeated cross-sectional design, on problem gambling prevalence, gambling behaviors and other health-related issues. Despite the lack of standardization of availability assessment within the field, our study design is novel in the sense that it eliminates opportunity for misclassification of gambling availability exposure with the assessment of a clean baseline, and uses the most accurate problem gambling measure currently available.

Questions still remain regarding the appropriateness of pre and post designs to study availability as a construct for problem gambling prevalence, gambling participation and related variables, and health covariates. In our circumstance, causality relationships

between problem gambling and health could not be established. More research into the etiology of problem gambling rather than availability alone is needed to add insight into these questions.

Our results have implications for policy prevention and intervention plans, as adaptation is believed to be more appropriate for planning treatment and prevention services rather than the initial introduction period of a casino (20). Considering that the general population has adapted to the presence of gambling venues, resources that focus on relapse prevention and recovery support would be beneficial. For vulnerable population groups, in addition to these services, culturally sensitive prevention efforts will be beneficial in mitigating the negative impacts created by additional gambling availability. Due to the small sizes in our sample of potentially vulnerable demographic groups, our future sensitivity models may also lack power due to small cell size. Therefore, continuation of focus groups and qualitative interviewing of vulnerable populations are research plans that are advisable to continue efforts to develop policy that protects public health for all residents.

Table 1. Demographics and Covariates by Survey Year

	2014		2016		
	Unweighted n = 1090 Weighted n = 294142.5		Unweighted n = 999 Weighted n = 295484.47		
Characteristic	**%**	**95% CI**	**%**	**95% CI**	**p-value**
PPGM					0.9373
Non-gambler	19.8	(16.7, 23.4)	19.3	(16.0, 23.0)	
Recreational Gambler	70.9	(66.9, 74.7)	70.8	(66.4, 74.7)	
At-risk or Problem Gambler	9.3	(6.8, 12.5)	9.9	(7.3, 13.4)	
Gender					0.9045
Male	49.2	(45.0, 53.5)	49.6	(45.2, 54.0)	
Female	50.8	(46.5, 55.0)	50.4	(46.0, 54.8)	
Education					0.3407
Less than or equal to High School degree	36.6	(32.1, 41.4)	32.1	(27.4, 37.3)	
Some college or Bachelor's degree	50.4	(46.2, 54.7)	53.3	(48.7, 57.7)	
Graduate, Professional or Doctoral degree	12.9	(11.2, 14.9)	14.6	(12.6, 16.8)	
Age					0.5014
Ages 18-24	10.0	(7.3, 13.6)	10.2	(6.8, 15.0)	
Ages 25-34	13.9	(10.8, 17.7)	16.4	(12.9, 20.6)	
Ages 35-54	40.9	(36.7, 45.3)	36.5	(32.3, 40.8)	
Ages 55+	35.2	(31.4, 39.1)	37.0	(33.0, 41.2)	
Mean Age	48.4	(46.9, 49.9)	48.1	(46.3, 49.9)	0.2715
Race					0.3985
White	88.4	(84.4, 91.5)	86.3	(82.5, 89.4)	
Non-White	11.6	(8.5, 15.6)	13.7	(10.6, 17.5)	
General Health					0.0118
Good to Excellent	88.7	(85.8, 91.1)	93.0	(90.7, 94.8)	
Fair to Poor	11.3	(8.9, 14.2)	7.0	(5.2, 9.3)	
Functional Limitation	7.0	(5.3, 9.3)	5.7	(3.8, 8.3)	0.355
Depression and anxiety	13.5	(10.7, 16.9)	14.6	(11.7, 18.0)	0.6368
100+ cigarettes in lifetime	38.6	(34.6, 42.7)	35.9	(31.9, 40.1)	0.3721
Current tobacco use	16.7	(13.4, 20.5)	15.6	(12.5, 19.2)	0.6593
Alcohol use					0.1135
Not in the past year	25.6	(21.8, 29.9)	22.1	(18.4, 26.4)	
Did not report in past 30 days but yes in past year	3.2	(2.1, 4.9)	6.0	(3.9, 9.0)	
Yes, in past 30 days	71.1	(66.8, 75.1)	71.9	(67.4, 76.0)	
Binge drinking	28.4	(24.5, 32.6)	33.5	(29.3, 37.9)	0.0911
Illegal drugs in past 12 month	12.8	(9.7, 16.6)	11.0	(8.5, 14.2)	0.4437

* Indicates small cell size.

Table 2. Gambling Behaviors by Survey Year

	2014			2016			
	Unweighted n = 1090 Weighted n = 294142.5			Unweighted n = 999 Weighted n = 295484.47			
Characteristic	**%**	**95% CI**		**%**	**95% CI**		**p-value**
Any lottery	66.5	(62.4, 70.3)		68.1	(63.7, 72.1)		0.5821
Any Traditional Lottery	63.4	(59.3, 67.3)		61.8	(57.4, 66.1)		0.607
Any Instant	40.8	(36.7, 45.1)		43.2	(38.8, 47.7)		0.445
Any Daily	12.1	(9.5, 15.4)		13.7	(10.8, 17.2)		0.4759
Any Raffle	36.7	(32.8, 40.8)		37.4	(33.3, 41.8)		0.8013
Any Sports Betting	14.8	(12.1, 18.1)		12.9	(10.3, 16.1)		0.3698
Any Bingo	3.2	(2.1, 4.9)		4.4	(2.9, 6.6)		0.3063
Any Horse Racing	5.3	(3.9, 7.2)		5.8	(4.0, 8.1)		0.7486
Any Private Betting	13.7	(10.7, 17.4)		9.0	(6.7, 12.0)		0.0312
Any Casino	23.3	(20.0, 26.9)		28.4	(24.4, 32.8)		0.0643
Any Online	2.0	(1.0, 3.7)	*	2.9	(1.7, 4.8)		0.3412
Any form of Lottery							0.8247
Never	33.5	(29.7, 37.6)		31.9	(27.9, 36.3)		
Yearly	33.8	(30.0, 37.8)		33.8	(30.0, 37.8)		
Monthly or Weekly	32.7	(28.8, 36.8)		34.3	(30.1, 38.8)		
Traditional Lottery							0.8574
Never	36.6	(32.7, 40.7)		38.2	(33.9, 42.6)		
Yearly	34.2	(30.3, 38.2)		33.9	(30.1, 38.0)		
Monthly or Weekly	29.2	(25.4, 33.3)		27.9	(24.0, 32.1)		
Instant							0.5089
Never	59.2	(54.9, 63.3)		56.8	(52.3, 61.2)		
Yearly	23.0	(19.6, 26.7)		22.2	(18.8, 25.9)		
Monthly or Weekly	17.9	(14.6, 21.7)		21.0	(17.3, 25.4)		
Sports							0.5769
Never	85.2	(81.9, 87.9)		87.1	(83.9, 89.7)		
Yearly	9.8	(7.7, 12.3)		8.0	(5.8, 10.9)		
Monthly or Weekly	5.0	(3.3, 7.7)		4.9	(3.5, 6.8)		
Horse Racing							0.9015
Never	94.7	(92.8, 96.1)		94.2	(91.9, 96.0)		
Yearly	3.5	(2.4, 5.0)		4.0	(2.7, 5.9)		
Monthly or Weekly	1.8	(1.0, 3.3)	*	1.8	(0.8, 3.7)	*	
Private Betting							0.0833
Never	86.3	(82.6, 89.3)		91.0	(88.0, 93.3)		
Yearly	8.5	(6.2, 11.5)		5.2	(3.4, 7.7)		
Monthly or Weekly	5.2	(3.3, 8.1)		3.9	(2.5, 6.0)		
Casino							0.1538
Never	76.7	(73.1, 80.0)		71.6	(67.2, 75.6)		
Yearly	20.6	(17.5, 24.1)		25.8	(21.9, 30.0)		
Monthly or Weekly	2.7	(1.7, 4.3)		2.6	(1.4, 4.9)	*	
Number of gambling activities	2.137	(2.0, 2.3)		2.184	(2.0, 2.3)		0.8553
Number times gambled at casino outside of MA	1.283	(0.9, 1.7)		1.351	(0.8, 1.9)		0.655
Total Gambling Expenditure	-826.746	(-3E3, 961)		-453.019	(-1E3, 225)		0.5887

* Indicates small cell size.

Table 3. Demographics and Covariates by Problem Gambling Status

	Non-gamblers			Recreational Gamblers			At-risk and Problem Gamblers			
	Unweighted n = 418 Weighted n = 115250.89			Unweighted n = 1525 Weighted n = 417766.12			Unweighted n = 146 Weighted n = 56609.96			**p-value**
Characteristic	**%**	**95% CI**		**%**	**95%CI**		**%**	**95%CI**		
Gender										<0.0001
Male	38.8	(31.9, 46.2)		49.5	(46.0, 53.1)		69.9	(59.5, 78.5)		
Female	61.2	(53.8, 68.1)		50.5	(46.9, 54.0)		30.1	(21.5, 40.5)		
Education										0.0074
Less than or equal to High School degree	31.8	(24.7, 39.9)		33.5	(29.6, 37.5)		46.8	(35.3, 58.6)		
Some college or Bachelor's degree	50.5	(43.6, 57.4)		53.0	(49.3, 56.6)		46.3	(35.5, 57.5)		
Graduate, Professional or Doctoral degree	17.7	(14.2, 21.8)		13.6	(12.0, 15.2)		6.9	(4.0, 11.8)		
Age										0.0188
Ages 18-24	14.5	(9.1, 22.5)		9.3	(6.7, 12.7)		7.4	(2.8, 17.8)	*	
Ages 25-34	19.1	(13.6, 26.3)		12.4	(10.1, 15.3)		27.5	(17.0, 41.3)		
Ages 35-54	29.7	(23.6, 36.6)		41.3	(37.8, 44.9)		36.7	(26.2, 48.6)		
Ages 55+	36.6	(30.5, 43.3)		37.0	(33.7, 40.3)		28.4	(20.4, 38.0)		
Mean Age	47.4	(44.5, 50.4)		48.9	(47.6, 50.3)		44.6	(40.7, 48.5)		0.2568
Race										0.2305
White	82.7	(75.2, 88.3)		88.9	(85.8, 91.4)		85.7	(76.1, 91.8)		
Non-White	8.3	(4.1, 15.8)	*	5.4	(3.6, 8.0)		5.2	(1.7, 15.0)	*	
General Health										0.2297
Good to Excellent	90.3	(86.0, 93.3)		91.8	(89.6, 93.5)		85.6	(76.8, 91.4)		
Fair to Poor	9.7	(6.7, 14.0)		8.2	(6.5, 10.4)		14.4	(8.6, 23.2)		
Functional Limitation	9.8	(6.3, 15.1)		5.1	(3.8, 6.8)		8.4	(4.0, 16.8)	*	0.0902
Depression and anxiety	16.0	(11.3, 22.0)		12.1	(9.9, 14.6)		24.8	(16.0, 36.3)		0.0374
100+ cigarettes in lifetime	30.8	(25.0, 37.3)		37.5	(34.2, 40.9)		48.6	(37.5, 59.8)		0.0172
Current tobacco use	13.8	(9.4, 19.8)		15.0	(12.4, 18.0)		29.2	(20.0, 40.6)		0.0341
Alcohol use										0.0011
Not in the past year	37.7	(30.8, 45.1)		19.9	(17.0, 23.3)		25.1	(16.4, 36.4)		
Did not report in past 30 days but yes in past year	5.0	(2.6, 9.5)	*	4.6	(3.1, 6.7)		4.1	(1.8, 9.4)	*	
Yes, in past 30 days	57.3	(50.1, 64.3)		75.5	(72.0, 78.7)		70.8	(59.5, 80.0)		
Binge drinking	21.6	(16.2, 28.2)		31.3	(28.0, 34.8)		47.2	(35.6, 59.0)		0.0007
Illegal drugs in past 12 month	7.9	(4.8, 12.7)		10.7	(8.5, 13.2)		29.3	(19.2, 41.8)		0.0069

* Indicates small cell size.

Table 4. Gambling Behaviors by Problem Gambling Status

	Recreational Gamblers Unweighted n = 1525 Weighted n = 417766.12		At-risk and Problem Gamblers Unweighted n =146 Weighted n = 56609.96		
Characteristic	**%**	**95% CI**	**%**	**95% CI**	**p-value**
Any lottery	83.0	(80.1, 85.5)	87.5	(78.9, 92.9)	0.2373
Any Traditional Lottery	77.0	(73.8, 79.9)	83.5	(73.5, 90.3)	0.1531
Any Instant	49.5	(46.0, 53.0)	72.3	(62.4, 80.4)	0.0001
Any Daily	12.4	(10.4, 14.9)	42.5	(31.5, 54.4)	<0.0001
Any Raffle	45.6	(42.1, 49.1)	50.0	(38.8, 61.3)	0.4744
Any Sports Betting	15.3	(12.9, 18.0)	31.7	(22.5, 42.6)	0.0023
Any Bingo	3.8	(2.7, 5.4)	11.1	(6.0, 19.6) *	0.0365
Any Horse Racing	4.7	(3.6, 6.1)	22.7	(14.8, 33.2)	0.0003
Any Private Betting	11.7	(9.4, 14.4)	32.2	(22.4, 43.8)	0.0008
Any Casino	27.8	(24.7, 31.0)	66.1	(54.6, 75.9)	<0.0001
Any Online	1.8	(1.0, 3.1)	12.3	(7.2, 20.4)	0.0018
Any Lottery					<0.0001
Never	17.0	(14.5, 19.9)	12.5	(7.1, 21.1)	
Yearly	46.2	(42.7, 49.7)	10.6	(6.4, 16.8)	
Monthly or Weekly	36.8	(33.4, 40.3)	76.9	(67.6, 84.2)	
Traditional Lottery					<0.0001
Never	23.0	(20.1, 26.2)	16.5	(9.7, 26.5)	
Yearly	46.1	(42.6, 49.6)	14.3	(9.0, 22.0)	
Monthly or Weekly	30.9	(27.7, 34.3)	69.2	(58.6, 78.1)	
Instant					<0.0001
Never	50.5	(47.0, 54.0)	27.7	(19.6, 37.6)	
Yearly	29.7	(26.6, 33.0)	15.8	(9.4, 25.3)	
Monthly or Weekly	19.8	(16.9, 23.0)	56.6	(45.4, 67.1)	
Sports					0.0009
Never	84.7	(82.0, 87.1)	68.3	(57.4, 77.5)	
Yearly	11.4	(9.3, 13.9)	8.4	(4.8, 14.2)	
Monthly or Weekly	3.8	(2.8, 5.3)	23.4	(15.2, 34.2)	
Horse Racing					0.0014
Never	95.3	(93.9, 96.4)	77.3	(66.8, 85.2)	
Yearly	3.9	(2.9, 5.2)	10.3	(5.4, 18.7) *	
Monthly or Weekly	0.8	(0.4, 1.6) *	12.4	(6.7, 21.8) *	
Private Betting					0.0036
Never	88.3	(85.6, 90.6)	67.8	(56.2, 77.6)	
Yearly	8.0	(6.1, 10.5)	12.0	(6.9, 20.2)	
Monthly or Weekly	3.6	(2.5, 5.3)	20.2	(11.9, 32.0)	
Casino					<0.0001
Never	72.2	(69.0, 75.3)	33.9	(24.1, 45.4)	
Yearly	26.2	(23.2, 29.4)	49.6	(38.1, 61.1)	
Monthly or Weekly	1.6	(0.9, 2.7)	16.5	(9.8, 26.5)	
Number of gambling activities	2.5	(2.4, 2.6)	4.2	(3.8, 4.7)	<0.0001
Number times gambled at casino outside of MA	0.9	(0.7, 1.1)	7.1	(4.2, 9.9)	<0.0001
Total Gambling Expenditure	-195.1	(-545, 154)	-5179.0	(-1E4, 4297)	<0.0001

* Indicates small cell size.

Table 5. Demographics and Covariates by Problem Gambling Status in 2014

	Non-gamblers			Recreational Gamblers			At-risk and Problem Gamblers			
	Unweighted n = 221 Weighted n = 58236.1			Unweighted n = 794 Weighted n = 208688.71			Unweighted n = 75 Weighted n = 27217.68			
Characteristic	**%**	**95% CI**		**%**	**95%CI**		**%**	**95% CI**		**p-value**
	19.8	(16.7, 23.4)		70.9	(66.9, 74.7)		9.3	(6.8, 12.5)		
Gender										0.0444
Male	41.5	(32.0, 51.8)		49.2	(44.4, 54.1)		65.6	(50.1, 78.3)		
Female	58.5	(48.2, 68.0)		50.8	(45.9, 55.6)		34.4	(21.7, 49.9)		
Education										0.1003
Less than or equal to High School degree	35.7	(26.3, 46.3)		34.5	(29.2, 40.2)		54.4	(39.0, 68.9)		
Some college or Bachelor's degree	47.3	(38.2, 56.7)		53.0	(47.9, 58.0)		38.1	(25.5, 52.5)		
Graduate, Professional or Doctoral degree	17.0	(12.5, 22.6)		12.5	(10.6, 14.7)		7.6	(3.4, 16.1)	*	
Age										0.6044
Ages 18-24	11.3	(6.4, 19.3)		9.5	(6.3, 14.0)		11.2	(3.7, 29.0)	*	
Ages 25-34	18.8	(11.0, 30.2)		11.9	(8.9, 15.7)		19.2	(8.0, 39.1)	*	
Ages 35-54	34.7	(25.9, 44.7)		42.3	(37.4, 47.4)		43.1	(27.6, 60.1)		
Ages 55+	35.2	(27.3, 44.1)		36.3	(31.9, 40.9)		26.6	(16.0, 40.8)		
Mean Age	48.3	(44.8, 51.9)		48.9	(47.2, 50.7)		44.8	(39.8, 49.8)		0.2568
Race										0.4588
White	91.3	(81.8, 96.0)		90.3	(85.5, 93.6)		94.8	(85.5, 98.2)		
Non-White	8.7	(4.0, 18.2)	*	9.7	(6.4, 14.5)		5.2	(1.8, 14.5)	*	
General health										0.5006
Good to Excellent	87.3	(80.4, 92.0)		89.7	(86.3, 92.4)		83.9	(69.6, 92.3)		
Fair to Poor	12.7	(8.0, 19.6)		10.3	(7.6, 13.7)		16.1	(7.7, 30.4)	*	
Functional Limitation	10.2	(6.0, 16.8)		5.5	(3.8, 7.8)		12.1	(5.1, 26.2)	*	0.1307
Depression and anxiety	18.4	(11.7, 27.5)		10.8	(8.1, 14.1)		24.5	(12.3, 42.9)	*	0.0703
100+ cigarettes in lifetime	33.3	(25.4, 42.4)		39.2	(34.6, 44.0)		44.7	(30.0, 60.3)		0.3555
Current tobacco use	13.0	(7.4, 21.7)		15.7	(12.1, 20.3)		31.6	(18.5, 48.5)		0.1208
Alcohol use										0.1634
Not in the past year	35.9	(26.9, 46.1)		22.2	(17.9, 27.0)		30.5	(17.2, 48.2)		
Did not report in past 30 days but yes in past year	2.9	(1.4, 6.0)	*	3.2	(1.9, 5.5)		4.2	(1.3, 12.4)	*	
Yes, in past 30 days	61.2	(51.2, 70.3)		74.6	(69.7, 79.0)		65.3	(48.2, 79.2)		
Binge drinking	19.2	(12.5, 28.2)		28.9	(24.5, 33.8)		43.9	(28.4, 60.7)		0.0202
Illegal drugs in past 12 month	6.8	(3.6, 12.6)	*	11.4	(8.3, 15.6)		35.7	(20.4, 54.6)		0.0204

* Indicates small cell size.

Table 6. Gambling Behaviors by Problem Gambling Status in 2014

	Recreational Gambler Unweighted n = 794 Weighted n = 208688.71			At-Risk and Problem Gamblers Unweighted n = 75 Weighted n = 27217.68			
Characteristic	**%**	**95% CI**		**%**	**95% CI**		**p-value**
Any lottery	81.9	(78.0, 85.3)		89.5	(76.2, 95.8)		0.1506
Any Traditional Lottery	77.8	(73.7, 81.4)		88.0	(74.7, 94.8)		0.0694
Any Instant	47.7	(42.9, 52.6)		75.6	(61.8, 85.5)		0.0011
Any Daily	10.8	(8.3, 13.9)		48.1	(32.4, 64.2)		0.0009
Any Raffle	45.6	(40.8, 50.4)		47.6	(31.9, 63.6)		0.8213
Any Sports Betting	16.9	(13.6, 20.8)		30.8	(17.6, 47.9)		0.1036
Any Bingo	2.7	(1.7, 4.4)		13.4	(5.9, 27.5)	*	0.053
Any Horse Racing	5.4	(3.8, 7.7)		15.8	(8.1, 28.4)	*	0.0436
Any Private Betting	14.6	(11.1, 19.0)		36.3	(22.0, 53.5)		0.0204
Any Casino	26.1	(22.3, 30.4)		53.5	(36.5, 69.8)		0.0039
Any Online	1.3	(0.5, 3.3)	*	11.6	(5.0, 24.4)	*	0.0338
Any Lottery							<0.0001
Never	18.1	(14.7, 22.0)		10.5	(4.2, 23.8)	*	
Yearly	46.1	(41.3, 51.0)		11.5	(5.7, 21.6)	*	
Monthly or Weekly	35.8	(31.3, 40.6)		78.0	(64.2, 87.5)		
Traditional Lottery							<0.0001
Never	22.2	(18.6, 26.3)		12.1	(5.2, 25.3)	*	
Yearly	46.3	(41.5, 51.1)		14.5	(7.0, 27.4)	*	
Monthly or Weekly	31.5	(27.2, 36.3)		73.5	(58.5, 84.5)		
Instant							0.0017
Never	52.3	(47.4, 57.1)		24.4	(14.5, 38.2)		
Yearly	29.5	(25.3, 34.1)		22.3	(11.4, 39.1)	*	
Monthly or Weekly	18.2	(14.6, 22.6)		53.3	(37.4, 68.5)		
Sports							0.0619
Never	83.1	(79.2, 86.4)		69.3	(52.1, 82.4)		
Yearly	12.8	(10.0, 16.3)		7.5	(3.4, 15.9)	*	
Monthly or Weekly	4.1	(2.5, 6.6)		23.3	(11.4, 41.7)	*	
Racing							0.088
Never	94.6	(92.3, 96.2)		84.2	(71.6, 91.9)		
Yearly	4.4	(3.0, 6.5)		4.2	(1.6, 10.7)	*	
Monthly or Weekly	1.0	(0.4, 2.5)	*	11.6	(5.1, 24.2)	*	
Private Betting							0.0651
Never	85.4	(81.0, 88.9)		63.7	(46.5, 78.0)		
Yearly	10.3	(7.3, 14.2)		13.4	(6.2, 26.4)	*	
Monthly or Weekly	4.3	(2.5, 7.5)		23.0	(11.0, 41.7)	*	
Casino							0.005
Never	73.9	(69.6, 77.7)		46.5	(30.2, 63.5)		
Yearly	23.8	(20.2, 27.9)		41.8	(26.3, 59.0)		
Monthly or Weekly	2.3	(1.2, 4.3)	*	11.8	(5.7, 22.9)	*	
Number of gambling activities	2.5	(2.3, 2.6)		4.2	(3.4, 4.9)		<0.0001
Number times gambled at casino outside of MA	1.1	(0.7, 1.5)		5.6	(2.3, 8.9)		<0.0001
Total Gambling Expenditure	-305.0	(-420, -190)		-6535.3	(-3E4, 12E3)		<0.0001

* Indicates small cell size.

Table 7. Demographics and Covariates by Problem Gambling Status in 2016

	Non Gamblers			Recreational Gamblers			At- Risk and Problem Gamblers			
	Unweighted = 197 Weighted = 57014.78			Unweighted = 731 Weighted = 209077.41			Unweighted = 71 Weighted = 29392.28			**p-value**
Characteristic	**%**	**95% CI**		**%**	**95% CI**		**%**	**95% CI**		
Gender										0.0004
Male	36.0	(26.6, 46.6)		49.9	(44.8, 55.0)		73.9	(59.5, 84.5)		
Female	64.0	(53.4, 73.4)		50.1	(45.0, 55.2)		26.1	(15.5, 40.5)		
Education										0.0518
Less than or equivalent to High School degree	27.6	(17.7, 40.5)		32.4	(27.0, 38.3)		39.2	(23.7, 57.3)		
Some college or Bachelor's degree	53.9	(43.4, 64.0)		52.9	(47.7, 58.1)		54.5	(37.8, 70.2)		
Graduate, Professional or Doctoral degree	18.5	(13.4, 24.9)		14.7	(12.4, 17.3)		6.3	(3.0, 12.9)	*	
Age										0.0274
Ages 18-24	18.1	(9.1, 32.8)	*	9.1	(5.4, 14.8)		3.8	(0.6, 22.3)	*	
Ages 25-34	19.5	(12.5, 29.1)		13.0	(9.6, 17.4)		35.2	(19.9, 54.4)		
Ages 35-54	24.2	(16.7, 33.6)		40.3	(35.3, 45.4)		30.8	(18.1, 47.3)		
Ages 55+	38.2	(28.9, 48.4)		37.7	(33.0, 42.5)		30.1	(19.1, 43.9)		
Mean Age	46.4	(41.7, 51.2)		49.0	(46.9, 51.0)		44.4	(38.6, 50.2)		0.2568
Race										0.0207
White	83.1	(72.6, 90.2)		93.4	(90.4, 95.5)		80.3	(63.9, 90.4)		
Non-White	16.9	(9.8, 27.4)		6.6	(4.5, 9.6)		19.7	(9.6, 36.1)	*	
General health										0.3887
Good to Excellent	93.3	(87.7, 96.5)		93.8	(91.0, 95.8)		87.2	(74.8, 93.9)		
Fair to Poor	6.7	(3.5, 12.3)	*	6.2	(4.2, 9.0)		12.8	(6.1, 25.2)	*	
Functional Limitation	9.4	(4.4, 19.0)	*	4.7	(3.0, 7.4)		5.0	(1.2, 18.3)	*	0.4591
Depression and anxiety	13.5	(7.9, 22.1)		13.4	(10.2, 17.3)		25.1	(14.0, 40.7)		0.2582
100+ cigarettes in lifetime	28.3	(20.3, 37.9)		35.7	(31.1, 40.6)		52.2	(36.3, 67.7)		0.0332
Current tobacco use	14.6	(8.5, 23.9)		14.2	(10.9, 18.4)		27.1	(15.4, 43.0)		0.2329
Alcohol use										0.0106
Not in the past year	39.4	(29.5, 50.3)		17.7	(13.8, 22.4)		20.0	(10.5, 34.6)	*	
Did not report in past 30 days but yes in past year	7.2	(3.0, 16.3)	*	5.9	(3.5, 9.8)		4.1	(1.2, 13.4)	*	
Yes, in past 30 days	53.4	(43.0, 63.5)		76.4	(71.2, 80.9)		75.9	(61.1, 86.4)		
Binge drinking	24.1	(16.2, 34.4)		33.7	(29.0, 38.8)		50.3	(33.9, 66.7)		0.0316
Illegal drugs in past 12 month	8.9	(4.2, 17.7)	*	9.9	(7.3, 13.3)		23.3	(12.5, 39.2)		0.1689

* Indicates small cell size.

Table 8. Gambling Behaviors by Problem Gambling Status in 2016

	Recreational Gamblers			At-Risk and Problem Gamblers			
	Unweighted = 731 Weighted = 209077.41			Unweighted = 71 Weighted = 29392.28			
Characteristic	**%**	**95% CI**		**%**	**95% CI**		**p-value**
Any lottery	84.0	(79.5, 87.6)		85.6	(72.5, 93.1)		0.7633
Any Traditional Lottery	76.2	(71.2, 80.6)		79.5	(63.4, 89.6)		0.6466
Any Instant	51.2	(46.2, 56.3)		69.3	(54.5, 81.0)		0.0294
Any Daily	14.1	(10.9, 18.0)		37.4	(23.0, 54.5)		0.0151
Any Raffle	45.6	(40.6, 50.7)		52.3	(36.6, 67.5)		0.4431
Any Sports Betting	13.6	(10.4, 17.6)		32.7	(20.9, 47.1)		0.0046
Any Bingo	4.9	(3.1, 7.7)		9.0	(3.5, 21.3)	*	0.3505
Any Horse Racing	4.0	(2.7, 5.9)		29.1	(16.8, 45.5)		0.0026
Any Private Betting	8.8	(6.2, 12.1)		28.4	(16.3, 44.5)		0.0133
Any Casino	29.4	(24.9, 34.4)		76.5	(64.0, 85.6)		<0.0001
Any Online	2.2	(1.1, 4.5)	*	13.0	(6.3, 25.0)	*	0.0218
Any form of Lottery							<0.0001
Never	16.0	(12.4, 20.5)		14.4	(6.9, 27.5)	*	
Yearly	46.3	(41.3, 51.3)		9.7	(4.7, 18.8)	*	
Monthly or Weekly	37.7	(32.8, 42.9)		76.0	(62.2, 85.8)		
Traditional Lottery							<0.0001
Never	23.8	(19.4, 28.8)		20.6	(10.4, 36.6)	*	
Yearly	45.9	(41.0, 51.0)		14.2	(7.8, 24.6)		
Monthly or Weekly	30.3	(25.7, 35.2)		65.2	(49.7, 78.1)		
Instant							0.0005
Never	48.8	(43.7, 53.8)		30.7	(19.0, 45.5)		
Yearly	29.9	(25.5, 34.8)		9.7	(4.7, 19.0)	*	
Monthly or Weekly	21.3	(17.0, 26.3)		59.6	(44.4, 73.2)		
Sports							0.0039
Never	86.4	(82.4, 89.6)		67.4	(52.9, 79.1)		
Yearly	10.0	(7.1, 13.9)		9.2	(4.2, 18.8)	*	
Monthly or Weekly	3.6	(2.4, 5.5)		23.5	(13.8, 37.1)		
Horse Racing							0.0107
Never	96.0	(94.1, 97.3)		70.9	(54.5, 83.2)		
Yearly	3.4	(2.2, 5.2)		15.8	(7.4, 30.8)	*	
Monthly or Weekly	0.6	(0.2, 1.7)	*	13.3	(5.4, 29.1)	*	
Private Betting							0.0461
Never	91.2	(87.9, 93.8)		71.7	(55.5, 83.7)		
Yearly	5.8	(3.7, 9.1)		10.8	(4.6, 23.0)	*	
Monthly or Weekly	3.0	(1.9, 4.7)		17.6	(8.1, 34.0)	*	
Casino							<0.0001
Never	70.6	(65.6, 75.1)		23.5	(14.4, 36.0)		
Yearly	28.6	(24.1, 33.5)		56.1	(40.5, 70.6)		
Monthly or Weekly	0.8	(0.3, 2.6)	*	20.4	(10.2, 36.6)	*	
Number of gambling activities	2.5	(2.3, 2.6)		4.3	(3.7, 4.8)		<0.0001
Number times gambled at casino outside of MA	0.7	(0.5, 0.9)		8.3	(3.9, 12.7)		<0.0001
Total Gambling Expenditure	-85.4	(-774, 603)		-3922.9	(-9E3, 782)		<0.0001

* Indicates small cell size.

Figure 1. Classification accuracy of CPGI, SOGS, NODS, PPGM

	CPGI	SOGS	NODS	PPGM
Sensitivity	91.2%	85.95	68.5%	99.7%
Specificity	85.5%	90.4%	96.8%	98.9%
Positive Predictive Power	49.4%	56.5%	76.8%	93.5%
Negative Predictive Power	98.4%	97.8%	95.2%	99.9%
Diagnostic Efficiency	86.3%	89.8%	93%	99.0%
Kappa	0.56	0.62	0.68	0.96
Instrument Prevalence/Clinician Prevalence	1.85	1.52	0.89	1.07

CPGI – Canadian Problem Gambling Index
SOGS – South Oaks Gambling Screen
NODS – National Council on Problem Gambling (NORC) Diagnostic Screen for Gambling Disorders
PPGM – Problem and Pathological Gambling Measure
Figure adapted from Volberg et al. (4).

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