

# Gambling and Problem Gambling in Massachusetts: In-Depth Analysis of Predictors



March 23, 2017

In 2013/2014, a general population survey of 9,578 Massachusetts adults was conducted with results reported in Volberg et al. (2015). The present report is a follow-up to this. Whereas Volberg et al. (2015) provided a description of the characteristics of non-gamblers, recreational gamblers, at-risk gamblers, and problem gamblers, the present report focuses on identifying the univariate and multivariate predictors of membership in these groups.

**SEIGMA**  **SOCIAL AND ECONOMIC IMPACTS  
OF GAMBLING IN MASSACHUSETTS**

UNIVERSITY OF MASSACHUSETTS SCHOOL OF PUBLIC HEALTH AND HEALTH SCIENCES

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# Authorship and Acknowledgements

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# Executive Summary

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This report is a compendium of four separate but related analyses completed on a general population survey of 9,578 Massachusetts adults conducted from September 2013 to May 2014. The four analyses included examination of:

- Univariate and multivariate differences between Recreational Gamblers and Non-Gamblers
- Multivariate predictors of Level of Gambling Participation in terms of number of formats engaged in, frequency of gambling, and gambling expenditure
- Univariate and multivariate differences between Recreational Gamblers and At-Risk Gamblers
- Univariate and multivariate differences between Recreational Gamblers and Problem and Pathological Gamblers

There is considerable overlap in the characteristics of Recreational Gamblers and Non-Gamblers. However, there were several variables that statistically predicted greater likelihood of being a Non-Gambler. The strongest predictor was having fewer friends and family that were regular gamblers. Perhaps not surprisingly, not using alcohol was also a fairly strong predictor of being a Non-Gambler. The other predictors were having higher educational attainment; being a student, homemaker, disabled or retired; being in the age range 18-34 or 65+; being born outside the United States; not being a binge drinker; having lower household income; not using tobacco; having a less happy childhood; not having served in the military; being non-White, and not having problems with drugs or alcohol.

While there is considerable overlap in the characteristics of people who have low levels of gambling participation relative to people with high levels of participation, there were also several variables that statistically predict higher involvement. Interestingly, the portion of friends and family that were regular gamblers was also the strongest predictor in this analysis, with higher gambling involvement being associated with more friends/family involvement. Lower educational attainment, male gender, binge drinking, poorer health, and tobacco use were also predictive of higher gambling involvement.

There are greater differences between Recreational Gamblers and At-Risk Gamblers. In order of importance, people who were At-Risk Gamblers were significantly more likely to be casino gamblers, have a greater portion of friends and family that are regular gamblers, play instant lottery games, play daily lottery games, be male, be online gamblers, be born outside of the United States, participate in private betting, have lower educational attainment, play bingo, not purchase raffle tickets, have lower household income, have mental health problems, and have no alcohol use in the past 30 days.

The greatest differences were found between Recreational Gamblers and Problem/Pathological Gamblers. In order of importance, people who were Problem/ Pathological Gamblers were significantly more likely to: play daily lottery games, have a greater portion of friends and family involved in gambling, be Black, engage in casino gambling, be male, engage in online gambling, play instant lottery games, have other behavioral addictions, have lower educational attainment, be born outside the United States, and have lower childhood happiness.

There are several important implications for prevention from these findings:

- The lack of marked differences in the health and mental health status of Non-Gamblers versus Recreational Gamblers suggests that intervention efforts to prevent harm from gambling should probably not be directed at gambling generally, but more specifically to excessive levels of gambling and/or At-Risk Gambling.
- The social network of gamblers is a particularly important target for prevention, as portion of friends and family that are regular gamblers was the strongest overall predictor of Non-Gambling and Level of Gambling Participation, and the second strongest predictor of At-Risk Gambling and Problem/Pathological Gambling. The power of this specific predictor makes it clear that:
  - Gamblers need to be aware of the normalizing effect that their social group has on their own gambling behavior;
  - Friends and family of regular gamblers need to be aware of the facilitative role they have on that person's gambling; and
  - All gamblers need to be aware that problem gambling (and presumably heavy gambling) has a substantial genetic component and, if they have a positive family history of problem gambling, need to be particularly vigilant to the risks of excessive gambling engagement.
- There are certain demographic groups meriting special attention for prevention due to their consistent association with higher levels of gambling involvement, At-Risk Gambling and/or Problem/Pathological Gambling. These are males, individuals with lower educational attainment, immigrants, and African-Americans.
- Most problem gamblers are involved in an array of gambling formats, all of which contribute, to some extent, to the problems they experience. Nonetheless, consistent with other research on this topic, there is evidence that certain forms of gambling pose elevated risk to Massachusetts residents due to their continuous nature (i.e., casino gambling, instant lottery games, daily lottery games) and/or greater convenience and 24-hour availability (i.e., online gambling).

# Background

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In November 2011, an *Act Establishing Expanded Gaming in the Commonwealth* was passed by the Massachusetts Legislature, allowing casinos and slot parlors to be introduced in Massachusetts for the first time under the regulatory auspices of the Massachusetts Gaming Commission (MGC). Three casino licenses were available, one in the Greater Boston area, one in Western Massachusetts, and one for Southeastern Massachusetts. A single slot parlor license was also available, with no geographic restriction on its location. Since that time, the slot parlor license has been granted to Plainridge Park Casino, which opened June 24, 2015 in Plainville. Two casinos have also been approved: MGM Springfield which is scheduled to open September 2018 in Springfield, and Wynn Boston Harbor Casino which is scheduled to open June 2019 in Everett.

Section 71 of the Expanded Gaming Act requires the Massachusetts Gaming Commission to establish an annual research agenda to understand the impact of these new venues. In 2012, the MGC selected a team from the University of Massachusetts Amherst School of Public Health and Health Sciences to conduct the Social and Economic Impacts of Gambling in Massachusetts (SEIGMA) study. As part of the SEIGMA investigation, a comprehensive baseline survey of gambling among Massachusetts adults was undertaken between September 2013 and May 2014. Descriptive results from this Baseline General Population Survey (BGPS) are contained in Volberg et al. (2015). The present report is a follow-up to this earlier report. Whereas the Volberg et al. (2015) report provided a description of the characteristics of non-gamblers, recreational gamblers, at-risk gamblers, and problem gamblers, the present report focuses on identifying the univariate and multivariate predictors of non-gambling, level of gambling, at-risk gambling, and problem gambling.

The next section of this report reviews the methodology used in the Baseline General Population Survey, including recruitment procedures, sample, weighting, survey questionnaire, and how gamblers were classified. A more comprehensive description of these procedures is contained in Volberg et al. (2015).



# Baseline General Population Survey Methods

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## Recruitment

In carrying out the BGPS, an Address-Based Sampling (ABS) approach was employed whereby a random sample of Massachusetts addresses was initially chosen, with over-selection of Western Massachusetts to ensure acceptable precision in establishing problem gambling prevalence in this part of the state. All selected addresses were mailed a letter and subsequent postcards inviting the adult (18+) household member with the most recent birthday to complete an online (WEB) survey. Households where no response was received after four weeks were mailed paper versions of the questionnaire and invited to alternatively complete the survey via this modality and return it by mail (SAQ). Households where no response was received after another four weeks were called on their landline (this number was available in 78% of cases) and invited to answer the questions over the telephone (CATI). The survey was launched on September 11, 2013 and data collection ended on May 31, 2014.

## Sample

A final sample of 9,578 respondents was obtained with a 36.6% AAPOR RR3 response rate (AAPOR, 2015).<sup>1</sup> Forty percent of the questionnaires were self-administered online, 52% were completed using the self-administered paper-and-pencil format, and 7% were completed by telephone interview. A total of 152 self-administered questionnaires and/or telephone interviews (1.6%) were completed in Spanish.

## Weighting

Weighting was applied to the BGPS sample to align the respondents to the known Massachusetts population as established in the 2012 census. The weighting procedure consisted of a series of six steps:

- Adjustment for the deliberate oversampling of addresses in Western Massachusetts. This weighting was assigned to all sampled addresses that were initially chosen.
- Adjustment for the unknown eligibility status. This weighting was assigned to eligible addresses to account for different rates of unknown eligibility (by address types, region, and Spanish versus English speaking neighborhood).
- Adjustment for the fact that differences in the rate of completed surveys varied as a function of region (Western or Eastern Massachusetts), language (English or Spanish), and survey modality (WEB, SAQ, CATI). These weights were applied to all completed surveys.
- Adjustment for household size (i.e., to compensate for the oversampling of people from small households and under-sampling of people from large households).
- Final adjustment via iterative raking to more closely align the distribution of the obtained sample to the known distribution of the 2012 Massachusetts adult (18+) population in terms of region x age, region x

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<sup>1</sup> The response rate calculations recommended by the American Association for Public Opinion Research (AAPOR) are commonly used in academic research. A Response Rate 3 (RR3) is equivalent to the Council of American Survey Research Organizations (CASRO) rate, which is the number of completed interviews divided by the estimated number of eligible respondents. The estimated number of eligible respondents is the number of complete and partially complete interviews + the number of people who refused and/or could not be contacted + an estimate of the number of eligible cases among the remaining cases with unknown eligibility.

gender, region x race/ethnicity, region x education, age x gender, age x race/ethnicity, age x education, gender x race/ethnicity, gender x education, and race/ethnicity x education.

- Trimming the maximum and minimum allowable weights so as to increase the accuracy of derived estimates (e.g., prevalence of problem gambling).

## Questionnaire

The questionnaire had sections on health behaviors, attitudes toward gambling, gambling participation, problem gambling, and demographics.

Gambling participation was assessed by asking about past year frequency of participation in 11 different types of gambling:

- Purchase of **lottery tickets** such as Megabucks, Powerball, Lucky for Life, or Mass Cash
- Purchase of **instant tickets or pull tabs**
- Purchase of **raffle tickets**
- Purchase of **daily lottery games** such as Keno or Jackpot Poker
- Betting money on **sporting events** (this includes sports pools)
- Gambling at a **bingo hall**
- Gambling at a **casino, racino, or slots parlor outside of Massachusetts**
- Betting on a **horse race** at either a horse race track or an off-track site
- Gambling or **betting money against other people** on things such as card games; golf, pool, darts, bowling; video games; board games, or poker outside of a casino
- Purchase of **high risk stocks, options or futures or day trade** on the stock market
- **Gambling online**, which includes things such as playing poker, buying lottery tickets, betting on sports, bingo, slots or casino table games for money or playing interactive games for money

Seven response options were provided, ranging from ‘not at all’ to ‘4 or more times a week’. For each type engaged in, participants were then asked “roughly how much money do you spend on [type of gambling] in a typical month? Spend means how much you are ahead (+\$) or behind (-\$), or your net win or loss in an average month in the past 12 months.” In the WEB and SAQ surveys, participants were provided with an open-ended response box that contained a negative sign (to indicate a ‘loss’) that could be removed or replaced with a positive sign if the person wished to convey they had a net win.

## Gambler Classification

All participants who reported gambling once a month or more on some type of gambling were administered the Problem and Pathological Gambling Measure (PPGM) (Williams & Volberg, 2010, 2014). The PPGM is a relatively new instrument with superior sensitivity, specificity, and classification accuracy compared to older instruments such as the Problem Gambling Severity Index (PGSI), Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition (DSM-IV), and the South Oaks Gambling Screen (SOGS) (Williams & Volberg, 2010, 2014).

The superior performance of the PPGM is due to several factors. For one, any pattern of item endorsement above the designated threshold is sufficient to be deemed a problem gambler in the PGSI, DSM, and SOGS, whereas the PPGM requires there to be evidence of harm deriving from gambling **and** impaired control over gambling (i.e., the commonly accepted elements contained in most definitions of problem gambling, e.g., Neal, Delfabbro, & O’Neil, 2005). For another, the PPGM assesses **all** potential harms deriving from gambling, whereas only subsets of potential problems are assessed with the traditional instruments (i.e., physical and mental health problems are not assessed in the DSM-IV or SOGS; illegal activity and school and/or work

problems are not assessed in the PGSI). A final reason is that the PPGM endeavors to minimize false positives and false negatives. The former is accomplished by requiring that a person report gambling at least once a month in the past year to be classified as a problem gambler (no corroborating gambling behavior is required in the PGSI, SOGS or the DSM-IV). The latter is accomplished by allowing for problem gambling designation of individuals reporting sub-threshold levels of symptomatology if their gambling expenditure and frequency are equal to those of unambiguously identified problem gamblers.

Based on responses to the PPGM, a person was categorized as a **Non-Gambler** if he or she reported no past year participation in any form of gambling (not including high risk stocks). A total of 2,523 people received this classification (26.5% of the sample before weighting and 26.6% after weighting).

A person was categorized as a **Recreational Gambler** if he or she reported participating in one or more types of gambling in the past year but no problem gambling symptomatology and frequency of gambling and gambling expenditure were below levels reported by Problem and Pathological Gamblers. A total of 6,271 people received this classification (65.9% of the sample before weighting and 62.9% after weighting).

A person was categorized as an **At-Risk Gambler** if he or she reported participating in one or more types of gambling in the past year *and* reported one or more symptoms of problem gambling. Alternatively, a person could receive this designation if their frequency of gambling and gambling losses were greater than or equal to the median reported for Problem and Pathological Gamblers. A total of 600 people received this classification (6.3% of the sample before weighting and 8.4% after weighting).

A person was categorized as a **Problem Gambler** if he or she reported gambling at least once a month on one or more types of gambling; had a Problems Score of 1 or higher; an Impaired Control Score of 1 or higher; and a Total Score of 2 to 4. Alternatively, a person could receive this designation if they had a Total Score of 3 or higher plus a frequency of gambling and reported gambling loss that was greater or equal to the median for Problem and Pathological Gamblers. A total of 75 people received this classification (0.79% of the sample before weighting and 1.16% after weighting).

A person was categorized as a **Pathological Gambler** if he or she reported gambling at least once a month on one or more types of gambling; had a Problems Score of 1 or higher; an Impaired Control Score of 1 or higher; and a Total Score of 5 or higher. A total of 54 people received this classification (0.57% of the sample before weighting and 0.87% after weighting).

Table 1 on the following page shows the distribution of the sample (prior to weighting) as a function of gambling category by race/ethnicity and gender.

**Table 1. Baseline General Population Survey Sample Enrollment Table**

<b>Race/ Ethnicity</b>	<b>Gender</b>	<b>Non- Gambler</b>	<b>Recreational Gambler</b>	<b>At-Risk Gambler</b>	<b>Problem Gambler</b>	<b>Pathological Gambler</b>
White	Male	681	2156	258	36	29
	Female	1260	3208	221	18	12
	Missing	9	35	1-4		
Hispanic	Male	48	86	17	1-4	1-4
	Female	120	173	19	1-4	1-4
	Missing	1-4		1-4		
Black	Male	39	64	18	9	1-4
	Female	74	123	23	1-4	1-4
	Missing		1-4		1-4	
Asian	Male	68	82	17	1-4	
	Female	101	83	6	1-4	
	Missing	1-4				
Other	Male	7	20	1-4		
	Female	22	26	1-4		
	Missing	1-4	1-4			
Missing	Male	36	95	9		
	Female	35	89	1-4	1-4	1-4
	Missing	18	29	1-4		
<b>TOTAL</b>		<b>2523</b>	<b>6271</b>	<b>600</b>	<b>75</b>	<b>54</b>

Note: The respondents represented in this table total 9523. This is less than the 9578 survey respondents because gambling category could not be determined for 55 respondents.

# Analyses

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Four primary analyses were conducted in the present investigation:

- An examination of **univariate and multivariate differences between Recreational Gamblers and Non-Gamblers**. A supplemental analysis also examined multivariate differences between Non-Gamblers and all Gamblers (i.e., Recreational, At-Risk, Problem, and Pathological Gamblers).
- An examination of the **multivariate predictors of Level of Gambling Participation among all Gamblers**. Three different measures of gambling participation were used: number of gambling formats engaged in; frequency of gambling; and gambling expenditure.
- An examination of the **univariate and multivariate differences between Recreational Gamblers and At-Risk Gamblers**. A supplemental analysis examined the contribution of individual forms of gambling to At-Risk Gambling after controlling for the number of gambling formats engaged in. An additional analysis examined whether there were any multivariate differences between At-Risk Gamblers and Problem Gamblers.
- An examination of the **univariate and multivariate differences between Recreational Gamblers and Problem and Pathological Gamblers**. A supplemental analysis examined whether there were any univariate differences between Problem Gamblers and Pathological Gamblers. An additional analysis examined the contribution of individual forms of gambling to Problem and Pathological Gambling after controlling for the number of gambling formats engaged in.

Recreational Gamblers were used as the reference group in most of these analyses to provide consistency across analyses and because Recreational Gambling is the normative/modal gambling category in Massachusetts. Unweighted data was used in all of the analyses since the focus was on identifying differences or relationships within the data, independent of the data's relationship to the general population.

Missing values were replaced in all multivariate analyses using multiple imputation (Rubin, 2004).<sup>2</sup> This involved imputing values for the 11 variables having the greatest number of missing values (i.e., household income, casino participation, mental health problems, age, binge drinking, race/ethnicity, marital status, being born in the United States, employment status, educational attainment, and current tobacco use) using a multivariate model that predicted a set of 10 likely values using the 25 variables having the strongest univariate association to the 11 aforementioned variables. Analyses were run for each of the imputed datasets and the results of these 10 imputations were then pooled using Rubin's rule (Rubin, 2004) to account for variability incurred through introduction of the imputed data. Relative efficiency was close to 1.0 for all 11 variables, indicating that the 10 imputations were sufficient.

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<sup>2</sup> One member of our research team strongly advocated for a missing value category approach, which we initially used in our analyses. We subsequently implemented the multiple imputation approach and found the results to be almost identical to the missing value category approach. Recognizing that multiple imputation is the more conventional strategy, we opted to use this approach in the report.

# Differences Between Recreational Gamblers and Non-Gamblers

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This analysis focuses on differences between Non-Gamblers and Recreational Gamblers. These results are interesting for their own sake and also have some practical value. In particular, it is useful to know whether there is any difference in the health and mental health status of Non-Gamblers compared to Recreational Gamblers as this has relevance to whether efforts to prevent gambling-related harm should be directed at gambling generally, or more targeted toward excessive gambling.

In contrast to the large literature on the predictors of problem gambling, the academic literature on the topic of gambling participation is relatively sparse (Rodgers, Caldwell & Butterworth, 2009). There are several potential reasons for this. One is the perceived ambiguity about which activities actually constitute gambling (Williams, Volberg, Stevens et al., 2017). Another is that the predictors of gambling participation have almost certainly changed over time, with gambling now widely considered a normative recreational activity rather than as something immoral and engaged in only by the fringes of society. As a consequence, the limited literature that does currently exist on this topic is focused primarily on special populations, such as predictors of gambling participation among under-age youth (e.g., Chalmers & Willoughby, 2006; Kwon, Kim & Choi, 2006; Moore & Ohtsuka, 1997) and seniors (e.g., Vander Bilt, Dodge, Pandav et al., 2004).

A few adult studies do exist. These studies have found the following attributes to be predictive of Non-Gambling:<sup>3</sup>

- **Female gender** (Gambling Commission, 2017; Kairouz, Paradis, Nadeau et al., 2015)
- **Ethnic/racial group** (African-Americans) (Raylu & Oei, 2004; Welte, Barnes, Wieczorek et al., 2002)
- **Age** (both younger and older people) (Gambling Commission, 2017; Kairouz, Paradis, Nadeau et al., 2015; Welte, Barnes, Wieczorek et al., 2002)
- **Lower socioeconomic status** (Kairouz, Paradis, Nadeau et al., 2015; Welte, Barnes, Wieczorek et al., 2002)
- **Higher educational attainment** (Kairouz, Paradis, Nadeau et al., 2015)
- **Religion** (Protestants relative to Catholics; Muslims) (Raylu & Oei, 2004; Welte, Barnes, Wieczorek, & Tidwell, 2004) and higher religiosity (Lam, 2006)

## Method

The categorical dependent variable in the present analysis was whether the person had not engaged in any form of gambling in the past year (i.e., was a Non-Gambler), or alternatively, had engaged in some form of gambling, but had not experienced any problems from their involvement (i.e., was a Recreational Gambler).

Twenty two independent variables were examined concerning whether they were significantly different between the two groups:

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<sup>3</sup> The comparison group in all of these studies was all gamblers, rather than just Recreational Gamblers.

- **10 demographic variables:** gender, age, race/ethnicity, whether the person was born in the United States, marital status, educational attainment, employment, household income, military service, and geographic region of Massachusetts where they resided
- **11 variables assessing a range of health, mental health, substance use, and other behavioral issues:** self-reported health status in past 12 months, participation in extreme sports, overall level of stress in the past 12 months, current tobacco use, alcohol use in the past 30 days, binge drinking in the past 30 days, illicit drug use in the past 12 months, self-reported drug or alcohol problems in the past 12 months, self-reported behavioral addictions in the past 12 months (overeating, sex or pornography, shopping, exercise, Internet chat lines, etc.), serious mental health problems in the past 12 months, and rating of childhood happiness
- **1 gambling-related variable:** portion of friends and family that are regular gamblers

The first part of the analysis involved conducting univariate chi-square tests for each variable to see whether Non-Gamblers had a significantly different pattern of response compared to Recreational Gamblers. The second part involved conducting binary logistic regression for all variables collectively to determine which variables significantly discriminated between the two groups. Variables were entered into the logistic regression in a forward stepwise manner, with variable entry order determined by the size of the Wald statistic (minimum entry level of  $p = .01$  and a removal level of  $p = .05$ ). As noted above, missing values were all replaced with multiple imputation.

## Univariate Results

The results of the univariate analyses are shown in Table 2 with the demographic variables presented first, followed by the health-related variables, and then the gambling-related variable. As can be seen, there are statistically significant differences (based on  $p$ -values) on most variables due to the large sample sizes. Focusing on variables where the 95% confidence intervals do not overlap, the following characteristics were significantly associated with being a Non-Gambler:

### Demographic Variables

- Female gender
- Being younger than 35
- Being Hispanic, Asian, or Black
- Being born outside the United States
- Never married
- Higher educational attainment
- Being retired or a student, homemaker, or disabled
- Lower household income
- No military service
- Residing in the Greater Boston region

### Health-Related Variables

- Poorer physical health
- Lower stress
- No tobacco use
- No alcohol use
- No binge drinking
- No illicit drug use

- No drug or alcohol problems
- Mental health problems
- Less happy childhood

Gambling-Related Variables

- Smaller portion of friends and family being regular gamblers

**Table 2. Univariate Differences Between Recreational Gamblers and Non-Gamblers**

		Non-Gamblers (n = 2,523)		Recreational Gamblers (n = 6,271)		p
		%	95% C.I.	%	95% C.I.	
<b>Gender</b>	Male	34.8	(33.0, 36.7)	39.9	(38.7, 41.1)	<.001
	Female	63.9	(62.0, 65.7)	59.0	(57.8, 60.2)	
	Missing	1.3	(0.9, 1.8)	1.1	(0.8, 1.3)	
<b>Age</b>	18-34	17.0	(15.6, 18.5)	12.9	(12.1, 13.7)	<.001
	35-64	42.5	(40.6, 44.4)	54.5	(53.3, 55.7)	
	65+	34.1	(32.3, 36.0)	28.2	(27.1, 29.3)	
	Missing	6.4	(5.5, 7.4)	4.4	(3.9, 5.0)	
<b>Race/Ethnicity</b>	Hispanic	6.7	(5.8, 7.8)	4.1	(3.7, 4.7)	<.001
	Black	4.5	(3.7, 5.4)	3.0	(2.6, 3.4)	
	White	77.3	(75.6, 78.9)	86.1	(85.2, 86.9)	
	Asian	6.7	(5.8, 7.8)	2.6	(2.3, 3.1)	
	Missing or Other	4.8	(4.0, 5.7)	4.1	(3.7, 4.7)	
<b>Born in United States</b>	No	19.3	(17.9, 20.9)	9.9	(9.1, 10.6)	<.001
	Yes	78.7	(77.1, 80.3)	88.0	(87.2, 88.8)	
	Missing	1.9	(1.5, 2.6)	2.1	(1.8, 2.5)	
<b>Marital status</b>	Never married	19.9	(18.3, 21.5)	15.0	(14.2, 15.9)	<.001
	Living with partner/ married/widowed	65.4	(63.5, 67.2)	70.3	(69.2, 71.4)	
	Divorced or separated	12.2	(11.0, 13.5)	12.2	(11.4, 13.0)	
	Missing	2.6	(2.0, 3.3)	2.4	(2.1, 2.9)	
<b>Education</b>	High school or less	18.0	(16.5, 19.5)	16.2	(15.3, 17.1)	<.001
	Some college or Bachelor's	46.1	(44.2, 48.1)	54.8	(53.5, 56.0)	
	Beyond Bachelor's degree	33.9	(32.1, 35.8)	27.2	(26.1, 28.3)	
	Missing	2.0	(1.5, 2.6)	1.8	(1.5, 2.2)	
<b>Employment</b>	Employed	49.7	(47.8, 51.6)	60.8	(59.6, 62.0)	<.001
	Unemployed	3.2	(2.6, 4.0)	3.6	(3.1, 4.0)	
	Retired	29.6	(27.9, 31.4)	24.5	(23.4, 25.6)	
	Other <sup>1</sup>	15.7	(14.3, 17.1)	9.1	(8.4, 9.8)	
	Missing	1.8	(1.4, 2.4)	2.1	(1.8, 2.5)	
<b>Household Income</b>	Less than \$15,000	11.8	(10.6, 13.1)	7.0	(6.4, 7.7)	<.001
	\$15,000-<\$30,000	11.7	(10.5, 13.0)	10.0	(9.3, 10.8)	
	\$30,000-<\$50,000	15.0	(13.6, 16.4)	13.2	(12.3, 14.0)	
	\$50,000-<\$100,000	22.7	(21.1, 24.4)	27.1	(26.0, 28.2)	
	\$100,000-<\$150,000	10.1	(9.0, 11.3)	16.3	(15.4, 17.2)	
	\$150,000 and more	11.4	(10.2, 12.7)	12.6	(11.8, 13.4)	
	Missing	17.4	(16.0, 19.0)	13.9	(13.0, 14.7)	



		Non-Gamblers (n = 2,523)		Recreational Gamblers (n = 6,271)		p
		%	95% C.I.	%	95% C.I.	
Military service	No	91.6	(90.4, 92.6)	89.0	(88.2, 89.7)	<.001
	Yes	7.5	(6.5, 8.6)	9.8	(9.1, 10.5)	
	Missing	1.0	(0.6, 1.4)	1.2	(1.0, 1.5)	
Region	Western Massachusetts	27.8	(26.3, 29.3)	29.4	(28.8, 30.1)	<.001
	Greater Boston	59.1	(57.4, 60.9)	54.0	(53.0, 55.0)	
	Southeastern Massachusetts	13.1	(11.8, 14.4)	16.6	(15.7, 17.5)	
Health status past 12 months	Excellent	22.5	(20.9, 24.1)	22.0	(21.0, 23.0)	<.001
	Very good	36.5	(34.6, 38.4)	39.6	(38.4, 40.8)	
	Good	26.2	(24.5, 27.9)	27.5	(26.4, 28.6)	
	Fair	11.4	(10.2, 12.7)	8.9	(8.2, 9.6)	
	Poor	3.3	(2.7, 4.1)	1.9	(1.6, 2.2)	
	Missing	cell size ≤ 5		0.2	(0.1, 0.3)	
Participate in extreme sports	No	93.4	(92.3, 94.3)	93.4	(92.7, 93.9)	.721
	Yes	6.4	(5.5, 7.4)	6.3	(5.7, 6.9)	
	Missing	0.2	(0.1, 0.5)	0.3	(0.2, 0.5)	
Overall stress past 12 months	Very low	4.5	(3.8, 5.4)	3.2	(2.8, 3.7)	.010
	Low	17.7	(16.2, 19.2)	15.7	(14.8, 16.6)	
	Moderate	44.7	(42.8, 46.7)	46.6	(45.4, 47.8)	
	High	24.5	(22.9, 26.2)	25.8	(24.7, 26.8)	
	Very high	8.1	(7.1, 9.3)	8.5	(7.8, 9.2)	
	Missing	0.4	(0.2, 0.7)	0.3	(0.2, 0.5)	
Current tobacco use	No	89.5	(88.2, 90.6)	84.9	(84.0, 85.7)	<.001
	Yes	8.4	(7.4, 9.6)	13.5	(12.7, 14.3)	
	Missing	2.1	(1.6, 2.7)	1.7	(1.4, 2.0)	
Alcohol use past 30 days	No	41.6	(39.7, 43.5)	24.6	(23.6, 25.7)	<.001
	Yes	57.9	(56.0, 59.8)	75.1	(74.0, 76.1)	
	Missing	0.5	(0.3, 0.8)	0.3	(0.2, 0.4)	
Binge drinking past 30 days	No	80.7	(79.2, 82.2)	69.6	(68.5, 70.7)	<.001
	Yes	14.7	(13.3, 16.1)	25.8	(24.8, 26.9)	
	Missing	4.6	(3.8, 5.5)	4.5	(4.1, 5.1)	
Illicit Drug use past 12 months	No	93.7	(92.7, 94.6)	90.9	(90.1, 91.5)	<.001
	Yes	5.3	(4.5, 6.2)	8.5	(7.8, 9.2)	
	Missing	1.0	(0.7, 1.5)	0.7	(0.5, 0.9)	
Drug or alcohol problems past 12 months	No	98.3	(97.8, 98.8)	97.4	(97.0, 97.8)	<.001
	Yes	0.8	(0.5, 1.2)	1.8	(1.5, 2.2)	
	Missing	0.9	(0.6, 1.4)	0.8	(0.6, 1.0)	
Behavioral addictions past 12 months	No	89.0	(87.7, 90.1)	89.3	(88.5, 90.0)	.922
	Yes	10.1	(9.0, 11.3)	9.9	(9.1, 10.6)	
	Missing	1.0	(0.6, 1.4)	0.9	(0.7, 1.2)	
Mental health problems past 12 months	No	78.2	(76.5, 79.7)	81.4	(80.4, 82.3)	.004
	Yes	15.7	(14.4, 17.2)	13.6	(12.7, 14.4)	
	Missing	6.1	(5.2, 7.1)	5.1	(4.6, 5.7)	

		Non-Gamblers (n = 2,523)		Recreational Gamblers (n = 6,271)		p
		%	95% C.I.	%	95% C.I.	
Childhood Rating	Very happy	26.4	(24.7, 28.1)	27.6	(26.5, 28.7)	<.001
	Happy	47.3	(45.3, 49.2)	49.4	(48.2, 50.6)	
	Neither happy nor unhappy	16.6	(15.2, 18.1)	16.2	(15.3, 17.1)	
	Unhappy	7.0	(6.0, 8.0)	4.6	(4.1, 5.2)	
	Very unhappy	1.9	(1.5, 2.6)	1.5	(1.2, 1.8)	
	Missing	0.8	(0.5, 1.3)	0.7	(0.5, 1.0)	
Portion of Friends and Family Regular Gamblers	None of them	64.0	(62.1, 65.9)	49.4	(48.2, 50.7)	<.001
	Some of them	32.8	(31.0, 34.7)	47.5	(46.2, 48.7)	
	Most of them	0.9	(0.6, 1.3)	1.5	(1.2, 1.8)	
	All of them	0.9	(0.6, 1.4)	0.5	(0.4, 0.8)	
	Missing	1.4	(1.0, 1.9)	1.1	(0.9, 1.4)	

Note: *Italicized figures indicate relative standard error >30%.*

<sup>1</sup>Student, homemaker, disabled were combined into 'Other' because of small sample sizes in each.

## Multivariate Results

Many of the above-mentioned individual variables are correlated with each other. Consequently, statistically significant differences between Recreational Gamblers and Non-Gamblers on some of these variables may reflect differences in the same underlying attribute. Thus, the more central question concerns which variables significantly differentiate the groups when these variables are analyzed simultaneously in a multivariate analysis (i.e., binary logistic regression).

A binary logistic regression found that maximal discrimination between the groups occurred via a model with a constant and 13 predictor variables. Table 3 on the following page shows the log of the odds ratio and Wald statistic for each of the 13 predictors. The variance accounted for was low with adjusted *R* squared ranging from 12.2% to 12.6% (depending on the imputation). Using a classification cutoff of 28.0% to maximize both sensitivity and specificity,<sup>4</sup> overall prediction success ranged from 62.1% to 62.9%. In order of importance, people who were Non-Gamblers were significantly more likely than Recreational Gamblers to:

- Have a lower portion of friends and family that were regular gamblers
- Not use alcohol
- Have higher educational attainment
- Be a student, homemaker, disabled, or retired
- Be either 18-34 or 65+
- Be born outside the United States
- Not binge drink
- Have lower household income
- Not use tobacco

<sup>4</sup> Whenever there are large differences in the sizes of the two groups being compared (as is the case in the present analysis), classification accuracy will be high simply by predicting that everyone is a member of the larger group (i.e., Recreational Gamblers). However, this figure disguises the fact that prediction accuracy for the smaller group may be poor. For this reason, it is better to choose a classification cut-off close to the size of the smaller group relative to the total sample (i.e., 28%). Using such a cutpoint, the analysis will strive to obtain high classification accuracy for **both** groups and the resultant overall classification accuracy will be very close to the individual classification accuracy for each group.

- Have less happy childhoods
- Not have served in the military
- Not have problems with drugs or alcohol
- Be non-White

**Table 3. Stepwise Logistic Regression Predicting Non-Gambling versus Recreational Gambling (n = 8,794)**

		Odds Ratio <sup>5</sup> & 95% C.I.	Wald Statistics <sup>6</sup>	p
<b>Portion of Friends and Family Regular Gamblers</b>		.64 (0.59, 0.71)	89.2	p < .0001
<b>Alcohol use in Past 30 Days</b>	No	1.72 (1.53, 1.93)	85.5	p < .0001
	Yes	Reference group		
<b>Education</b>	High School or Less	Reference group	Reference group	
	Bachelor's or some College	1.07 (0.93, 1.23)	0.9	p = .0029
	Beyond Bachelor's degree	1.72 (1.46, 2.03)	41.3	p < .0001
<b>Employment</b>	Employed	Reference group	Reference group	
	Unemployed	1.00 (0.75, 1.33)	0.0	p = .8811
	Retired	1.17 (0.98, 1.38)	3.1	p < .0001
	Other <sup>1</sup>	1.68 (1.43, 1.97)	41.1	p < .0001
<b>Age</b>	18-34	1.60 (1.37, 1.86)	38.2	p < .0001
	35-64	Reference group	Reference group	
	65+	1.34 (1.14, 1.57)	12.4	p < .0001
<b>Born in United States</b>	No	1.57 (1.33, 1.85)	28.3	p < .0001
	Yes	Reference group		
<b>Binge Drinking</b>	Yes	Reference group	25.3	p < .0001
	No	1.43 (1.24, 1.65)		
<b>Household Income</b>		.97 (0.96, 0.98)	23.4	p < .0001
<b>Current Tobacco use</b>	Yes	Reference group	16.9	p < .0001
	No	1.42 (1.20, 1.69)		
<b>Unhappy Childhood</b>		1.12 (1.06, 1.18)	16.8	p < .0001
<b>Military Service</b>	Yes	Reference group	9.0	p < .0001
	No	1.32 (1.10, 1.58)		
<b>Problems with Drugs or Alcohol</b>	Yes	Reference group	8.5	p < .0001
	No	2.14 (1.28, 3.57)		
<b>Race/Ethnicity</b>	Hispanic	1.19 (0.94, 1.51)	2.1	p = .0048
	Black	1.44 (1.11, 1.86)	7.7	p < .0001
	White	Reference group	Reference group	
	Asian	1.45 (1.10, 1.91)	8.0	p = .0017
	Other	1.54 (0.95, 2.49)	3.2	p = .0001

<sup>1</sup> Student, homemaker, disabled were combined into 'Other' because of small sample sizes in each.

<sup>5</sup> In logistic regression, the odds ratio is the increase (or decrease if the ratio is less than one) in the odds of being in the predicted category when the value of the predictor variable increases by one unit. With categorical variables (as used in the present analysis), it is the odds of being in the predicted category relative to the reference group. In the present example the odds ratio for alcohol use (1.72) means that respondents who did not drink alcohol in the last 30 days are 72% more likely not to gamble than those who did drink alcohol in the last 30 days. It should be noted that odds ratios will be higher than 'relative risk' when the two group sizes are reasonably comparable (as they are in the present analysis).

<sup>6</sup> The Wald statistic assesses the statistical significance of the coefficients. It is analogous to the t-test for assessing the significance of a coefficient in a bivariate correlation.

### Multivariate Differences between Non-Gamblers and All Gamblers

A second multivariate analysis examined which set of variables maximally differentiated Non-Gamblers from *all* Gamblers (i.e., Recreational, At-Risk, Problem and Pathological Gamblers). As can be seen in Table 4, the results are very similar to the results obtained when just comparing Non-Gamblers to Recreational Gamblers. The only difference between the two analyses is that race/ethnicity was a predictive variable in the previous analysis, but not in the present analysis. This variable was one of the weakest variables in the first analysis and became nonsignificant in the present analysis due to the increased predictive power of variables such as portion of friends/family who are regular gamblers, educational attainment, age, binge drinking, tobacco use, and military service (as several of these variables bear a strong relationship with At-Risk and Problem/Pathological Gambling). The variance accounted for was again low with adjusted *R* squared ranging from 12.5% to 12.9% and classification accuracy ranging from 65.0% to 65.8%.

**Table 4. Stepwise Logistic Regression Predicting Non-Gambling versus Gambling (n = 9,523)**

		Odds Ratio & 95% C.I.	Wald Statistics	<i>p</i>
<b>Portion of Friends and Family Regular Gamblers</b>		.58 (0.53, 0.64)	138.8	<i>p</i> < .0001
<b>Alcohol use in Past 30 Days</b>	No	1.71 (1.53, 1.92)	88.1	<i>p</i> < .0001
	Yes	Reference group		
<b>Born in United States</b>	No	1.69 (1.48, 1.94)	60.7	<i>p</i> < .0001
	Yes	Reference group		
<b>Education</b>	High School or Less	Reference group	Reference group	
	Bachelor's or some College	1.15 (1.00, 1.32)	3.8	<i>p</i> < .0001
	Beyond Bachelor's degree	1.88 (1.60, 2.22)	59.5	<i>p</i> < .0001
<b>Age</b>	18-34	1.66 (1.43, 1.92)	47.3	<i>p</i> < .0001
	35-64	Reference group	Reference group	
	65+	1.31 (1.11, 1.53)	11.1	<i>p</i> < .0001
<b>Employment</b>	Employed	Reference group	Reference group	
	Unemployed	.98 (0.74, 1.29)	0.0	<i>p</i> = .7743
	Retired	1.19 (1.01, 1.41)	4.3	<i>p</i> < .0001
	Other <sup>1</sup>	1.70 (1.46, 2.00)	45.7	<i>p</i> < .0001
<b>Binge Drinking</b>	Yes	Reference group	33.5	<i>p</i> < .0001
	No	1.50 (1.31, 1.73)		
<b>Household Income</b>		.97 (0.96, 0.98)	23.1	<i>p</i> < .0001
<b>Current Tobacco use</b>	Yes	Reference group	22.3	<i>p</i> < .0001
	No	1.49 (1.26, 1.76)		
<b>Military Service</b>	Yes	Reference group	15.0	<i>p</i> < .0001
	No	1.42 (1.19, 1.70)		
<b>Unhappy Childhood</b>		1.10 (1.05, 1.16)	13.3	<i>p</i> < .0001
<b>Problems with Drugs or Alcohol</b>	Yes	Reference group	9.4	<i>p</i> < .0001
	No	2.20 (1.33, 3.65)		

<sup>1</sup> Student, homemaker, disabled were combined into 'Other' because of small sample sizes in each.

# Predictors of Level of Gambling Participation Among Gamblers

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Higher levels of gambling involvement are likely to have increased potential for gambling-related harm. Thus, the purpose of the present analysis is to identify characteristics associated with more intensive gambling involvement.

Level of gambling involvement has four basic attributes: (1) number of types of gambling engaged in; (2) frequency of gambling; (3) total expenditure; and (4) time spent gambling (Williams, Volberg, Stevens et al., 2017). The first three measures were used in the present analysis. Time spent gambling was not assessed in the Baseline General Population Survey for several reasons, including space limitations, the fact that time spent gambling is highly correlated with the other measures of gambling involvement, and controversies in how time should be calculated for certain formats (e.g., should time spent watching sporting events and/or calculating odds be included in sports betting; should time travelling to a gambling venue be included).

There is a voluminous literature on the predictors of problem gambling, which is associated with higher levels of gambling involvement. There is a much smaller literature on the predictors of level of gambling involvement, independent of their relationship to problem gambling. These studies have found the following attributes to be predictive of higher levels of gambling involvement:

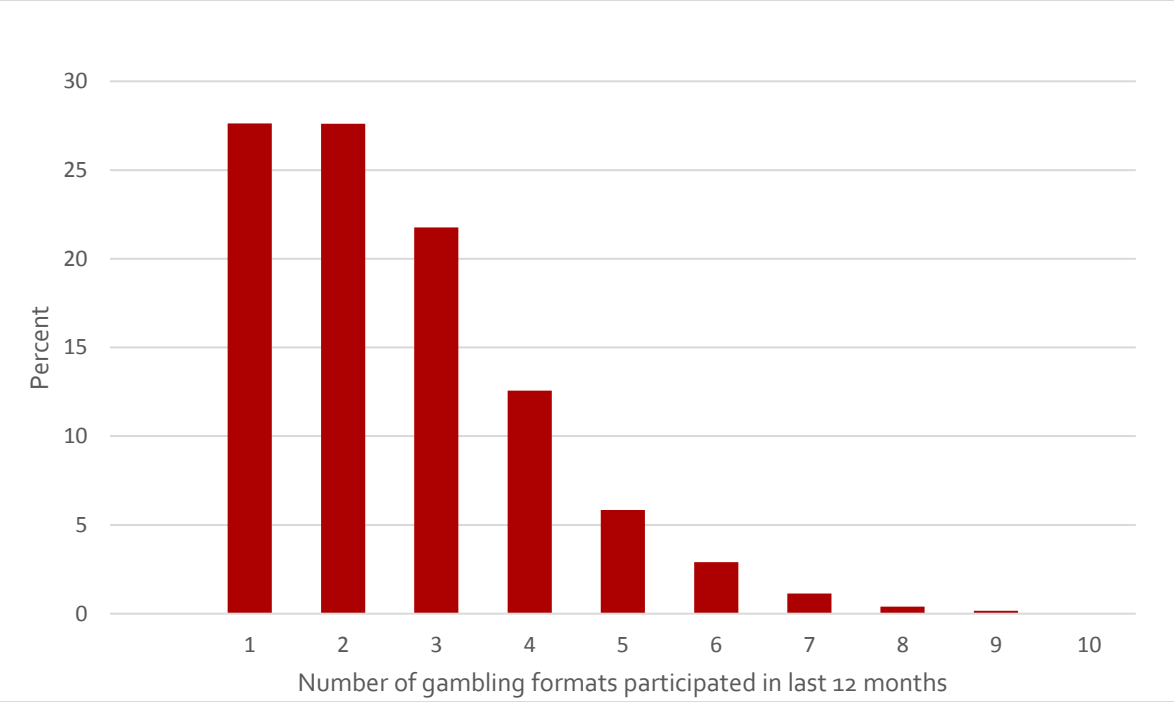
- **Male gender** (Gambling Commission, 2017; Kairouz et al., 2015; Welte, Barnes, Wieczorek et al., 2004)
- **Ethnic/racial group** (Raylu & Oei, 2004; Williams, Stevens & Nixon, 2011)
- **Lower educational attainment** (Williams, Hann, Schopflocher et al., 2015)
- **Lower socioeconomic status** (Welte, Barnes, Wieczorek et al., 2004)
- **Marital status** (divorced, widowed, or cohabiting) (Welte, Barnes, Wieczorek et al., 2004)
- **Nonreligiosity** (Lam, 2006)
- **Friend and family involvement in gambling** (Browne & Brown, 1994; Welte, Wieczorek, Barnes, & Tidwell, 2006; Williams, Hann, Schopflocher et al., 2015)
- **Propensity for risk and excitement seeking** (Cyders & Smith, 2008; Gibbs van Brunschot, 2009; Mishra, Lalumière, & Williams, 2010; Williams, Hann, Schopflocher et al., 2015)
- **Impulsivity** (Cronce & Corbin, 2010; Cyders & Smith, 2008; Upton, Bishara, Ahn & Stout, 2011)
- **Antisociality** (Mishra, Lalumière, Morgan & Williams, 2011; Williams, Hann, Schopflocher et al., 2015)
- **Gambling availability** (LaBrie, Shaffer, LaPlante & Wechsler, 2003; Welte, Wieczorek, Barnes et al., 2004)
- **Gambling fallacies** (Leonard & Williams, 2016; Williams, Hann, Schopflocher et al., 2015; Yakovenko, Hodgins, el-Guebaly et al., 2016)

## Method

All respondents in the Baseline General Population Survey who had gambled in the past year were included in this analysis (n = 6,992). Three dependent variables were used as aggregate overall measures of gambling participation.

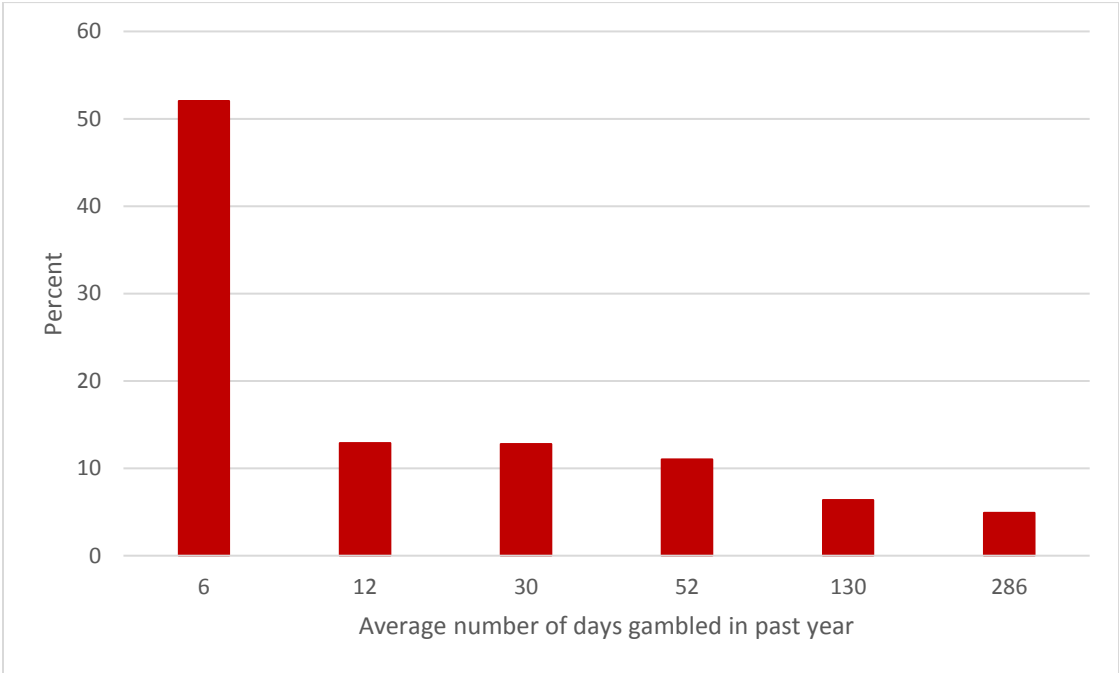
The first measure of gambling participation was the **number of gambling formats** (ranging from 1 to 10) that each respondent reported participating in within the past year. Among all gamblers, the average number of gambling formats engaged in was 2.6, the median was 2.0, the mode was 1.0, and the range was 1 to 10. The distribution of the number of formats engaged in among past year gamblers is shown in Figure 1.

**Figure 1. Number of Gambling Formats Engaged in Among Gamblers in Past 12 Months (n = 6,992)**



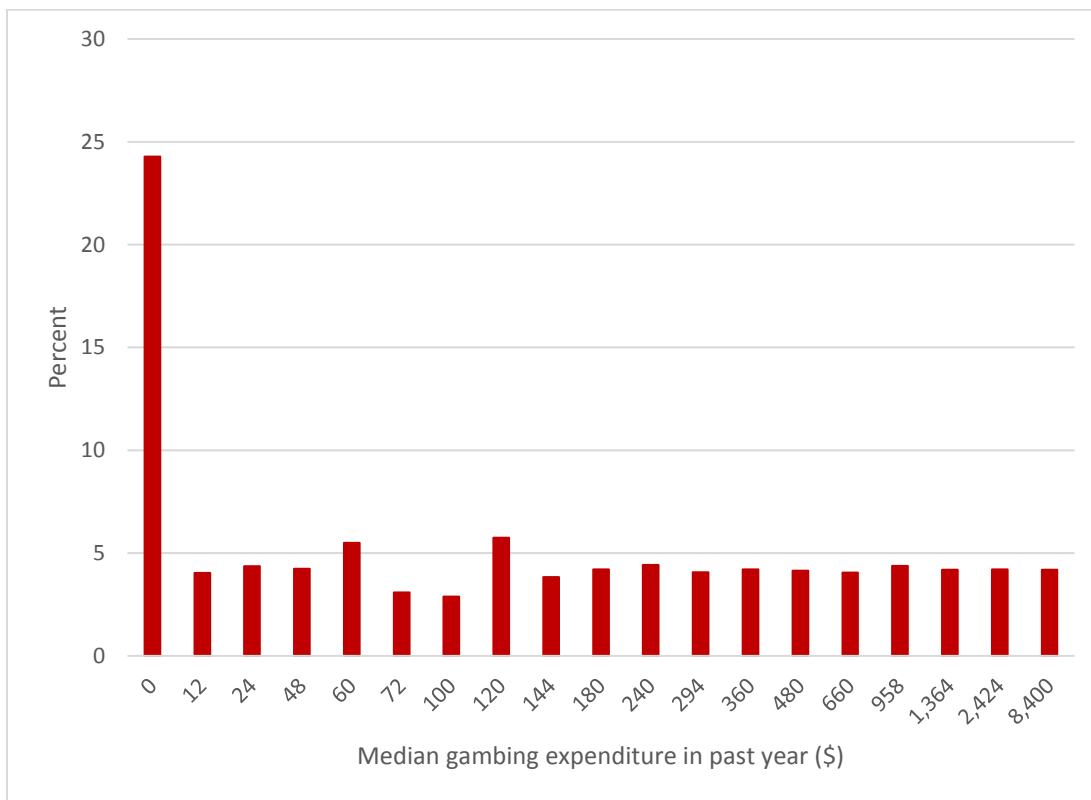
The second measure of gambling involvement was overall **frequency of gambling**, as measured by the maximum frequency reported for any type of gambling in the past year. A reported frequency of 4 or more times per week (mean 5.5 days/week) was converted to an annual frequency of 286 days (52 weeks x 5.5); 2-3 times per week was given a value of 130 days (52 weeks x 2.5); once a week was given a value of 52 days (52 weeks x 1); 2-3 times per month was given a value of 30 days (12 months x 2.5); and a frequency of less than once a month was given a value of 6 days (12 months x 0.5). Among all gamblers, the average number of overall days gambled in the past 12 months was 36.6, the median was 6.0 days, the mode was 6.0 days, and the range was 6 to 286 days. The distribution of number of days gambled in the past 12 months among past year gamblers is presented in Figure 2.

**Figure 2. Number of Days Gambled Among Gamblers in Past 12 Months (n = 6,992)**



The third measure of gambling participation was **total gambling expenditure** on all types of gambling in the past year. Total reported monthly gambling expenditure ranged widely, from a loss of \$1,120,001 to reported winnings of \$44,940. To reduce the impact of outliers and to correct for skewness, expenditures were re-categorized into 20 groups by rank (20 groupings was determined to be a sufficient re-categorization to reduce skewness while preserving the continuous nature of the variable). All respondents who reported positive gains from gambling ( $n = 500$ ; 7.2%) were placed in the first group. All respondents who reported \$0 average gain/loss ( $n = 1,197$ ; 17.1%) were placed in the second group. The remaining 5,293 respondents who reported losses were categorized into 18 additional groups ordered by reported expenditure. Each respondent was assigned a 'gambling expenditure' equal to the score defined by the median expenditure in their reported expenditure group. Among gamblers, the average past year gambling expenditure was \$669.44, the median was \$120.00 and the mode was \$0. The distribution of gambling expenditure among past year gamblers is presented in Figure 3.

**Figure 3. Total Gambling Expenditure Among Gamblers in Past 12 Months ( $n = 6,992$ )**





Twenty two independent variables were examined to assess whether they were significantly associated with each of the three measures of gambling involvement:

- **10 demographic variables:** gender, age, race/ethnicity, whether the person was born in the United States, marital status, educational attainment, employment, household income, military service, and geographic region of Massachusetts where they resided
- **11 variables assessing a range of health, mental health, substance use, and other behavioral issues:** self-reported health status in past 12 months, participation in extreme sports, overall level of stress in the past 12 months, current tobacco use, alcohol use in the past 30 days, binge drinking in the past 30 days, illicit drug use in the past 12 months, self-reported drug or alcohol problems in the past 12 months, self-reported behavioral addictions in the past 12 months (overeating, sex or pornography, shopping, exercise, Internet chat lines, etc.), serious mental health problems in the past 12 months, and rating of childhood happiness
- **1 gambling-related variable:** portion of friends and family that are regular gamblers

Models predicting level of gambling participation among gamblers were developed via multiple regression. Entry of the independent variables into the model was forward stepwise, using a *p*-value for variable entry of 0.01, and a *p*-value of 0.05 for exclusion from the model. Missing values were all replaced with multiple imputation.

### Multivariate Predictors of Number of Gambling Formats Engaged In

Table 5 displays the variables that contributed significantly to prediction of the number of gambling formats engaged in, their standardized regression coefficients,<sup>7</sup> and the adjusted *R*<sup>2</sup> at each step.<sup>8</sup> Altogether, 12.3% - 12.5% (depending on the imputation) of the variability in number of gambling formats was predicted by all of the independent variables taken together. Because of the skewness of the dependent variable we also examined a model where number of gambling formats was collapsed into four categories. The results were very similar to the original results with no improvement in the proportion of variance explained.

**Table 5. Stepwise Multiple Regression Predicting Number of Gambling Formats Engaged In (n = 6,992)**

	Standardized Regression Coefficients	Adjusted <i>R</i> <sup>2</sup>	Step
Portion of friends and family regular gamblers	.193	.051-.053	1
Binge drinking	.124	.077-.079	2
Male gender	.084	.089-.091	3
High school or less	.110	.090-.092	4
Bachelor’s or some College	.103	.096-.098	
Beyond Bachelor’s degree	Reference group	Reference group	

<sup>7</sup> Standardized regression coefficients show the importance of each variable relative to the other variables. A standardized regression coefficient for a particular independent variable of 0.5 means that one standard deviation increase in this variable predicts 0.5 of a standard deviation increase in the dependent variable (in this case, number of gambling formats).

<sup>8</sup> Adjusted *R*<sup>2</sup> takes into account the number of independent variables so that *R*<sup>2</sup> will only increase if a variable improves *R*<sup>2</sup> above what would be expected by chance.

	Standardized Regression Coefficients	Adjusted R <sup>2</sup>	Step
Employed	.122	.099-.101	5
Unemployed	.031	.099-.101	
Retired	.097	.102-.104	
Other <sup>1</sup>	Reference group	Reference group	
Alcohol use in past 30 days	.068	.106-.108	6
Behavioral addictions	.055	.108-.111	7
Born in United States	.053	.112-.114	8
Age 18-34	Reference group	Reference group	9
Age 35-64	.078	.115-.117	
Age 65+	.022	.115-.117	
Military service	.049	.117-.119	10
Level of general health	-.054	.119-.121	11
Level of childhood unhappiness	.040	.121-.123	12
Current tobacco use	.043	.122-.124	13
Level of household income	.040	.123-.125	14

<sup>1</sup> Student, homemaker, disabled were combined into 'Other' because of small sample sizes in each.

### Multivariate Predictors of Gambling Frequency

Table 6 displays the variables that contributed significantly to prediction of overall frequency of gambling, their standardized regression coefficients, and the adjusted R<sup>2</sup> at each step. Altogether, 10.8% - 11.0% of the variability in frequency of gambling was predicted by all of the independent variables taken together. Because of the skewness of the dependent variable, we also examined a model where frequency of gambling was collapsed into three categories, but here again, the results were very similar with no improvement in the percentage of variance explained.

**Table 6. Stepwise Multiple Regression Predicting Maximum Gambling Frequency (n = 6,992)**

	Standardized Regression Coefficients	Adjusted R <sup>2</sup>	Step
High school or less	.172	.029	1
Bachelor's or some College	.071	.036-.037	
Beyond Bachelor's degree	Reference group	Reference group	
Male gender	.148	.071-.072	2
Portion of friends and family regular gamblers	.137	.091-.093	3
Age 18-34	Reference group	Reference group	4
Age 35-64	.102	.091-.093	
Age 65+	.117	.096-.098	
Current tobacco use	.052	.100-.102	5
Level of general health	-.054	.103-.104	6
Binge drinking	.057	.105-.108	7
Military service	.055	.108-.110	8

## Multivariate Predictors of Total Gambling Expenditure

Table 7 displays the variables that contributed significantly to prediction of total gambling expenditure, their standardized regression coefficients, and the adjusted  $R^2$  at each step. Altogether, 8.7% - 8.9% of the variability in number of gambling formats was predicted by all of the independent variables taken together. Because of the skewness and discontinuity of the dependent variable, we examined a model where expenditure was collapsed into four categories but found the results and percentage of variance explained to be very similar.

**Table 7. Stepwise Multiple Regression Predicting Total Gambling Expenditure (n = 6,992)**

	Standardized Regression Coefficients	Adjusted $R^2$	Step
Portion of friends and family regular gamblers	.168	.040-.041	1
Male gender	.130	.060-.061	2
High school or less	.132	.072-.073	3
Bachelor's or some College	.062	.076-.077	
Beyond Bachelor's degree	Reference group	Reference group	
Binge drinking	.062	.080-.081	4
Level of general health	-.040	.082-.083	5
Current tobacco use	.050	.083-.085	6
Employed	.078	.083-.084	7
Unemployed	.010	.083-.085	
Retired	.092	.086-.088	
Other <sup>1</sup>	Reference group	Reference group	
Behavioral addictions	.036	.087-.089	8

<sup>1</sup> Student, homemaker, disabled were combined into 'Other' because of small sample sizes in each.

## Summary across Analyses

Table 8 below summarizes the results of the three analyses, with a rank ordering of predictors according to their average standardized regression coefficient.

**Table 8. Multivariate Predictors of Gambling Involvement (n = 6,992)**

	Standardized Regression Coefficients			
	# Formats	Maximum Frequency	Total Expenditure	Average
Portion of friends and family regular gamblers	.193	.137	.168	.166
High school or less	.110	.172	.132	.138
Bachelor's or some College	.103	.071	.062	.079
Beyond Bachelor's degree	reference	reference	reference	reference
Male gender	.084	.148	.130	.121
Binge drinking	.124	.057	.062	.081
Level of general health	-.054	-.054	-.040	-.049
Current tobacco use	.043	.052	.050	.048

		Standardized Regression Coefficients			
		# Formats	Maximum Frequency	Total Expenditure	Average
Age 18-34	reference	reference	reference	reference	reference
Age 35-64	.078	.102	0	.060	
Age 65+	.022	.117	0	.046	
Employed	.122	0	.078	.067	
Unemployed	.031	0	.010	.014	
Retired	.097	0	.092	.063	
Other <sup>1</sup>	reference	reference	reference	reference	
Military service	.049	.055	0	.035	
Alcohol use in past 30 days	.068	0	0	.023	
Behavioral addictions	.055	0	.036	.030	
Born in United States	.053	0	0	.018	
Level of childhood unhappiness	.040	0	0	.013	
Level of household income	.040	0	0	.013	

<sup>1</sup>Student, homemaker, disabled were combined into 'Other' because of small sample sizes in each.

# Differences Between Recreational Gamblers and At-Risk Gamblers

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Identification of risk factors for experiencing gambling-related harm is important for the development of effective problem gambling prevention, intervention and treatment initiatives. As indicated in the previous analysis, one way of doing this is to identify variables predictive of higher levels of gambling involvement. However, another way, and the focus of the present analysis, is to identify variables predictive of being in the At-Risk Gambler category. It is expected that many of these variables will be similar to the variables predictive of higher levels of gambling involvement. Nonetheless, it is instructive to determine whether any differences exist.

While at-risk gambling is a universally accepted concept, it is not a universally accepted diagnostic category nor is there consensus on the criteria that constitute 'at-risk' gambling. Conventionally, most problem gambling assessment instruments (including the PPGM) identify At-Risk Gamblers as individuals with symptoms of problem gambling, but at a level below what is needed for problem gambling designation. More specifically, an At-Risk Gambler in the PPGM is someone who reports problem gambling symptomatology but not evidence of both impaired control and significant problems deriving from this impaired control that would allow the person to be designated as a Problem or Pathological Gambler. Additionally, the PPGM allows an At-Risk designation if the person reports a frequency of gambling and gambling losses that are equal to or greater than that reported for Problem and Pathological Gamblers.

It is important to note that all of the major longitudinal studies of gambling that have examined the predictive validity of the At-Risk Gambling designation have found it to be one of the strongest predictors of future problem gambling (Billi, Stone, Marden & Yeung, 2014; el-Guebaly, Casey, Currie et al., 2015; Williams, Hann, Schopflocher et al., 2015).<sup>9</sup> Despite the predictive value of the At-Risk designation, the existing academic literature on the predictors of At-Risk Gambling is virtually nonexistent.

## Method

The categorical dependent variable in the present analysis was whether the person was a Recreational Gambler or an At-Risk Gambler. Respondents classified as Problem and/or Pathological Gamblers were not included in the analysis.

Thirty two independent variables were examined to determine whether they were significantly different between the two groups:

- **10 demographic variables:** gender, age, race/ethnicity, whether the person was born in the United States, marital status, educational attainment, employment, household income, military service, and geographic region of Massachusetts where they resided

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<sup>9</sup> That being said, Williams, Hann, Schopflocher et al. (2015) have noted that the predictive validity of the At-Risk category could be even higher if additional criteria were used in the At-Risk designation: i.e., past history of problem gambling; higher frequency of involvement in electronic gambling machines and/or casino table games; having family members and/or close friends that are regular or problem gamblers; having a big gambling win in the past year; higher levels of gambling fallacies; using gambling as a way of escaping from problems; and having a history of impulsivity. This is being considered for future versions of the Problem and Pathological Gambling Measure (Williams & Volberg, 2010, 2014).

- **11 variables assessing a range of health, mental health, substance use, and other behavioral issues:** self-reported health status in past 12 months, participation in extreme sports, overall level of stress in the past 12 months, current tobacco use, alcohol use in the past 30 days, binge drinking in the past 30 days, illicit drug use in the past 12 months, self-reported drug or alcohol problems in the past 12 months, self-reported behavioral addictions in the past 12 months (overeating, sex or pornography, shopping, exercise, Internet chat lines, etc.), serious mental health problems in the past 12 months, and rating of childhood happiness
- **11 gambling-related variables:** portion of friends and family that are regular gamblers, lottery purchase in the past 12 months, daily lottery purchase in the past 12 months, instant lottery purchase in the past 12 months, raffle purchase in the past 12 months, sports betting in the past 12 months, bingo participation in the past 12 months, horse race betting in the past 12 months, private betting in the past 12 months, casino gambling in the past 12 months, and online gambling in the past 12 months.

The first part of the analysis involved conducting univariate chi-square tests for each variable to see whether Recreational Gamblers had a significantly different pattern of response compared to At-Risk Gamblers. The second part involved conducting binary logistic regression for all variables collectively to determine which variables significantly discriminated between the two groups. Variables were entered into the logistic regression in a forward stepwise manner, with variable entry order determined by the size of the Wald statistic (minimum entry level of  $p = .01$  and a removal level of  $p = .05$ ). Missing values were all replaced with multiple imputation.

## Univariate Results

The results of the univariate analyses are shown in Table 9 on the following page with the demographic variables presented first, followed by the health-related variables, and then the gambling-related variables. As can be seen, there are statistically significant differences (based on  $p$ -values) on most variables due to the large sample sizes. Focusing on variables where the 95% confidence intervals do not overlap, the following variables significantly predicted At-Risk Gambling status:

### Demographic Variables

- Male gender
- Being Black
- Being born outside the United States
- Lower educational attainment
- Lower household income
- Military service

### Health-Related Variables

- Poorer physical health
- Tobacco use
- No alcohol use in past 30 days
- Binge drinking
- Behavioral addictions
- Mental health problems

### Gambling-Related Variables

- Greater portion of friends and family being regular gamblers
- Greater rates of participation in all types of gambling except raffle tickets

- Engaging in a larger number of gambling formats

**Table 9. Univariate Differences Between Recreational Gamblers and At-Risk Gamblers**

		Recreational Gamblers (n = 6,271)		At-Risk Gamblers (n = 600)		p
		%	95% C.I.	%	95% C.I.	
<b>Gender</b>	Male	39.9	(38.7, 41.1)	53.3	(49.3, 57.3)	.001
	Female	59.0	(57.8, 60.2)	45.8	(41.9, 49.8)	
	Missing	1.1	(0.8, 1.3)	cell size ≤ 5		
<b>Age</b>	18-34	12.9	(12.1, 13.7)	14.2	(11.6, 17.2)	.085
	35-64	54.5	(53.3, 55.7)	51.0	(47.0, 55.0)	
	65+	28.2	(27.1, 29.3)	31.7	(28.1, 35.5)	
	Missing	4.4	(3.9, 5.0)	3.2	(2.0, 4.9)	
<b>Race/Ethnicity</b>	Hispanic	4.1	(3.7, 4.7)	6.2	(4.5, 8.4)	<.001
	Black	3.0	(2.6, 3.4)	6.8	(5.1, 9.1)	
	White	86.1	(85.2, 86.9)	80.2	(76.8, 83.2)	
	Asian	2.6	(2.3, 3.1)	3.8	(2.6, 5.7)	
	Missing or Other	4.1	(3.7, 4.7)	3.0	(1.9, 4.7)	
<b>Born in United States</b>	No	9.9	(9.1, 10.6)	15.7	(13.0, 18.8)	<.001
	Yes	88.0	(87.2, 88.8)	83.5	(80.3, 86.3)	
	Missing	2.1	(1.8, 2.5)	cell size ≤ 5		
<b>Marital status</b>	Never married	15.0	(14.2, 15.9)	17.3	(14.5, 20.6)	<.001
	Living with partner/ married/widowed	70.3	(69.2, 71.4)	68.0	(64.2, 71.6)	
	Divorced or separated	12.2	(11.4, 13.0)	13.8	(11.3, 16.8)	
	Missing	2.4	(2.1, 2.9)	cell size ≤ 5		
<b>Education</b>	High school or less	16.2	(15.3, 17.1)	30.2	(26.6, 34.0)	<.001
	Some college or Bachelor's	54.8	(53.5, 56.0)	54.5	(50.5, 58.4)	
	Beyond Bachelor's degree	27.2	(26.1, 28.3)	14.7	(12.1, 17.7)	
	Missing	1.8	(1.5, 2.2)	cell size ≤ 5		
<b>Employment</b>	Employed	60.8	(59.6, 62.0)	56.0	(52.0, 59.9)	.001
	Unemployed	3.6	(3.1, 4.0)	5.5	(3.9, 7.6)	
	Retired	24.5	(23.4, 25.6)	26.8	(23.4, 30.5)	
	Other <sup>1</sup>	9.1	(8.4, 9.8)	11.2	(8.9, 13.9)	
	Missing	2.1	(1.8, 2.5)	cell size ≤ 5		
<b>Household Income</b>	Less than \$15,000	7.0	(6.4, 7.7)	12.5	(10.1, 15.4)	<.001
	\$15,000-<\$30,000	10.0	(9.3, 10.8)	14.0	(11.5, 17.0)	
	\$30,000-<\$50,000	13.2	(12.3, 14.0)	16.8	(14.1, 20.0)	
	\$50,000-<\$100,000	27.1	(26.0, 28.2)	27.5	(24.1, 31.2)	
	\$100,000-<\$150,000	16.3	(15.4, 17.2)	13.0	(10.5, 15.9)	
	\$150,000 and more	12.6	(11.8, 13.4)	7.7	(5.8, 10.1)	
	Missing	13.9	(13.0, 14.7)	8.5	(6.5, 11.0)	
<b>Military service</b>	No	89.0	(88.2, 89.7)	83.5	(80.3, 86.3)	<.001
	Yes	9.8	(9.1, 10.5)	15.5	(12.8, 18.6)	
	Missing	1.2	(1.0, 1.5)	1.0	(0.5, 2.2)	
<b>Region</b>	Western Massachusetts	29.4	(28.8, 30.1)	29.0	(25.6, 32.6)	.847
	Greater Boston	54.0	(53.0, 55.0)	53.5	(49.6, 57.4)	
	South Eastern Massachusetts	16.6	(15.7, 17.5)	17.5	(14.7, 20.7)	

		Recreational Gamblers (n = 6,271)		At-Risk Gamblers (n = 600)		p
		%	95% C.I.	%	95% C.I.	
Health status past 12 months	Excellent	22.0	(21.0, 23.0)	12.7	(10.2, 15.6)	<.001
	Very good	39.6	(38.4, 40.8)	36.7	(32.9, 40.6)	
	Good	27.5	(26.4, 28.6)	35.2	(31.5, 39.1)	
	Fair	8.9	(8.2, 9.6)	11.7	(9.3, 14.5)	
	Poor	1.9	(1.6, 2.2)	3.8	(2.6, 5.7)	
	Missing	0.2	(0.1, 0.3)	0.0	NA	
Participate in extreme sports	No	93.4	(92.7, 93.9)	91.5	(89.0, 93.5)	<.001
	Yes	6.3	(5.7, 6.9)	8.5	(6.5, 11.0)	
	Missing	0.3	(0.2, 0.5)	0.0	NA	
Overall stress past 12 months	Very low	3.2	(2.8, 3.7)	4.2	(2.8, 6.1)	.268
	Low	15.7	(14.8, 16.6)	14.0	(11.5, 17.0)	
	Moderate	46.6	(45.4, 47.8)	44.2	(40.2, 48.2)	
	High	25.8	(24.7, 26.8)	26.3	(23.0, 30.0)	
	Very high	8.5	(7.8, 9.2)	11.0	(8.7, 13.8)	
	Missing	0.3	(0.2, 0.5)	cell size < 5		
Current tobacco use	No	84.9	(84.0, 85.7)	75.8	(72.3, 79.1)	<.001
	Yes	13.5	(12.7, 14.3)	21.7	(18.6, 25.1)	
	Missing	1.7	(1.4, 2.0)	2.5	(1.5, 4.1)	
Alcohol use past 30 days	No	24.6	(23.6, 25.7)	30.8	(27.3, 34.6)	.007
	Yes	75.1	(74.0, 76.1)	68.8	(65.0, 72.4)	
	Missing	0.3	(0.2, 0.4)	cell size < 5		
Binge drinking past 30 days	No	69.6	(68.5, 70.7)	59.2	(55.2, 63.0)	<.001
	Yes	25.8	(24.8, 26.9)	35.8	(32.1, 39.7)	
	Missing	4.5	(4.1, 5.1)	5.0	(3.5, 7.1)	
Illicit Drug use past 12 months	No	90.9	(90.1, 91.5)	88.3	(85.5, 90.7)	.170
	Yes	8.5	(7.8, 9.2)	10.7	(8.4, 13.4)	
	Missing	0.7	(0.5, 0.9)	1.0	(0.5, 2.2)	
Drug or alcohol problems past 12 months	No	97.4	(97.0, 97.8)	96.2	(94.3, 97.4)	.296
	Yes	1.8	(1.5, 2.2)	2.5	(1.5, 4.1)	
	Missing	0.8	(0.6, 1.0)	1.3	(0.7, 2.6)	
Behavioral addictions past 12 months	No	89.3	(88.5, 90.0)	84.3	(81.2, 87.0)	.006
	Yes	9.9	(9.1, 10.6)	14.5	(11.9, 17.5)	
	Missing	0.9	(0.7, 1.2)	1.2	(0.6, 2.4)	
Mental health problems past 12 months	No	81.4	(80.4, 82.3)	74.5	(70.9, 77.8)	<.001
	Yes	13.6	(12.7, 14.4)	20.2	(17.2, 23.6)	
	Missing	5.1	(4.6, 5.7)	5.3	(3.8, 7.4)	
Childhood Rating	Very happy	27.6	(26.5, 28.7)	23.3	(20.1, 26.9)	.047
	Happy	49.4	(48.2, 50.6)	48.3	(44.4, 52.3)	
	Neither happy nor unhappy	16.2	(15.3, 17.1)	18.5	(15.6, 21.8)	
	Unhappy	4.6	(4.1, 5.2)	6.7	(4.9, 9.0)	
	Very unhappy	1.5	(1.2, 1.8)	2.3	(1.4, 3.9)	
	Missing	0.7	(0.5, 1.0)	cell size < 5		
Portion of Friends and Family Regular Gamblers	None of them	49.4	(48.2, 50.7)	21.0	(17.9, 24.4)	<.001
	Some of them	47.5	(46.2, 48.7)	69.2	(65.4, 72.7)	
	Most of them	1.5	(1.2, 1.8)	6.5	(4.8, 8.8)	
	All of them	0.5	(0.4, 0.8)	2.5	(1.5, 4.1)	
	Missing	1.1	(0.9, 1.4)	cell size < 5		



		Recreational Gamblers (n = 6,271)		At-Risk Gamblers (n = 600)		p
		%	95% C.I.	%	95% C.I.	
Played Traditional Lottery Games in Past 12 months	No	23.0	(22.0, 24.1)	11.0	(8.7, 13.8)	<.001
	Yes	76.8	(75.8, 77.9)	88.8	(86.1, 91.1)	
	Missing	0.2	(0.1, 0.3)	cell size ≤ 5		
Played Instant Games in Past 12 months	No	52.7	(51.5, 54.0)	27.0	(23.6, 30.7)	<.001
	Yes	46.7	(45.4, 47.9)	71.5	(67.8, 75.0)	
	Missing	0.6	(0.4, 0.8)	1.5	(0.8, 2.9)	
Played Daily Lottery Games in Past 12 months	No	85.1	(84.2, 86.0)	62.0	(58.1, 65.8)	<.001
	Yes	14.1	(13.3, 15.0)	36.8	(33.1, 40.8)	
	Missing	0.8	(0.6, 1.0)	1.2	(0.6, 2.4)	
Played Raffles in Past 12 months	No	49.2	(48.0, 50.5)	53.0	(49.0, 57.0)	.182
	Yes	49.9	(48.7, 51.1)	46.0	(42.1, 50.0)	
	Missing	0.8	(0.6, 1.1)	1.0	(0.5, 2.2)	
Gambled at Casino in Past 12 months	No	71.8	(70.7, 72.9)	43.0	(39.1, 47.0)	<.001
	Yes	23.3	(22.2, 24.3)	51.5	(47.5, 55.5)	
	Missing	4.9	(4.4, 5.5)	5.5	(3.9, 7.6)	
Played Bingo in Past 12 months	No	96.1	(95.6, 96.5)	89.5	(86.8, 91.7)	<.001
	Yes	3.3	(2.9, 3.8)	10.3	(8.1, 13.0)	
	Missing	0.6	(0.4, 0.8)	cell size ≤ 5		
Bet on Horse Racing in Past 12 months	No	95.6	(95.1, 96.1)	90.3	(87.7, 92.4)	<.001
	Yes	4.0	(3.5, 4.5)	9.5	(7.4, 12.1)	
	Missing	0.4	(0.3, 0.6)	cell size ≤ 5		
Sports Betting in Past 12 months	No	86.2	(85.3, 87.0)	74.8	(71.2, 78.1)	<.001
	Yes	13.3	(12.5, 14.1)	25.0	(21.7, 28.6)	
	Missing	0.5	(0.4, 0.8)	cell size ≤ 5		
Private Betting in Past 12 months	No	88.1	(87.2, 88.8)	78.0	(74.5, 81.1)	<.001
	Yes	10.9	(10.1, 11.7)	21.3	(18.2, 24.8)	
	Missing	1.1	(0.8, 1.4)	cell size ≤ 5		
Online Gambling in Past 12 months	No	97.9	(97.5, 98.2)	93.0	(90.7, 94.8)	<.001
	Yes	1.0	(0.8, 1.3)	5.3	(3.8, 7.4)	
	Missing	1.1	(0.9, 1.4)	1.7	(0.9, 3.1)	
Number of Gambling Formats Engaged in	0	0.0	NA	1.3	(0.7, 2.6)	<.001
	1	29.9	(28.8, 31.0)	8.5	(6.5, 11.0)	
	2	28.8	(27.7, 29.9)	19.2	(16.2, 22.5)	
	3	21.8	(20.7, 22.8)	21.0	(17.9, 24.4)	
	4	11.5	(10.7, 12.3)	20.7	(17.6, 24.1)	
	5	5.0	(4.5, 5.5)	13.2	(10.7, 16.1)	
	6	2.2	(1.9, 2.6)	8.5	(6.5, 11.0)	
	7	0.6	(0.5, 0.9)	5.2	(3.7, 7.2)	
	8	0.2	(0.1, 0.3)	2.0	(1.1, 3.5)	
	9	cell size ≤ 5		cell size ≤ 5		
10	0.0	NA	cell size ≤ 5			

Note: *Italicized figures indicate relative standard error >30%*

<sup>1</sup> Student, homemaker, disabled were combined into 'Other' because of small sample sizes in each.

## Multivariate Results

Many of the above-mentioned individual variables are correlated with each other. Consequently, statistically significant differences between Recreational Gamblers and At-Risk Gamblers on some of these variables may reflect differences in the same underlying attribute. Thus, the more central question concerns which variables significantly differentiate the groups when these variables are analyzed simultaneously in a multivariate analysis (i.e., binary logistic regression).

A binary logistic regression found that maximal discrimination between the groups occurred with a model including a constant and 14 predictor variables. Table 10 on the following page shows the log of the odds ratio and Wald statistic for each of the 14 predictors. The variance accounted for was modest, with adjusted *R* squared ranging between 21.9% and 22.0% for the 10 imputations. Using a classification cutoff of 8.0% to maximize both sensitivity and specificity, overall prediction success ranged between 70.8% and 71.0%. In order of importance, people who were At-Risk Gamblers were significantly more likely to:

- Be a casino gambler
- Have a greater portion of friends and family that are regular gamblers
- Play instant lottery games
- Play daily lottery games
- Be male
- Be an online gambler
- Be born outside of the United States
- Participate in private betting
- Have lower educational attainment
- Play bingo
- Not purchase raffle tickets
- Have lower household income
- Have mental health problems
- Have no alcohol use in the past 30 days

**Table 10. Stepwise Logistic Regression Predicting At-Risk Gambling versus Recreational Gambling (n = 6,871)**

		Odds Ratio & 95% C.I.	Wald Statistics	<i>p</i>
<b>Casino Gambling</b>	No	Reference group	110.4	<i>p</i> < .0001
	Yes	2.73 (2.26, 3.29)		
<b>Portion of friends and family regular gamblers</b>		2.16 (1.86, 2.51)	101.0	<i>p</i> < .0001
<b>Instant Games</b>	No	Reference group	48.3	<i>p</i> < .0001
	Yes	2.04 (1.67, 2.50)		
<b>Daily Lottery Games</b>	No	Reference group	41.6	<i>p</i> < .0001
	Yes	1.97 (1.61, 2.43)		
<b>Gender</b>	Male	1.60 (1.33, 1.94)	24.1	<i>p</i> < .0001
	Female	Reference group		
<b>Online Gambling</b>	No	Reference group	22.1	<i>p</i> < .0001
	Yes	3.31 (2.01, 5.46)		
<b>Born in United States</b>	No	1.79 (1.37, 2.32)	19.0	<i>p</i> < .0001
	Yes	Reference group		
<b>Private Betting</b>	No	Reference group	18.3	<i>p</i> < .0001
	Yes	1.70(1.34, 2.18)		

		Odds Ratio & 95% C.I.	Wald Statistics	<i>p</i>
<b>Education</b>	High school or less	1.92 (1.40, 2.63)	16.7	<i>p</i> < .0001
	Bachelor's or some College	1.24 (0.95, 1.62)	2.4	<i>p</i> < .0001
	Beyond Bachelor's degree	Reference group	Reference group	
<b>Bingo</b>	No	Reference group	13.4	<i>p</i> < .0001
	Yes	1.88 (1.34, 2.64)		
<b>Raffles</b>	No	1.30 (1.08, 1.57)	7.3	<i>p</i> < .0001
	Yes	Reference group		
<b>Household income</b>		.97 (0.95, 0.99)	6.9	<i>p</i> = .0008
<b>Mental health problems past 12 months</b>	No	Reference group	6.7	<i>p</i> = .0002
	Yes	1.36 (1.07, 1.73)		
<b>Alcohol use past 30 days</b>	No	1.32 (1.07, 1.63)	6.5	<i>p</i> < .0001
	Yes	Reference group		

### Controlling for Number of Gambling Formats Engaged In

A supplemental analysis was undertaken to examine the contribution of individual forms of gambling to At-Risk Gambling status after controlling for the number of gambling formats engaged in. This was done by adding number of gambling formats as an additional predictor variable. The reason for this supplemental analysis is that the strong relationship between problem gambling and engaging in certain forms of gambling (e.g., online gambling) is partly due to the fact that these forms tend to be patronized by individuals with high levels of gambling involvement (Baggio, Dupuis, Berchtold et al., 2017; LaPlante, Nelson, LaBrie & Shaffer, 2009; Wood, Williams & Parke, 2012). Thus, entering the number of gambling formats engaged in as an additional variable helps determine whether there are specific types of gambling that provide additional power to predict At-Risk Gambling after number of gambling formats enters the model.

As seen in Table 11 on the following page, when number of gambling formats is added to the model, casino gambling and non-involvement in raffles still add predictive power. Also, as expected, number of gambling formats becomes the most powerful predictive variable as it is best seen as an aspect of At-Risk Gambling.

**Table 11. Stepwise Logistic Regression Predicting At-Risk Gambling versus Recreational Gambling after Controlling for Number of Gambling Formats Engaged In (n = 6,871)**

		Odds Ratio & 95% C.I.	Wald Statistics	p
<b>Number of gambling formats engaged in</b>		1.63 (1.51, 1.76)	165.0	$p < .0001$
<b>Portion of friends and family regular gamblers</b>		2.12 (1.82, 2.46)	96.6	$p < .0001$
<b>Raffles</b>	No	2.13 (1.71, 2.66)	46.1	$p < .0001$
	Yes	Reference group		
<b>Born in United States</b>	No	1.86 (1.43, 2.42)	21.9	$p < .0001$
	Yes	Reference group		
<b>Casino Gambling</b>	No	Reference group	20.3	$p < .0001$
	Yes	1.63 (1.32, 2.02)		
<b>Education</b>	High school or less	1.93 (1.41, 2.63)	17.1	$p < .0001$
	Bachelor's or some College	1.25 (.96, 1.63)	2.7	$p < .0001$
	Beyond Bachelor's degree	Reference group	Reference group	
<b>Gender</b>	Male	1.46 (1.21, 1.76)	16.1	$p < .0001$
	Female	Reference group		
<b>Household income</b>		.96 (.94, .99)	11.3	$p = .0002$
<b>Mental health problems past 12 months</b>	No	Reference group	9.9	$p < .0001$
	Yes	1.45 (1.14, 1.83)		
<b>Alcohol use past 30 days</b>	No	1.33 (1.08, 1.65)	7.3	$p < .0001$
	Yes	Reference group		

**Multivariate Differences between At-Risk Gamblers and Problem and Pathological Gamblers**

A final analysis examined whether there were any variables that differentiated At-Risk Gamblers from Problem and Pathological Gamblers. This analysis included the 729 respondents classified as At-Risk or Problem/Pathological Gamblers based on the PPGM. Binary logistic regression found that maximal discrimination between the groups occurred with a constant and only 2 predictor variables. Table 12 shows the log of the odds ratios and Wald statistic for the 2 predictors. The variance accounted for was very low, with adjusted R squared ranging between 7.6% and 8.1%. Using a classification cutoff of 18.0% to maximize both sensitivity and specificity, overall prediction success was very weak, ranging between 56.0% and 56.4%. In order of importance, people who were Problem/Pathological Gamblers were significantly more likely than At-Risk Gamblers to:

- Have behavioral addictions (overeating, sex or pornography, shopping, exercise, Internet chat lines, etc.)
- Play daily lottery games

**Table 12. Stepwise Logistic Regression Predicting At-Risk Gambling versus Problem and Pathological Gambling (n = 729)**

		Odds Ratio & 95% C.I.	Wald Statistics	p
<b>Behavioral Addictions</b>	No	Reference group	24.8	$p < .0001$
	Yes	2.99 (1.94, 4.62)		
<b>Daily Lottery Games</b>	No	Reference group	9.1	$p < .0001$
	Yes	1.83 (1.24, 2.71)		

# Differences Between Recreational Gamblers and Problem and Pathological Gamblers

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Identification of variables associated with problem gambling has obvious implications for prevention and treatment. There are many studies that have identified cross-sectional and or longitudinal predictors of problem gambling. These are as follows:

- **Male gender** (Blanco et al., 2006; Johansson et al., 2009; Kessler, Hwang, LaBrie et al., 2008; Petry, 2005; Petry, Stinson & Grant, 2005; Volberg, Abbott, Ronnberg et al., 2001; Williams, Volberg & Stevens, 2012)
- **Non-Caucasian or a member of a minority group** (Alegria et al., 2009; Kessler et al., 2008; Petry, 2005; Petry, Stinson & Grant, 2005; Williams, Volberg & Stevens, 2012)
- **Young age** (18 – 25) (Johansson et al., 2009; Kessler et al., 2008; Petry, 2005; Volberg, Abbott, Ronnberg et al., 2001; Williams, Volberg & Stevens, 2012)
- **Less education or poor school performance** (Afifi, Cox, Martens et al., 2010a; Billi et al., 2014; Scherrer et al., 2007; Scholes-Balog et al., 2014; Williams, Volberg & Stevens, 2012; Winters et al., 2005).
- **Being divorced or separated** (e.g., Afifi, Cox, Martens et al., 2010a; Black et al., 2012; Petry, Stinson & Grant, 2005)
- **Lower income** (Afifi, Cox, Martens et al., 2010a; Volberg, Abbott, Ronnberg et al., 2001; Williams, Volberg & Stevens, 2012)
- **Abusive or neglectful upbringing** (Black et al., 2012; Hodgins et al., 2010; Kausch et al., 2006; Petry & Steinberg, 2005; Specker et al., 1996)
- **Family history of gambling and/or problem gambling** (Eisen et al., 1998; Hardoon, Gupta & Derevensky, 2004; Langhinrichsen-Rohling et al., 2004; Lobo & Kennedy, 2009; Shah et al., 2005; Reith & Dobbie, 2011; Slutske, Zhu, Meier et al., 2009, 2010).
- **Early onset of gambling** (Kessler et al., 2008; Vitaro & Bujold, 1996; Vitaro, Arsenault & Tremblay, 1997; Vitaro, Wanner, Ladouceur et al., 2004; Winters, Stinchfield, Botzet et al. 2002, 2005)
- **Peer group or friends involvement in gambling** (Welte, Wieczorek, Barnes et al., 2006; Williams, Hann, Schopflocher et al., 2015)
- **Poorer physical health** (Afifi, Cox, Martens et al., 2010b; Morasco & Petry, 2006)
- **Impulsivity, risk-taking, and attentional problems** (Carlton et al., 1987; Clarke, 2004; Cyders & Smith, 2008; Lawrence et al., 2009; Lee et al., 2011; MacLaren, Fugelsang, et al., 2011; Mishra, Lalumiere & Williams, 2010; Nower & Blaszczynski, 2006; Pagani et al, 2009; Parke, Griffiths & irwing, 2004; Shenasse et al., 2012; Specker, Carlson, Christenson et al., 1995; Vitaro, Arsenault & Tremblay, 1999).
- **Neuroticism, lower agreeableness, and lower conscientiousness** (Bagby et al., 2007; MacLaren, Best, Dixon et al., 2011; MacLaren, Fugelsang, Harrigan et al., 2011; Myrseth et al., 2009; Williams, Hann, Schopflocher et al., 2015)
- **Conduct disorder and/or antisocial personality** (Blaszczynski & McConaghy, 1994; Crockford & el-Guebaly, 1998; Johansson et al., 2009; Meyer & Fabian, 1991; Mishra, Lalumiere, Morgan et al., 2011; Petry, Stinson & Grant, 2005; Slutske, Eisen, Xian et al., 2001; Welte, Barnes, Tidwell et al., 2009; Williams, Hann, Schopflocher et al., 2015)

- **Significant stressors and/or poor support systems** (Afifi et al., 2010a; Coman, Burrows & Evans, 1997; Goudriaan et al., 2009; Reith & Dobbie, 2011, 2013; Turner, Zangeneh & Littman-Sharp, 2006; Williams, Hann, Schopflocher et al., 2015)
- **Substance use and abuse** (Grant, Kushner & Kim, 2002; Lorains et al., 2011; Petry, 2007; Petry, Stinson & Grant, 2005; Rush et al., 2008; Slutske et al., 2000)
- **Mental health problems** (particularly mood and anxiety disorders) (Johansson et al., 2009; Kim et al., 2006; Lorains et al., 2011; Mood Disorders of Canada, 2004; Petry, Stinson & Grant, 2005; Quigley et al., 2014; Rush et al., 2008; Williams, Hann, Schopflocher et al., 2015; Zimmerman et al., 2006)
- **Cultural tradition of gambling** (Loo, Raylu & Oei, 2008; Raylu & Oei, 2004; Williams, Belanger & Pruzak, 2016; Williams, Stevens & Nixon, 2011)
- **Greater intensity of gambling involvement as measured by higher frequency, expenditure, and number of formats engaged in** (Goudriaan et al., 2009; Romild, Volberg & Abbott, 2014; Williams, Hann, Schopflocher et al., 2015)
- **Experiencing a 'big win'** (Billi et al., 2014; Lesieur & Custer, 1984; Turner, Zangeneh & Littman-Sharp, 2006; Turner, Jain, Spence et al., 2008; Williams, Hann, Schopflocher et al., 2015).
- **Engaging in 'continuous' forms of gambling** (electronic gambling machines) that provide a high frequency of reinforcement (Dowling, Smith & Thomas, 2005; Meyer, Hayer & Griffiths, 2009; Welte, Barnes, Wieczorek et al., 2007; Williams, Volberg & Stevens, 2012)
- **Internet gambling** (Wood & Williams, 2007, 2011; Wood, Williams & Parke, 2012)
- **Readily available gambling opportunities** (Lester, 1994; Rush, Veldhuizen & Adlaf, 2007; St-Pierre et al., 2014; Thomas, Bates, Moore et al., 2011; Welte, Barnes, Wieczorek et al., 2004, 2007; Williams, West & Simpson, 2012)
- **Gambling fallacies** (Delfabbro, 2004; Gaboury & Ladouceur, 1989; Goodie & Fortune, 2013; Johansson et al., 2009; Joukhador, Blaszczyński & Maccallum, 2004; Joukhador, Maccallum & Blaszczyński, 2003; Leonard & Williams, 2016; Miller & Currie, 2008; Myrseth, Pallesen, Molde et al., 2009; Toneatto, Blitz-Miller, Calderwood et al., 1997; Wohl & Enzle, 2002)
- **Gambling serving a psychological need** (i.e., escape; money being an important goal or measure of success to the individual) (Blaszczyński & Nower, 2010; Clarke, 2004; Ledgerwood & Petry, 2006; Li, 2007; Nixon & Solowoniuk, 2009; Nixon, Solowoniuk & McGowan, 2006; Schull, 2002; Volberg, Reitzes & Boles, 1997; Wood & Griffiths, 2007)

## Method

The categorical dependent variable in the present analysis was whether the respondent was a Recreational Gambler (n=6,271) or a Problem or Pathological Gambler (n=129)

Thirty two independent variables were examined concerning whether they were significantly different between the two groups:

- **10 demographic variables:** gender, age, race/ethnicity, whether the person was born in the United States, marital status, educational attainment, employment, household income, military service, and geographic region of Massachusetts where they resided
- **11 variables assessing a range of health, mental health, substance use, and other behavioral issues:** self-reported health status in past 12 months, participation in extreme sports, overall level of stress in the past 12 months, current tobacco use, alcohol use in the past 30 days, binge drinking in the past 30 days, illicit drug use in the past 12 months, self-reported drug or alcohol problems in the past 12 months, self-reported behavioral addictions in the past 12 months (overeating, sex or pornography, shopping, exercise, Internet chat lines, etc.), serious mental health problems in the past 12 months, and rating of childhood happiness

- **11 gambling-related variables:** portion of friends and family that are regular gamblers, lottery purchase in the past 12 months, daily lottery purchase in the past 12 months, instant lottery purchase in the past 12 months, raffle purchase in the past 12 months, sports betting in the past 12 months, bingo participation in the past 12 months, horse race betting in the past 12 months, private betting in the past 12 months, casino gambling in the past 12 months, and online gambling in the past 12 months.

The first part of the analysis involved conducting univariate chi-square tests for each variable to see whether Recreational Gamblers had a significantly different pattern of response compared to Problem and Pathological Gamblers. The second part involved conducting binary logistic regression for all variables collectively to determine which variables significantly discriminated between the two groups. Variables were entered into the logistic regression in a forward stepwise manner, with variable entry order determined by the size of the Wald statistic (minimum entry level of  $p = .01$  and a removal level of  $p = .05$ ). Missing values were all replaced with multiple imputation.

## Univariate Results

The results of the univariate analysis comparing Recreational Gamblers to Problem and Pathological Gamblers are shown in Table 13 with the demographic variables presented first, followed by the health-related variables, and then the gambling-related variables. As can be seen, there are statistically significant differences (based on  $p$ -values) on most variables due to the large sample sizes. Focusing on variables where the 95% confidence intervals do not overlap, the following variables significantly predicted Problem/Pathological Gambling status:

### Demographic Variables

- Male gender
- Being Black
- Being born outside the United States
- Being divorced or separated
- Lower educational attainment
- Unemployment
- Lower household income
- Military service

### Health-Related Variables

- Poorer physical health
- Tobacco use
- Binge drinking
- Illicit drug use
- Drug or alcohol problems
- Behavioral addictions
- Mental health problems
- Less happy childhood

### Gambling-Related Variables

- Greater portion of friends and family regular gamblers
- Greater rates of participation in all types of gambling except raffle tickets
- Engaging in a larger number of gambling formats

**Table 13. Univariate Differences between Recreational Gamblers and Problem and Pathological Gamblers**

		Recreational Gamblers (n = 6,271)		Problem Gamblers (n = 129)		p
		%	95% C.I.	%	95% C.I.	
<b>Gender</b>	Male	39.9	(38.7, 41.1)	65.9	(57.3, 73.5)	<.001
	Female	59.0	(57.8, 60.2)	33.3	(25.8, 41.9)	
	Missing	1.1	(0.8, 1.3)	cell size ≤ 5		
<b>Age</b>	18-34	12.9	(12.1, 13.7)	15.5	(10.2, 22.8)	.700
	35-64	54.5	(53.3, 55.7)	55.0	(46.4, 63.4)	
	65+	28.2	(27.1, 29.3)	26.4	(19.5, 34.6)	
	Missing	4.4	(3.9, 5.0)	cell size ≤ 5		
<b>Race/Ethnicity</b>	Hispanic	4.1	(3.7, 4.7)	6.2	(3.1, 11.9)	.001
	Black	3.0	(2.6, 3.4)	14.7	(9.6, 21.9)	
	White	86.1	(85.2, 86.9)	73.6	(65.4, 80.5)	
	Asian	2.6	(2.3, 3.1)	cell size ≤ 5		
	Missing or Other	4.1	(3.7, 4.7)	cell size ≤ 5		
<b>Born in United States</b>	No	9.9	( 9.1, 10.6)	20.9	(14.8, 28.8)	<.001
	Yes	88.0	(87.2, 88.8)	79.1	(71.2, 85.2)	
	Missing	2.1	(1.8, 2.5)	0.0	NA	
<b>Marital status</b>	Never married	15.0	(14.2, 15.9)	20.9	(14.8, 28.8)	.004
	Living with partner/ married/widowed	70.3	(69.2, 71.4)	57.4	(48.7, 65.6)	
	Divorced or Separated	12.2	(11.4, 13.0)	20.9	(14.8, 28.8)	
	Missing	2.4	(2.1, 2.9)	cell size ≤ 5		
<b>Education</b>	High school or less	16.2	(15.3, 17.1)	41.9	(33.7, 50.5)	<.001
	Some college or Bachelor's	54.8	(53.5, 56.0)	44.2	(35.9, 52.8)	
	Beyond Bachelor's degree	27.2	(26.1, 28.3)	10.9	(6.5, 17.5)	
	Missing	1.8	(1.5, 2.2)	cell size ≤ 5		
<b>Employment</b>	Employed	60.8	(59.6, 62.0)	53.5	(44.9, 61.9)	.026
	Unemployed	3.6	(3.1, 4.0)	12.4	(7.7, 19.3)	
	Retired	24.5	(23.4, 25.6)	20.2	(14.1, 27.9)	
	Other <sup>1</sup>	9.1	(8.4, 9.8)	12.4	(7.7, 19.3)	
	Missing	2.1	(1.8, 2.5)	cell size ≤ 5		
<b>Household Income</b>	Less than \$15,000	7.0	(6.4, 7.7)	18.6	(12.8, 26.2)	<.001
	\$15,000-<\$30,000	10.0	(9.3, 10.8)	17.1	(11.5, 24.5)	
	\$30,000-<\$50,000	13.2	(12.3, 14.0)	15.5	(10.2, 22.8)	
	\$50,000-<\$100,000	27.1	(26.0, 28.2)	25.6	(18.8, 33.8)	
	\$100,000-<\$150,000	16.3	(15.4, 17.2)	10.1	(5.9, 16.6)	
	\$150,000 and more	12.6	(11.8, 13.4)	6.2	(3.1, 11.9)	
	Missing	13.9	(13.0, 14.7)	7.0	(3.7, 12.9)	
<b>Military service</b>	No	89.0	(88.2, 89.7)	77.5	(69.5, 83.9)	.011
	Yes	9.8	(9.1, 10.5)	20.2	(14.1, 27.9)	
	Missing	1.2	(1.0, 1.5)	cell size ≤ 5		
<b>Region</b>	Western Massachusetts	29.4	(28.8, 30.1)	30.2	(23.0, 38.6)	.941
	Greater Boston	54.0	(53.0, 55.0)	54.3	(45.7, 62.6)	
	South Eastern Massachusetts	16.6	(15.7, 17.5)	15.5	(10.2, 22.8)	



		Recreational Gamblers (n = 6,271)		Problem Gamblers (n = 129)		p
		%	95% C.I.	%	95% C.I.	
Health status past 12 months	Excellent	22.0	(21.0, 23.0)	7.0	(3.7, 12.9)	<.001
	Very good	39.6	(38.4, 40.8)	27.9	(20.9, 36.2)	
	Good	27.5	(26.4, 28.6)	43.4	(35.1, 52.1)	
	Fair	8.9	(8.2, 9.6)	17.8	(12.2, 25.4)	
	Poor	1.9	(1.6, 2.2)	cell size ≤ 5		
	Missing	0.2	(0.1, 0.3)	0.0	NA	
Participate in extreme sports	No	93.4	(92.7, 93.9)	89.9	(83.4, 94.1)	.429
	Yes	6.3	(5.7, 6.9)	9.3	(5.4, 15.7)	
	Missing	0.3	(0.2, 0.5)	cell size ≤ 5		
Overall stress past 12 months	Very low	3.2	(2.8, 3.7)	cell size ≤ 5		<.001
	Low	15.7	(14.8, 16.6)	8.5	(4.8, 14.7)	
	Moderate	46.6	(45.4, 47.8)	50.4	(41.9, 58.9)	
	High	25.8	(24.7, 26.8)	32.6	(25.1, 41.1)	
	Very high	8.5	(7.8, 9.2)	7.0	(3.7, 12.8)	
	Missing	0.3	(0.2, 0.5)	0.0	NA	
Current tobacco use	No	84.9	(84.0, 85.7)	65.9	(57.3, 73.5)	<.001
	Yes	13.5	(12.7, 14.3)	31.8	(24.4, 40.3)	
	Missing	1.7	(1.4, 2.0)	cell size ≤ 5		
Alcohol use past 30 days	No	24.6	(23.6, 25.7)	27.9	(20.9, 36.2)	<.001
	Yes	75.1	(74.0, 76.1)	72.1	(63.8, 79.1)	
	Missing	0.3	(0.2, 0.4)	0.0	NA	
Binge drinking past 30 days	No	69.6	(68.5, 70.7)	48.1	(39.6, 56.6)	<.001
	Yes	25.8	(24.8, 26.9)	44.2	(35.9, 52.8)	
	Missing	4.5	(4.1, 5.1)	7.8	(4.2, 13.8)	
Illicit Drug use past 12 months	No	90.9	(90.1, 91.5)	82.2	(74.6, 87.8)	<.001
	Yes	8.5	(7.8, 9.2)	17.8	(12.2, 25.4)	
	Missing	0.7	(0.5, 0.9)	0.0	NA	
Drug or alcohol problems past 12 months	No	97.4	(97.0, 97.8)	90.7	(84.4, 94.6)	.029
	Yes	1.8	(1.5, 2.2)	8.5	(4.8, 14.7)	
	Missing	0.8	(0.6, 1.0)	cell size ≤ 5		
Behavioral addictions past 12 months	No	89.3	(88.5, 90.0)	64.3	(55.7, 72.1)	<.001
	Yes	9.9	(9.1, 10.6)	34.9	(27.2, 43.5)	
	Missing	0.9	(0.7, 1.2)	cell size ≤ 5		
Mental health problems past 12 months	No	81.4	(80.4, 82.3)	69.0	(60.5, 76.4)	.007
	Yes	13.6	(12.7, 14.4)	26.4	(19.5, 34.6)	
	Missing	5.1	(4.6, 5.7)	4.7	(2.1, 10.0)	
Childhood rating	Very happy	27.6	(26.5, 28.7)	17.1	(11.5, 24.5)	<.001
	Happy	49.4	(48.2, 50.6)	41.9	(33.7, 50.5)	
	Neither happy nor unhappy	16.2	(15.3, 17.1)	28.7	(21.6, 37.1)	
	Unhappy	4.6	(4.1, 5.2)	11.6	(7.1, 18.4)	
	Very unhappy	1.5	(1.2, 1.8)	cell size ≤ 5		
	Missing	0.7	(0.5, 1.0)	0.0	NA	

		Recreational Gamblers (n = 6,271)		Problem Gamblers (n = 129)		p
		%	95% C.I.	%	95% C.I.	
Portion of friends and family regular gamblers	None of them	49.4	(48.2, 50.7)	14.7	(9.6, 21.9)	<.001
	Some of them	47.5	(46.2, 48.7)	71.3	(63.0, 78.4)	
	Most of them	1.5	(1.2, 1.8)	9.3	(5.4, 15.7)	
	All of them	0.5	(0.4, 0.8)	<i>cell size ≤ 5</i>		
	Missing	1.1	(0.9, 1.4)	<i>cell size ≤ 5</i>		
Traditional Lottery Games in past 12 months	No	23.0	(22.0, 24.1)	<i>cell size ≤ 5</i>		<.001
	Yes	76.8	(75.8, 77.9)	96.1	(91.0, 98.4)	
	Missing	0.2	(0.1, 0.3)	0.0	NA	
Instant Lotteries in past 12 months	No	52.7	(51.5, 54.0)	17.8	(12.2, 25.4)	<.001
	Yes	46.7	(45.4, 47.9)	82.2	(74.6, 87.8)	
	Missing	0.6	(0.4, 0.8)	0.0	NA	
Daily Lottery Games in past 12 months	No	85.1	(84.2, 86.0)	46.5	(38.1, 55.1)	<.001
	Yes	14.1	(13.3, 15.0)	53.5	(44.9, 61.9)	
	Missing	0.8	(0.6, 1.0)	0.0	NA	
Raffles in past 12 months	No	49.2	(48.0, 50.5)	48.1	(39.6, 56.6)	.798
	Yes	49.9	(48.7, 51.1)	50.4	(41.9, 58.9)	
	Missing	0.8	(0.6, 1.1)	<i>cell size ≤ 5</i>		
Casino gambling in past 12 months	No	71.8	(70.7, 72.9)	39.5	(31.5, 48.2)	<.001
	Yes	23.3	(22.2, 24.3)	55.0	(46.4, 63.4)	
	Missing	4.9	(4.4, 5.5)	5.4	(2.6, 10.9)	
Bingo in past 12 months	No	96.1	(95.6, 96.5)	84.5	(77.2, 89.8)	.002
	Yes	3.3	(2.9, 3.8)	14.0	(9.0, 21.0)	
	Missing	0.6	(0.4, 0.8)	<i>cell size ≤ 5</i>		
Horse Race betting in past 12 months	No	95.6	(95.1, 96.1)	80.6	(72.9, 86.5)	<.001
	Yes	4.0	(3.5, 4.5)	18.6	(12.8, 26.2)	
	Missing	0.4	(0.3, 0.6)	<i>cell size ≤ 5</i>		
Sports betting in past 12 months	No	86.2	(85.3, 87.0)	67.4	(58.9, 74.9)	<.001
	Yes	13.3	(12.5, 14.1)	31.8	(24.3, 40.3)	
	Missing	0.5	(0.4, 0.8)	<i>cell size &lt; 5</i>		
Private betting in past 12 months	No	88.1	(87.2, 88.8)	76.0	(67.9, 82.6)	.006
	Yes	10.9	(10.1, 11.7)	23.3	(16.8, 31.3)	
	Missing	1.1	(0.8, 1.4)	<i>cell size ≤ 5</i>		
Online gambling in Past 12 months	No	97.9	(97.5, 98.2)	86.0	(79.0, 91.0)	<.001
	Yes	1.0	(0.8, 1.3)	11.6	(7.1, 18.4)	
	Missing	1.1	(0.9, 1.4)	<i>cell size ≤ 5</i>		
Number of gambling formats engaged in	1	29.9	(28.8, 31.0)	4.7	(2.1, 10.0)	<.001
	2	28.8	(27.7, 29.9)	7.0	(3.7, 12.8)	
	3	21.8	(20.7, 22.8)	24.8	(18.1, 33.0)	
	4	11.5	(10.7, 12.3)	24.8	(18.1, 33.0)	
	5	5.0	(4.5, 5.5)	13.2	(8.4, 20.2)	
	6	2.2	(1.9, 2.6)	11.6	(7.1, 18.4)	
	7	0.6	(0.5, 0.9)	7.0	(3.7, 12.9)	
	8	0.2	(0.1, 0.3)	<i>cell size ≤ 5</i>		
	9	<i>cell size ≤ 5</i>		<i>cell size ≤ 5</i>		
	10	0.0	NA	0.0	NA	

Note: *Italicized figures indicate relative standard error >30%*

<sup>1</sup> Student, homemaker, disabled were combined into 'Other' because of small sample sizes in each.

### Univariate Differences Between Problem Gamblers and Pathological Gamblers

A supplemental analysis investigated whether there were any significant univariate differences between Problem Gamblers and Pathological Gamblers. The results of this analysis are shown in Table 14. Although small sample sizes limited the ability to detect statistically significant differences, there were few large differences in the large majority of demographic and health-related variables. There was a trend toward higher tobacco and illicit drug use among Pathological Gamblers as well as a tendency for gambling participation rates to be higher, although the differences were not statistically significant. There was only one variable where the 95% confidence intervals did not overlap: higher rates of participation in daily lottery games.

**Table 14. Univariate Predictors of Problem Gambling versus Pathological Gambling**

		Problem Gamblers (n = 75)		Pathological Gamblers (n = 54)		p
		%	95% C.I.	%	95% C.I.	
<b>Gender</b>	Male	66.7	(55.3, 76.4)	64.8	(51.3, 76.3)	.573
	Female	32.0	(22.5, 43.3)	35.2	(23.7, 48.7)	
	Missing	cell size ≤ 5		0	NA	
<b>Age</b>	18-34	14.7	(8.3, 24.6)	16.7	(8.9, 29.0)	.823
	35-64	53.3	(42.1, 64.2)	57.4	(44.0, 69.8)	
	65+	29.3	(20.2, 40.5)	22.2	(13.1, 35.2)	
	Missing	cell size ≤ 5		cell size ≤ 5		
<b>Race/Ethnicity</b>	Hispanic	cell size ≤ 5		cell size ≤ 5		.162
	Black	16.0	(9.3, 26.1)	13.0	(6.3, 24.8)	
	White	72.0	(60.9, 81.0)	75.9	(62.9, 85.5)	
	Asian	cell size ≤ 5		0.0	NA	
	Missing or Other	cell size ≤ 5		cell size ≤ 5		
<b>Born in United States</b>	No	22.7	(14.6, 33.5)	18.5	(10.3, 31.1)	.562
	Yes	77.3	(66.5, 85.4)	81.5	(68.9, 89.7)	
	Missing	0.0	NA	0.0	NA	
<b>Marital status</b>	Never married	14.7	(8.3, 24.6)	29.6	(19.0, 43.0)	.141
	Living with partner/ married/widowed	64.0	(52.6, 74.0)	48.1	(35.3, 61.3)	
	Divorced or separated	21.3	(13.5, 32.0)	20.4	(11.7, 33.1)	
	Missing	0.0	NA	cell size ≤ 5		
<b>Education</b>	High school or less	42.7	(32.0, 54.0)	40.7	(28.6, 54.2)	.666
	Some college or Bachelor's	45.3	(34.5, 56.6)	42.6	(30.2, 56.0)	
	Beyond Bachelor's degree	10.7	(5.4, 19.9)	11.1	(5.1, 22.6)	
	Missing	cell size < 5		cell size ≤ 5		
<b>Employment</b>	Employed	58.7	(47.3, 69.2)	46.3	(33.6, 59.5)	.236
	Unemployed	12.0	(6.4, 21.5)	13.0	(6.3, 24.8)	
	Retired	21.3	(13.5, 32.0)	18.5	(10.3, 31.1)	
	Other <sup>1</sup>	8.0	(3.6, 16.7)	18.5	(10.3, 31.1)	
	Missing	0.0	NA	cell size ≤ 5		

		Problem Gamblers (n = 75)		Pathological Gamblers (n = 54)		p
		%	95% C.I.	%	95% C.I.	
Household income	Less than \$15,000	18.7	(11.4, 29.1)	18.5	(10.3, 31.1)	.855
	\$15,000-<\$30,000	18.7	(11.4, 29.1)	14.8	(7.6, 26.9)	
	\$30,000-<\$50,000	14.7	(8.3, 24.6)	16.7	(8.9, 29.0)	
	\$50,000-<\$100,000	21.3	(13.5, 32.0)	31.5	(20.6, 44.9)	
	\$100,000-<\$150,000	12.0	(6.4, 21.5)	cell size ≤ 5		
	\$150,000 and more	cell size ≤ 5		cell size ≤ 5		
	Missing	8.0	(3.6, 16.7)	cell size ≤ 5		
Military service	No	73.3	(62.3, 82.1)	83.3	(71.0, 91.1)	.384
	Yes	24.0	(15.7, 34.9)	14.8	(7.6, 26.9)	
	Missing	cell size ≤ 5		cell size ≤ 5		
Region	Western Massachusetts	30.7	(21.4, 41.9)	29.6	(19.1, 42.9)	.747
	Greater Boston	52.0	(40.8, 63.0)	57.4	(44.1, 69.8)	
	South Eastern Massachusetts	17.3	(10.3, 27.6)	13.0	(6.3, 24.8)	
Health status past 12 months	Excellent	8.0	(3.6, 16.7)	cell size ≤ 5		.980
	Very good	26.7	(17.9, 37.7)	29.6	(19.0, 43.0)	
	Good	44.0	(33.3, 55.3)	42.6	(30.2, 56.0)	
	Fair	17.3	(10.4, 27.6)	18.5	(10.3, 31.1)	
	Poor	cell size ≤ 5		cell size ≤ 5		
	Missing	0.0	NA	0.0	NA	
Participate in extreme sports	No	88.0	(78.5, 93.6)	92.6	(81.9, 97.2)	.482
	Yes	10.7	(5.4, 19.9)	cell size ≤ 5		
	Missing	cell size ≤ 5		0.0	NA	
Overall stress past 12 months	Very low	0.0	NA	cell size ≤ 5		.116
	Low	cell size ≤ 5		11.1	(5.1, 22.6)	
	Moderate	58.7	(47.3, 69.2)	38.9	(26.9, 52.3)	
	High	30.7	(21.3, 41.9)	35.2	(23.7, 48.7)	
	Very high	cell size ≤ 5		11.1	(5.1, 22.6)	
	Missing	0.0	NA	0.0	NA	
Current tobacco use	No	74.7	(63.7, 83.2)	53.7	(40.5, 66.4)	.050
	Yes	24.0	(15.7, 34.9)	42.6	(30.2, 56.0)	
	Missing	cell size ≤ 5		cell size ≤ 5		
Alcohol use past 30 days	No	29.3	(20.2, 40.5)	25.9	(16.0, 39.1)	.668
	Yes	70.7	(59.5, 79.8)	74.1	(60.9, 84.0)	
	Missing	0.0	NA	0.0	NA	
Binge drinking past 30 days	No	53.3	(42.1, 64.2)	40.7	(28.6, 54.2)	.173
	Yes	37.3	(27.2, 48.7)	53.7	(40.5, 66.4)	
	Missing	9.3	(4.5, 18.3)	cell size ≤ 5		
Illicit Drug use past 12 months	No	88.0	(78.5, 93.6)	74.1	(60.9, 84.0)	.051
	Yes	12.0	(6.4, 21.5)	25.9	(16.0, 39.1)	
	Missing	0.0	NA	0.0	NA	
Drug or alcohol problems past 12 months	No	92.0	(83.3, 96.4)	88.9	(77.4, 94.9)	.426
	Yes	cell size ≤ 5		11.1	(5.1, 22.6)	
	Missing	cell size ≤ 5		0.0	NA	
Behavioral addictions past 12 months	No	70.7	(59.5, 79.8)	55.6	(42.2, 68.1)	.160
	Yes	29.3	(20.2, 40.5)	42.6	(30.2, 56.0)	
	Missing	0.0	NA	cell size ≤ 5		

		Problem Gamblers (n = 75)		Pathological Gamblers (n = 54)		p
		%	95% C.I.	%	95% C.I.	
Mental health problems past 12 months	No	72.0	(60.9, 81.0)	64.8	(51.3, 76.3)	.519
	Yes	22.7	(14.6, 33.4)	31.5	(20.6, 44.9)	
	Missing	cell size ≤ 5		cell size ≤ 5		
Childhood Rating	Very happy	13.3	(7.3, 23.0)	22.2	(13.1, 35.2)	.150
	Happy	49.3	(38.3, 60.5)	31.5	(20.6, 44.9)	
	Neither happy nor unhappy	29.3	(20.2, 40.5)	27.8	(17.5, 41.1)	
	Unhappy	8.0	(3.6, 16.7)	16.7	(8.9, 29.0)	
	Very unhappy	0.0	NA	cell size ≤ 5		
	Missing	0.0	NA	0.0	NA	
Portion of friends and family regular gamblers	None of them	13.3	(7.3, 23.0)	16.7	(8.9, 29.0)	.489
	Some of them	72.0	(60.9, 81.0)	70.4	(57.0, 81.0)	
	Most of them	12.0	(6.4, 21.5)	cell size ≤ 5		
	All of them	cell size ≤ 5		cell size ≤ 5		
	Missing	0.0	NA	cell size ≤ 5		
Traditional Lottery Games in past 12 months	No	cell size ≤ 5		cell size ≤ 5		.274
	Yes	94.7	(86.7, 98.0)	98.1	(88.1, 99.7)	
	Missing	0.0	NA	0.0	NA	
Instant Lottery Games in past 12 months	No	18.7	(11.4, 29.1)	16.7	(8.9, 29.0)	.768
	Yes	81.3	(70.9, 88.6)	83.3	(71.0, 91.1)	
	Missing	0.0	NA	0.0	NA	
Daily Lottery Games in past 12 months	No	57.3	(46.0, 68.0)	31.5	(20.6, 44.9)	.003
	Yes	42.7	(32.0, 54.0)	68.5	(55.1, 79.4)	
	Missing	0.0	NA	0.0	NA	
Raffles in past 12 months	No	50.7	(39.5, 61.7)	44.4	(31.9, 57.7)	.254
	Yes	46.7	(35.8, 57.9)	55.6	(42.3, 68.1)	
	Missing	cell size ≤ 5		0.0	NA	
Casino gambling in past 12 months	No	38.7	(28.4, 50.1)	40.7	(28.6, 54.2)	.663
	Yes	57.3	(46.0, 68.0)	51.9	(38.7, 64.7)	
	Missing	cell size ≤ 5		cell size ≤ 5		
Bingo in past 12 months	No	81.3	(70.9, 88.6)	88.9	(77.4, 94.9)	.248
	Yes	16.0	(9.3, 26.1)	11.1	(5.1, 22.6)	
	Missing	cell size ≤ 5		0.0	NA	
Horse Race betting in past 12 months	No	89.3	(80.1, 94.6)	68.5	(55.1, 79.4)	.019
	Yes	10.7	(5.4, 19.9)	29.6	(19.0, 43.0)	
	Missing	0.0	NA	cell size ≤ 5		
Sports betting in past 12 months	No	70.7	(59.5, 79.8)	63.0	(49.5, 74.7)	.358
	Yes	28.0	(19.0, 39.1)	37.0	(25.3, 50.5)	
	Missing	cell size ≤ 5		0.0	NA	
Private betting in past 12 months	No	78.7	(68.0, 86.5)	72.2	(58.9, 82.5)	.378
	Yes	20.0	(12.4, 30.5)	27.8	(17.5, 41.1)	
	Missing	cell size ≤ 5		0.0	NA	
Online gambling in past 12 months	No	88.0	(78.5, 93.6)	83.3	(71.0, 91.1)	.087
	Yes	8.0	(3.6, 16.7)	16.7	(8.9, 29.0)	
	Missing	cell size ≤ 5		0.0	NA	

		Problem Gamblers (n = 75)		Pathological Gamblers (n = 54)		p
		%	95% C.I.	%	95% C.I.	
Number of gambling formats engaged in	1	<i>cell size ≤ 5</i>		<i>cell size ≤ 5</i>		.094
	2	12.0	(6.4, 21.5)	0.0	NA	
	3	22.7	(14.6, 33.5)	27.8	(17.5, 41.1)	
	4	25.3	(16.8, 36.3)	24.1	(14.5, 37.1)	
	5	12.0	(6.4, 21.5)	14.8	(7.6, 26.9)	
	6	10.7	(5.4, 19.9)	13.0	(6.3, 24.7)	
	7	<i>cell size ≤ 5</i>		<i>cell size ≤ 5</i>		
	8	<i>cell size ≤ 5</i>		<i>cell size ≤ 5</i>		
	9	<i>cell size ≤ 5</i>		<i>cell size ≤ 5</i>		
	10	0.0	NA	0.0	NA	

Note: *Italicized figures indicate relative standard error >30%*

<sup>1</sup>Student, homemaker, disabled were combined into 'Other' because of small sample sizes in each.

## Multivariate Results

Many of the above-mentioned individual variables are correlated with each other. Consequently, statistically significant differences between Recreational Gamblers and Problem and Pathological Gamblers on some of these variables may reflect differences in the same underlying attribute. Thus, the more central question concerns which variables significantly differentiate the groups when these variables are analyzed simultaneously in a multivariate analysis (i.e., binary logistic regression).

A binary logistic regression found that maximal discrimination between Recreational Gamblers and Problem/Pathological Gamblers occurred for a model with a constant and 11 predictor variables. Table 15 (below) shows the log of the odds ratio and Wald statistic for each of the 11 predictors. The variance accounted for was modest, with adjusted *R* squared ranging between 30.7% and 31.1%. Using a classification cutoff of 2% to maximize both sensitivity and specificity, overall prediction success was between 81.4% and 81.7%.

**Table 15. Stepwise Logistic Regression Predicting Problem and Pathological Gambling versus Recreational Gambling (n = 6,400)**

		Odds Ratio & 95% C.I.	Wald Statistics	p
Daily Lottery Games	No	Reference group	28.2	p < .0001
	Yes	3.00 (2.00, 4.50)		
Portion of friends and family regular gamblers		2.25 (1.66, 3.05)	27.9	p < .0001
Race/Ethnicity	Other	.86 (0.30, 2.43)	0.1	p = .8420
	Hispanic	.70 (0.28, 1.79)	0.6	p = .3097
	Black	4.60 (2.55, 8.30)	25.8	p < .0001
	White	Reference group	Reference group	
Casino Gambling	No	Reference group	23.1	p < .0001
	Yes	2.65 (1.78, 3.94)		
Gender	Male	2.62 (1.75, 3.92)	22.1	p < .0001
	Female	Reference group		
Online Gambling	No	Reference group	19.8	p < .0001
	Yes	5.71 (2.65, 12.30)		

		Odds Ratio & 95% C.I.	Wald Statistics	<i>p</i>
<b>Instant Lottery</b>	No	Reference group	15.4	<i>p</i> < .0001
	Yes	2.70 (1.64, 4.43)		
<b>Behavioral Addictions</b>	No	Reference group	14.3	<i>p</i> < .0001
	Yes	2.34 (1.50, 3.65)		
<b>Education</b>	High school or less	3.27 (1.69, 6.33)	13.2	<i>p</i> < .0001
	Bachelor's or some College	1.20 (0.63, 2.28)	0.4	<i>p</i> = .3333
	Beyond Bachelor's degree	Reference group	Reference group	
<b>Born in United States</b>	No	2.49 (1.42, 4.34)	10.3	<i>p</i> < .0001
	Yes	Reference group		
<b>Childhood Unhappiness</b>		1.38 (1.12, 1.69)	9.1	<i>p</i> < .0001

### Controlling for Number of Gambling Formats Engaged In

A supplemental analysis was undertaken to examine the contribution of individual forms of gambling to Problem/Pathological Gambling status after controlling for the number of gambling formats engaged in (i.e., number of gambling formats was added as an additional predictor variable).

As shown in Table 16, when number of gambling formats is added to the model, the only type of gambling that added power in predicting Problem or Pathological Gambling was non-involvement in raffle tickets and engagement in private gambling. As expected, number of gambling formats becomes the most powerful predictive variable as it is best seen as a manifestation of Problem/Pathological Gambling.

**Table 16. Stepwise Logistic Regression Predicting Problem and Pathological Gambling versus Recreational Gambling after Controlling for Number of Gambling Formats Engaged In (n = 6,400)**

		Odds Ratio & 95% C.I.	Wald Statistics	<i>p</i>
<b>Number of gambling formats engaged in</b>		2.22 (1.91, 2.57)	112.6	<i>p</i> < .0001
<b>Race/Ethnicity</b>	Other	0.90 (0.32, 2.52)	0.1	<i>p</i> = .8959
	Hispanic	0.65 (0.26, 1.62)	0.9	<i>p</i> = .1712
	Black	4.69 (2.59, 8.50)	26.3	<i>p</i> < .0001
	White	Reference group	Reference group	
<b>Portion of friends and family regular gamblers</b>		2.07 (1.53, 2.79)	22.8	<i>p</i> < .0001
<b>Raffles</b>	No	2.81 (1.76, 4.49)	18.6	<i>p</i> < .0001
	Yes	Reference group		
<b>Gender</b>	Male	2.29 (1.52, 3.45)	15.7	<i>p</i> < .0001
	Female	Reference group		
<b>Born in United States</b>	No	3.03 (1.73, 5.30)	15.3	<i>p</i> < .0001
	Yes	Reference group		
<b>Education</b>	High school or less	3.06 (1.57, 5.98)	11.5	<i>p</i> < .0001
	Bachelor's or some College	1.23 (0.64, 2.36)	0.5	<i>p</i> = .2785
	Beyond Bachelor's degree	Reference group	Reference group	
<b>Behavioral Addictions</b>	No	Reference group	9.8	<i>p</i> < .0001
	Yes	2.05 (1.30, 3.24)		
<b>Childhood Unhappiness</b>		1.37 (1.11, 1.70)	8.5	<i>p</i> < .0001
<b>Poorer health status</b>		1.32 (1.08, 1.61)	7.2	<i>p</i> < .0001
<b>Private betting</b>	No	2.17 (1.23, 3.85)	7.1	<i>p</i> < .0001
	Yes	Reference group		

# Summary of Multivariate Predictors

The significant multivariate predictors from each of the analyses are reported in Table 17. Entries in the columns of the table indicate characteristics of respondents that are more common in the risk group, compared to Recreational Gamblers.

**Table 17. Multivariate Predictors of Non-Gambling, Level of Gambling, At-Risk Gambling, and Problem & Pathological Gambling**

	Non-Gambler	Higher Gambling Involvement	At-Risk Gambler	Problem and Pathological Gambler
Gender		Male	Male	Male
Age	18-34 or 65+			
Race/Ethnicity	Non-White			Black
Born in United States	No		No	No
Marital Status				
Educational Attainment	Higher	Lower	Lower	Lower
Employment	Student, Homemaker, Disabled, or Retired			
Household Income	Lower		Lower	
Military Service	No			
Region of Massachusetts				
Health Status		Poorer		
Extreme Sports				
Stress Level				
Tobacco Use	No	Yes		
Alcohol Use	No		No	
Binge Drinking	No	Yes		
Illicit Drug Use				
Drug or Alcohol Problems	No			
Behavioral Addictions				Yes
Mental Health Problems			Yes	
Childhood Unhappiness	Higher			Higher
Friend & Family Gambling	<b>Fewer</b>	More	More	More
Traditional Lottery	--	--		
Daily Lottery Games	--	--	Yes	Yes
Instant Lottery Games	--	--	Yes	Yes
Raffles	--	--	No	
Casino Gambling	--	--	Yes	Yes
Bingo	--	--	Yes	
Horse Racing	--	--		
Sports Betting	--	--		
Private Gambling	--	--	Yes	
Online Gambling	--	--	Yes	Yes

Shaded cells indicate the strongest individual predictor in each analysis.



# Discussion

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This report presents four separate but related analyses of data from a general population survey of Massachusetts adults. The focus of these analyses is on the univariate and multivariate differences between Recreational Gamblers in Massachusetts and three other groups, namely Non-Gamblers, At-Risk Gamblers and Problem/Pathological Gamblers. The purpose of these analyses is to identify variables that differentiate these groups. This information is important for the development of effective problem gambling prevention, intervention and treatment initiatives in the Commonwealth.

## Recreational Gamblers versus Non-Gamblers

All of the variables identified in prior research as predictive of being a non-gambler were also predictive in the present univariate or multivariate results: female gender, minority group status, younger and older age, lower socioeconomic status, higher educational attainment. Prior studies have identified religion and religiosity as being predictive of non-gambling. However, religion and religiosity were not assessed in the Baseline General Population Survey. Additional variables identified in the present investigation that have not been previously identified as predictive of non-gambling are: not using alcohol or tobacco; not having problems with drugs or alcohol; having a smaller portion of friends and family that are regular gamblers; being a student, homemaker, or disabled; not having served in the military; being an immigrant; and having a somewhat lower level of childhood happiness.

The strongest predictor of being a Non-Gambler rather than a Recreational Gambler in Massachusetts was the single gambling-related variable: having a lower portion of friends and family that are regular gamblers. There were several additional variables that significantly discriminated between the groups to some extent. Focusing on the multivariate results, demographically, Non-Gamblers were more likely to have higher educational attainment; be a student, homemaker, disabled, or retired; in the age range of 18-34 or 65+; be born outside of the United States; have lower incomes; not to have served in the military; and to be non-White. In terms of health-related variables, Non-Gamblers were more likely not to use tobacco, not to use alcohol, not to binge drink, not to have problems with drugs or alcohol, and to have less happy childhoods.

The only difference in these results when the comparison group was **all** gamblers rather than just Recreational Gamblers was that being non-White was no longer a significant predictor.

The ability of the multivariate model to discriminate between Non-Gamblers and Recreational Gamblers was relatively weak with *R* squared being only 12.2% to 12.6% and classification accuracy being only 62.1% to 62.9%. The implication of this result is that there are many similarities between the two groups. This makes some theoretical sense, as a good portion of Recreational Gamblers are designated as such simply because of their occasional purchase of lottery or raffle tickets. Similarly, a portion of occasional raffle or lottery ticket purchasers will be classified as Non-Gamblers because they made no purchases in the past year.

## Prevention Implications

There are no marked differences in the health and mental health status of Recreational Gamblers versus Non-Gamblers. While it is true that having drug or alcohol problems was a multivariate predictor of Recreational Gambling, it was the weakest of the 13 predictors and the actual percentage difference is only 1% (0.8% of Non-Gamblers versus 1.8% of Recreational Gamblers). Offsetting this is the fact that there were small but significant univariate differences favoring Recreational Gamblers (i.e., better physical health status, lower rate of mental health problems). The lack of marked differences in the health and mental health of these two groups implies

that intervention efforts to prevent harm from gambling should probably not be directed at gambling generally, as recreational gambling is a normative activity not clearly associated with elevated harm. Rather, the focus should be more specific to excessive levels of gambling and/or At-Risk Gambling.

### **Predicting Level of Gambling Participation Among Gamblers**

The ability of the multivariate models to predict level of gambling involvement among gamblers was also fairly weak, with each of these models only able to account for between 9% - 12% of the variance. Here again, this indicates that there are many similarities between gamblers at different levels of gambling involvement.

Nonetheless, there were some variables that did statistically predict higher involvement across all measures of gambling participation. Demographically, higher intensity gamblers were more likely to be male and have lower educational attainment. In terms of health-related behaviors, they were more likely to be a binge drinker, report poorer physical health, and to be a current tobacco user. Similar to what was found for the prediction of Recreational Gamblers relative to Non-Gamblers, the strongest predictor of higher levels of gambling involvement was having a higher portion of friends and family being regular gamblers.

Although the literature on this topic is not large, it is notable that friend and family involvement in gambling, lower educational attainment, and male gender have all previously been identified in other studies as predictive of a higher level of gambling involvement.

### **Prevention Implications**

Higher levels of gambling involvement are likely to increase the potential for gambling-related harm. Indeed, as will be discussed later, many of the above-mentioned variables are also predictive of At-Risk and Problem/Pathological Gambling.

Thus, it is useful to know that having a larger portion of friends and family who are regular gamblers is the strongest predictor of more intensive gambling. While people tend to gravitate to other people with similar interests, longitudinal research has shown that friend and family involvement is an important prospective risk factor for future problem gambling (Reith & Dobbie, 2011, 2013; Williams, Hann, Schopflocher et al., 2015; Winters et al., 1995, 2002, 2005). The mechanism by which this occurs is presumably because having a gambling-involved social network both encourages gambling involvement and normalizes excessive involvement. In the case of family members, it likely also speaks to a shared genetic predisposition to problem gambling, the magnitude of which has been shown to be quite substantial (Eisen, Lin, Lyons et al., 1998; Lobo & Kennedy, 2006, 2009; Shah, Eisen, Xian & Potenza, 2005; Slutske, Zhu, Meier, & Martin, 2010). Thus it is clear that (a) gamblers need to be aware of the normalizing effect that their social group has on their own gambling behavior; (b) friends and family of regular gamblers need to be aware of the facilitative role they have on that person's gambling; and (c) all gamblers need to be aware that problem gambling (and presumably heavy gambling) has a significant genetic basis and thus need to be particularly vigilant if they have a positive family history.

The other practical implication of the present investigation is that it points to demographic groups suited for targeted prevention: i.e., males and people with lower educational attainment. People who use tobacco, binge drink, and have poorer general health also merit special attention.

### **Recreational Gamblers versus At-Risk Gamblers**

The ability of the multivariate model to discriminate between Recreational Gamblers and At-Risk Gamblers was modest, with *R* squared being 21.9% - 22.0%. Part of the reason for the improved discriminative ability relative to the previous analyses is that 10 additional gambling variables were utilized for the At-Risk analysis.

Nonetheless, the results of our analysis indicate that some important differences exist between these groups (and more so than exists for just higher or lower levels of gambling involvement). In contrast, considerable similarities were found between At-Risk Gamblers and Problem/Pathological Gamblers, with a multivariate model examining differences having an *R* squared of only 7.6% - 8.1% and only two variables being significantly more common among Problem and Pathological Gamblers relative to At-Risk Gamblers: behavioral addictions and playing daily lottery games.<sup>10</sup>

Focusing on the multivariate results, demographically, At-Risk Gamblers compared to Recreational Gamblers are more likely to be male, to be born outside the United States, and to have lower educational attainment, and lower household income. In terms of health, they are more likely to have mental health problems and not to have used alcohol in the past 30 days. It is unclear why alcohol abstinence is predictive of At-Risk Gambling, but it may be due to the fact that people with a history of alcohol abuse or who come from a family with alcohol abusers tend to have a bimodal distribution of alcohol use themselves (i.e., high rates of heavy users and high rates of abstinence) (e.g., Weitzman & Wechsler, 2000). The strongest predictors of being an At-Risk Gambler are gambling-related variables, with At-Risk Gamblers significantly more likely to participate in casino gambling, have a greater portion of friends and family that are regular gamblers, play instant lottery games, play daily lottery games, be online gamblers, play bingo, and not to purchase raffle tickets. However, when controlling for the number of gambling formats engaged in, casino gambling and not participating in raffles are the only types of gambling that remain significant predictors. Non-involvement in raffles is likely predictive because purchasing raffle tickets is often done to support charitable causes rather than to win money.

There is virtually no literature to reference concerning the relationship between the variables that discriminated between the groups in the present analysis and variables that have been identified in prior research.

### **Prevention Implications**

The practical implications of the present results are similar to the implications discussed in the previous analysis, in that it provides further indication that targeting the social networks of At-Risk Gamblers is particularly important in prevention.

These results also reaffirm the notion that certain demographic groups are well suited for targeted prevention. In addition to males and individuals with lower educational attainment that were also identified in the previous analysis, immigrants and individuals with lower income have a higher risk profile. Also similar to the previous analysis, poorer health was implicated in the form of higher rates of mental health problems. However, in contrast to the previous analysis that found higher rates of tobacco and binge drinking associated with higher levels of gambling involvement, the only substance-use variable that was significant in the present analysis was that non-use of alcohol in the previous 30 days was more predictive of being an At-Risk Gambler.

The present results also reaffirm prior research showing that certain types of gambling have a higher risk profile than other types. Casino gambling, which was the strongest individual predictor of At-Risk Gambling status, primarily involves slot machines and casino table games, which have a strong association to gambling-related harm because of their continuous nature (Dowling, Smith & Thomas, 2005; Meyer, Hayer & Griffiths, 2009; Welte, Barnes, Wieczorek et al., 2007; Williams, West, & Simpson, 2012). Instant lottery games were also a strong predictor of At-Risk Gambling, which may be similarly related to the short period of time between the wager and the outcome and the ability to immediately re-wager (Griffiths, 2002; Papoff & Norris, 2009; Short et al., 2015). It is important to note that although the majority of problem gamblers in Massachusetts do not

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<sup>10</sup> There are still important differences in overall level of gambling involvement and problem gambling symptomatology, which is the basis for the different classifications of members of these two groups.

identify any particular type of gambling as being more problematic than others, those that do identify a problematic format are most likely to identify instant lottery games (see Williams, Pekow, Volberg et al., 2017 for a discussion of this issue). Finally, as has also been found in previous research, online gambling was a significant predictor of At-Risk Gambling, presumably due to its 24-hour availability, convenience, and the fact that it offers continuous forms of gambling.

The caveat to these gambling-related results is that only casino gambling and not participating in raffles remain significant after number of gambling formats engaged in was entered into the multivariate model. This is a further reminder that most problem gamblers engage in several different types of gambling, all of which contribute to their problems and there is often not a singular problematic format. At the same time it is important to recognize that entering number of gambling formats into the multivariate model has significant limitations in illustrating the importance of specific gambling formats. The most important limitation is that extensive involvement in several different types of gambling is **one aspect** of being an At-Risk Gambler or a Problem/Pathological Gambler, which is why it is not normally used as a predictor (and why aggregate gambling frequency and total gambling expenditure were also not used as predictors). This is also why it is overwhelmingly the strongest predictor when entered into the model. When an aspect of a disorder is entered as a predictor of the disorder, it becomes very difficult for other variables to add any predictive power as it is analogous to trying to predict Pathological Gambling after Problem Gambling is entered as a predictor, or Major Depression after low mood is entered as a predictor.<sup>11</sup>

Of final note, there are important implications to the fact that there were almost no characteristics that differentiated At-Risk Gamblers from Problem and Pathological Gamblers. This reaffirms previous research that shows At-Risk Gambling to be one of the strongest prospective predictors of future problem gambling. It also means that (a) the variables predictive of Problem and Pathological Gambling will likely be similar to the variables predictive of At-Risk Gambling and (b) that targeting the variables predictive of At-Risk Gambling will have significant efficacy in preventing Problem Gambling. It is important to recognize that prevention efforts are often more effective with people at-risk for developing problems, as their behavior is less entrenched than with people who have already developed problems (Hodgins & el-Guebaly, 2000; Shaffer & Korn, 2002).

### Recreational Gamblers versus Problem and Pathological Gamblers

The ability of the multivariate model to discriminate between Recreational Gamblers and Problem and Pathological Gamblers was stronger than any of the other analyses undertaken in this report, with between 30.7% and 31.1% of the variance explained and overall prediction success between 81.4% and 81.7%. In contrast, there were relatively few differences between Problem Gamblers and Pathological Gamblers, other than a trend toward higher substance use and rates of gambling participation. This is similar to the earlier finding of very few differences between At-Risk and Problem/Pathological Gamblers. It is interesting to note,

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<sup>11</sup> The other challenge to this approach concerns the equivalency and substitutability of more harmful forms of gambling. Using a drug example, polydrug use is common among drug abusers. Some use caffeine + tobacco + heroin; some use caffeine + tobacco + cocaine; some use caffeine + cannabis + methamphetamine, etc. Thus, using multiple drugs is a very strong predictor of drug abuse and it is often not possible to **statistically** show that heroin use, or cocaine use, or methamphetamine use have additive harm, even though it is self-evident they are causing the most problems and are what people are seeking treatment for. The issue has to do with the substitutability and equivalency of more harmful substances. In other words, the person who is using heroin is just as impaired as the person using cocaine who is just as impaired as the person using methamphetamine. It is difficult to show an addictive effect of heroin, cocaine, or methamphetamine when controlling for the **number of drugs** and easier when controlling for specific 'light drugs' (i.e., tobacco, caffeine, and cannabis).

however, that in both cases playing daily lottery games was predictive of being a Pathological Gambler rather than a Problem Gambler and a Problem Gambler rather than an At-Risk Gambler.

Focusing on the multivariate results, demographically, Problem and Pathological Gamblers were more likely to be Black,<sup>12</sup> male, have lower educational attainment, and be born outside the United States. In terms of health, they were more likely to have behavioral addictions and lower childhood happiness. Gambling-related variables were the strongest discriminators, with the following variables significantly predicting greater likelihood of being a Problem or Pathological Gambler: having a greater portion of friends and family involved in gambling, playing daily lottery games, engaging in casino gambling, engaging in online gambling, and playing instant lottery games. However, none of these gambling formats was predictive when controlling for number of gambling formats engaged in (although private betting and non-involvement in raffles do become predictive). As before, this reminds us that problem gamblers typically engage in several different types of gambling, all of which contribute to their difficulties. At the same time, we also have to be aware that entering number of gambling formats into the model reduces the marginal (or incremental) importance of individual types of gambling.

The present results are highly consistent with prior research in that all variables associated with Problem/Pathological Gambling in either the univariate or multivariate results have also been found to be predictive of problem gambling in prior research (i.e., male gender, minority group status, immigrants, divorce/separation, lower educational attainment, lower income, unemployment, poorer physical health, substance use and abuse, behavioral addictions, unhappier childhoods, friend/family involvement in gambling, higher rates of participation in each individual type of gambling, engagement in continuous forms of gambling, engagement in online gambling). One interesting and unique finding not previously reported in the literature is that the purchase of raffle tickets in Massachusetts is predictive of *not* being a Problem or Pathological Gambler. As was explained for At-Risk Gambling, this is presumably because raffle tickets are often purchased in order to support charitable causes, rather than with aspirations to win.

### Prevention Implications

As was the case for Level of Gambling Involvement, one of the strongest individual predictors of being a Problem/Pathological Gambler was having a larger portion of friends and family also regularly involved in gambling (it was also the second strongest predictor for being an At-Risk Gambler). This is further evidence that targeting the social networks of heavy gamblers, At-Risk Gamblers, and Problem/Pathological Gamblers needs to be a very high priority.

Also similar to the analyses on Level of Gambling Involvement and At-Risk Gambling, the present results reaffirm that certain demographic groups merit special targeting for intervention, with most of these groups having already been identified in previous analyses: males, Blacks, lower educational attainment, and being born outside of the United States. It is interesting that being born outside of the United States was a predictor of problem gambling even when controlling for education and race/ethnicity. This may be because many immigrants to Massachusetts come from countries (e.g., Latin America), where legal forms of gambling are less available. The present results also indicate that adverse health-related conditions are related to Problem and Pathological Gambling, but there is less consistency between the analyses concerning what these conditions are.

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<sup>12</sup> It is worth noting that both Non-Gamblers and Problem/Pathological Gamblers in Massachusetts are significantly more likely to be non-White than Recreational Gamblers. It is possible that non-Whites in Massachusetts represent a bi-modal group in the population, with a relatively large proportion who have little or no involvement in gambling and a significant minority who gamble frequently and experience gambling-related difficulties. This pattern has been found among recent immigrants, youth and women in other jurisdictions and may reflect recent exposure to legal, commercial gambling as well as heightened vulnerability to the development of gambling-related difficulties (Abbott, Volberg & Rönnerberg, 2004).

In the present analysis, it was having other behavioral addictions (e.g., shopping, sex, exercise), a less happy childhood, and poorer physical health.

Finally, as was also seen with At-Risk Gambling, interventions directed at continuous forms of gambling (i.e., casino gambling, instant lottery games) and online gambling are warranted given their statistical association with Problem/Pathological Gambling.

Of final note, there is considerable overlap in the predictors for higher gambling involvement, At-Risk Gambling and Problem/Pathological Gambling in the Commonwealth. An important implication of this finding is that, for the most part, targeted prevention and intervention efforts aimed at At-Risk Gamblers and heavily involved gamblers will be effective for Problem/Pathological Gamblers, and vice versa.

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