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ORIGINAL ARTICLE

Proximity to Casino Gambling Venues and Risk of Problem Gambling in Massachusetts

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Abstract
We examine the relationship between proximity to electronic gambling machines or casino table games within gambling venues and the risk of being a person who experiences gambling problems among participants in a Massachusetts high-risk sample cohort study. The analysis employs data from Wave 2 through Wave 5 of the Massachusetts Gambling Impact Cohort (MAGIC) study conducted from 2015 to 2019. The Problem and Pathological Gambling Measure (PPGM) was employed to categorize participants as non-gamblers, recreational gamblers, at-risk gamblers, or problem/pathological gamblers. No significant relationship was found between the type of gambler and either table game or electronic gambling machine distance or density for either the wave prior to casino introduction or any of the waves subsequent to casino introduction. Results suggest that the Massachusetts population may be desensitized to some of the potential negative effects of casino proximity due to long-term exposure to casinos in neighboring jurisdictions.

Keywords Gambling venue · Casino proximity · Problem gambling · Casino table games · Electronic gambling machines

An ongoing debate exists in the field of gambling research as to the relationship between the availability of gambling opportunities and the risk of developing gambling problems. The availability theory suggests that an increased exposure to gambling opportunities in a population would result in more individuals experiencing gambling problems and associated harms (Abbott & Volberg, 1999; Raylu & Oei, 2002; Room, 2005). An alternative theory on adaptation suggests that a population will develop immunity to a newly introduced form of gambling and any gambling-related problems and harms would be short lived (Abbott, 2005, 2006; Abbott et al., 1999; Shaffer, 2005; Shaffer et al., 1997). Many gambling studies have been undertaken to elucidate the role of proximity in the risk of

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developing gambling problems; however, as these studies have varied methodologies and target populations, outcomes also vary.

Cross-sectional studies conducted in the USA and other jurisdictions over the past several decades observed positive relationships between gambling problems in a population and their increased exposure to gambling opportunities. Gerstein et al. (1999) found higher rates of problem gambling when a gambling venue was within 50 miles of a home location. A US national telephone survey in 1999/2000 found similar results for individuals living within 10 miles of a gambling venue (Welte et al., 2004). In a follow-up study conducted a decade later, individuals in closer proximity to a gambling venue again had higher rates of gambling participation and gambling problems (Welte et al., 2016). An analysis of respondents to the 2002/2003 New Zealand Health Survey found that neighborhoods with increased access to gambling had higher rates of gambling problems and related population inequalities (Pearce et al., 2008). A 2002 Canadian population survey found a modest association between proximity to gambling venues offering EGMs and problem gambling (Rush et al., 2007). However, another study conducted in Canada that did find an association between proximity to a gambling venue and the level of gambling participation and expenditure on gambling in the local population found no correlation between proximity and rates of problem gambling suggesting the population may have already adapted to the presence of local casinos (Sevigny et al., 2008).

Several longitudinal studies investigated the opening of a new gambling venue in Canada and found an initial increase in gambling problems in the year following the opening (Jacques et al., 2000; Room et al., 1999). However, these initial increases in the prevalence of at-risk and problem gambling observed in the local population 1 year after the venue opening were not supported at 2- and 4-year follow-ups (Jacques & Ladouceur, 2006).

Although commercial gambling in the USA was first legalized in Nevada in the early 1930s, the first casino to open in the Northeastern United States was in Atlantic City in 1978, shortly after gambling became legalized in the state (Fenich, 1996). Additional casinos offering EGMs and/or table games opened in several states in the northeast region throughout the 1990s and continue to this day. A diverse gambling landscape now exists in the region. Large, resort-style casinos currently exist in Rhode Island, Connecticut, and New York State accompanying several smaller venues within these states, while New Hampshire provides gambling opportunities at several smaller venues that offer table games. Until 2014, Vermont and Massachusetts remained the only regional states without legalized casino gambling. However, in November 2011, then Massachusetts Governor, Deval Patrick, signed the Expanded Gaming Act paving the way for the introduction of gambling venues in the state. Plainridge Park Casino became the first casino in the state in June 2015. MGM Springfield opened in August 2018, and Encore Boston Harbor opened nearly 2 years later in June 2019 (although Massachusetts had legal horse/dog racing, charitable gambling, and lottery for several decades prior).

As part of the introduction of venues offering EGMs and/or table games in the Commonwealth, the Massachusetts Gaming Commission (MGC) was tasked with developing a research agenda to investigate the social and economic impacts of introducing venues offering EGMs and/or table games to Massachusetts. To this end, the MGC funded the Massachusetts Gambling Impact Cohort (MAGIC) study to assess the incidence of people with a gambling problem in Massachusetts and ultimately develop an etiological model of problem gambling. This cohort was assessed on roughly an annual basis from 2013 to 2019.

The MAGIC study was able to follow a cohort of Massachusetts residents, identified as being at high risk for developing gambling-related problems, as venues offering EGMs

and/or tables games were introduced to the state. Obtaining survey data from cohort participants over five waves provides a unique opportunity to investigate gambling participation and problem gambling status over time. Therefore, the focus of this current circumscribed study is to investigate the relationship between EGM and/or table game venue proximity and an increased risk of gambling problems among MAGIC participants through the introduction of venues offering EGM and/or table games to the jurisdiction. In addition, we investigate the distance to a participant's closest venue offering table games and/or EGMs and the associated risk, based on that distance, of having a gambling problem.

Methods

Respondents

Respondent data for this analysis was taken from the MAGIC study, a cohort study established by means of a statewide baseline general population survey (BGPS) of health and recreation conducted in Massachusetts in 2013/2014 as part of the Social and Economic Impacts of Gambling in Massachusetts study *[authors]*. Problem gambling status was assessed with the Problem and Pathological Gambling Measure (PPGM) (Williams & Volberg, 2010, 2014). The BGPS respondents were categorized into high-risk strata (people experiencing a gambling problem, at-risk gamblers, gamblers who spent $1200 or more on gambling annually [based on the 85th percentile of gambling expenditure for all BGPS respondents], participants who gambled weekly, and participants who had served in the military since September 11, 2001 (Etuk et al., 2020; Freeman et al., 2020)) and a low-risk stratum (all other respondents). A sample of the BGPS respondents, including all of the high-risk respondents and one-third of the low-risk respondents, created an initial eligible sample of 4860 participants. An overture was made to these individuals to participate in a multiyear cohort study, with 3139 of these individuals responding and completing the initial 2015 follow-up survey (i.e., MAGIC Wave 2) and were continuously followed for an additional three waves of the cohort study. The sampling strategy to establish the cohort, inclusion criteria for Wave 2 participants from Wave 1 respondents, and background on data collection and sampling methods, can be found in the Supplementary Materials (Supplementary Table 1).

Data Collection

Data collection for Waves 2 through 5 of MAGIC was conducted in 2015, 2016, 2018, and 2019 (Fig. 1). The vast majority of Wave 2 data collection occurred prior to the opening of any venue offering EGMs and/or table games in Massachusetts with 95.2% of the questionnaires ($n = 2972$) completed or returned prior to the opening of Plainridge Park Casino in Plainville on June 22, 2015. Waves 3 through 5 were collected after the opening of the slots parlor. Wave 4 data collection overlapped with the opening of MGM Springfield although 99.7% of surveys were collected prior to the opening. As Encore Boston Harbor opened during the Wave 5 data collection period on June 23, 2019 (with 96.3% of Wave 5 surveys completed prior to the opening), this venue is not included in the present analysis. The institutional review board (IRB) at the *[authors]* Human Research Protection Office approved this study; all cohort participants gave informed consent.

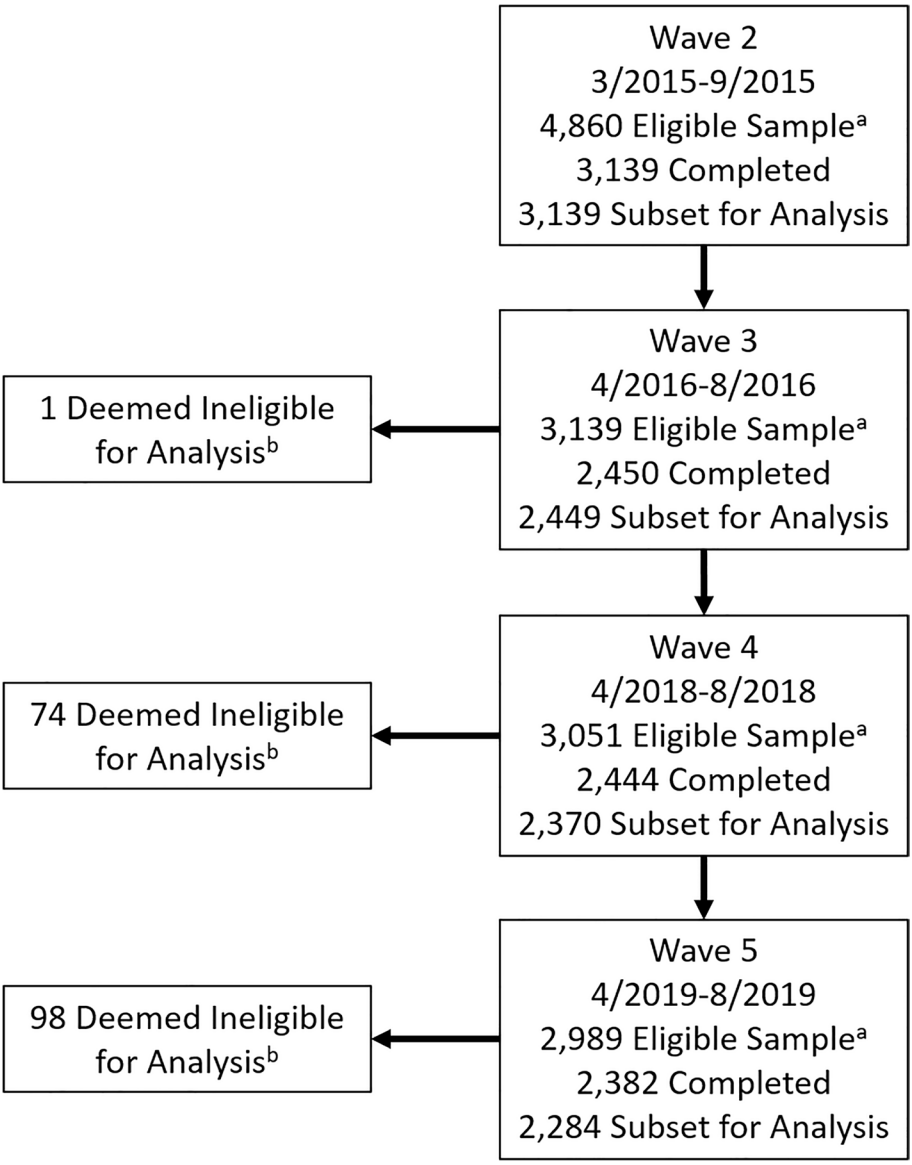

Fig. 1 CONSORT diagram illustrating the subset of samples from each wave of the MAGIC study used in the current analysis. [a] Members of the defined cohort (i.e., people who completed MAGIC Wave 2) excluding individuals who were unable to participate due to death or permanent medical incapacitation; [b] respondents who no longer live in Massachusetts

The MAGIC survey questionnaire included questions regarding recreation, physical and mental health, alcohol/drug use, and demographics, as well as gambling-related questions such as gambling behavior, gambling attitudes, gambling motivations, and awareness of problem gambling services *[authors]*. The survey was administered by NORC at the University of Chicago through a multi-mode data collection approach

(computer-assisted web interviewing—> self-administered paper-and-pencil questionnaire—> computer-assisted telephone administration in Waves 1 and 2; computer-assisted-web interviewing—> self-administered paper-and-pencil questionnaire—> computer-assisted telephone prompting in Waves 3, 4, and 5).

Gambling Status

Utilizing survey responses, PPGM criteria were used to classify participants into four groups: non-gambler, recreational gambler, at-risk gambler, and problem/pathological gambler. The PPGM has high internal consistency based on a Cronbach's alpha of 0.76–0.81 & 1 month test–retest reliability ($r = 0.78$) (Williams and Volberg, 2010, 2014). It also has excellent construct validity (Christensen et al., 2019), increased sensitivity, positive predictive power, diagnostic efficiency, and overall classification accuracy in an evaluation of individuals with a gambling problem when compared to other problem gambling measurement instruments (Williams & Volberg, 2010, 2014).

Non-gamblers were defined as participants who had not engaged in any form of gambling in the past year, excluding high-risk stocks. Recreational gamblers were participants who had engaged in one or more types of gambling in the past year but did not endorse symptoms of problem gambling and with gambling frequency and gambling losses less than the median reported for problem/pathological gamblers. At-risk gamblers engaged in one or more types of gambling at least once a month within the past year and endorsed one or more symptoms of problem gambling. An individual could also be categorized as an at-risk gambler if their gambling losses or frequency of gambling was equal to or greater than the median reported for problem/pathological gamblers. Problem/pathological gamblers were individuals who gambled at least once a month and reported indications of impaired control over their gambling as well as serious adverse consequences deriving from this impaired control. Alternatively, people could be designated as experiencing a gambling problem if they endorsed three or more indicators of problem gambling and had a gambling frequency and expenditure equal to or greater than the median reported for this category. Pathological gamblers were individuals who endorsed both impaired control and serious adverse consequences plus had a total PPGM score of five or higher. (For the present analysis, those identified as pathological gamblers were included with people experiencing gambling problems due to the small sample sizes in these groups and the lack of statistically significant differences between the two groups).

Gambling Venues

The location of gambling venues in the greater New England area (Maine, New Hampshire, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania; Vermont did not have licensed gambling venues at the time of this analysis) within 200 driving miles of the Massachusetts border were obtained according to the date the venue was established. Information about the venue size, the number of table games, the number of EGMs, and distance was acquired and verified (see Supplementary Table 2). The venue list used for the analysis was modified as venues opened (including those in Massachusetts) or closed according to the data collection period for each wave of the cohort study.

Analysis

SAS statistical software (https://www.sas.com/) was used to calculate the distance to the closest venue offering EGMs and/or table games and to conduct the statistical analyses (one-way ANOVAs and logistic regressions). Using the list of venues offering EGMs and/or table games, distance to the closest venue was calculated for each MAGIC survey respondent using the distance between the zip code of the respondent's residence and the zip code of the closest venue offering EGMs and/or table games as calculated by Google Maps in driving minutes. In addition, measures were created to reflect the number of table games, number of EGMs, and number of venues within an hour's drive of each respondent's zip code (based on a 60-mph driving speed) which would allow most survey participants access to an out-of-state gambling venue. The cutoff to categorize high or low number of table games and/or EGMs was 100 and 4500, respectively, as determined by the equal proportion of cohort participants who lived within a 1-h drive to above or below this number of table games and/or EGMs. For the ANOVAs, the *p*-values of the F statistic were used to determine if a difference in distance to the closest venue offering EGMs and/or table games by type of gambler existed. For the multivariate logistic regressions, the strength of the relationship between category of gambler and number of table games and/or EGMs was determined through the Wald chi-square statistic resulting from a Type 3 Analysis of Effects and associated *p*-value for each of the waves. When the *p*-value was less than 0.05, odds ratio estimates resulting from the logistic regressions (with 95% Wald confidence limits) were utilized to determine if significant differences existed. Map creation was completed using R statistical software (https://www.r-project.org/) with the ggmap package (Kahle & Wickham, n.d.).

Results

Samples for Waves 2 through 5 of the MAGIC study utilized in this analysis are detailed in Fig. 1. The size of the eligible sample declined with each wave as participants were identified as deceased. The subset for analysis differs from the number of completed surveys as those respondents who no longer lived in Massachusetts were excluded from the analysis. The unweighted prevalence rates of problem/pathological gambling within the cohort for Waves 2 through 5 were 2.6% (95% CI: 2.0, 3.3), 3.1% (95% CI: 2.5, 3.9), 3.1% (95% CI: 2.4, 3.9), and 3.8% (95% CI: 3.1, 4.7), respectively. A demographic summary of the characteristics of the initial cohort (Wave 2) can be found in Supplementary Materials (Supplementary Table 3). Data from the study is available to interested parties upon submission of an application through the Massachusetts Open Data Exchange (MODE) program (https://massgaming.com/about/research-agenda/#access).

The 22 venues offering EGMs and/or table games that were open during the first survey period in 2015 were located in the greater New England area ranging from 1.7 to 195 miles from the Massachusetts border (see Supplementary Table 2). The states with the most venues were New York and New Hampshire with six each. Maine, Rhode Island, and Connecticut each had two and Pennsylvania offered four venues offering EGMs and/or table games. Plainridge Park Casino and an additional venue in New York opened during the summer of 2015 and were included in the Wave 3 analysis. Before Wave 4 data collection began in 2018, New York added an additional four venues and

New Hampshire added an additional three venues. Prior to Wave 5, MGM Springfield and two additional venues in New York opened. The final number of venues within 200 miles of the Massachusetts border for use in this analysis was 34. The number of table games ranged from none at venues in Rhode Island and New York to 475 at a resort casino in New York City, while EGMs ranged from none at venues in New Hampshire, where EGMs are not licensed, to 5532 at Mohegan Sun in Connecticut. The maps in Figs. 2 and 3 display the number and location of venues offering table games and EGMs, respectively, in the greater New England area during this time.

The distribution of driving distance (in minutes) to the closest venue offering EGMs and/or table games by type of gambler demonstrates a slight variation in the median values and quartiles of the distances to the closest venue by type of gambler as seen in Fig. 4. However, a statistically significant difference was not observed for any of the four waves of the MAGIC study as determined by one-way ANOVA F statistics and p-values < 0.05.

The results of the logistic regressions between type of gambler and number of table games within a 1-h drive or number of EGMs within a 1-h drive are provided below (Table 1). Nearly all correlations, for each wave for both table games and EGMs, show no difference among gambler type for any amount of table games and/or EGMs within a 1-h drive. However, the p-value for Wave 5 table games is less than 0.05, and, therefore, the odds ratio from the logistic regression was evaluated to determine whether the

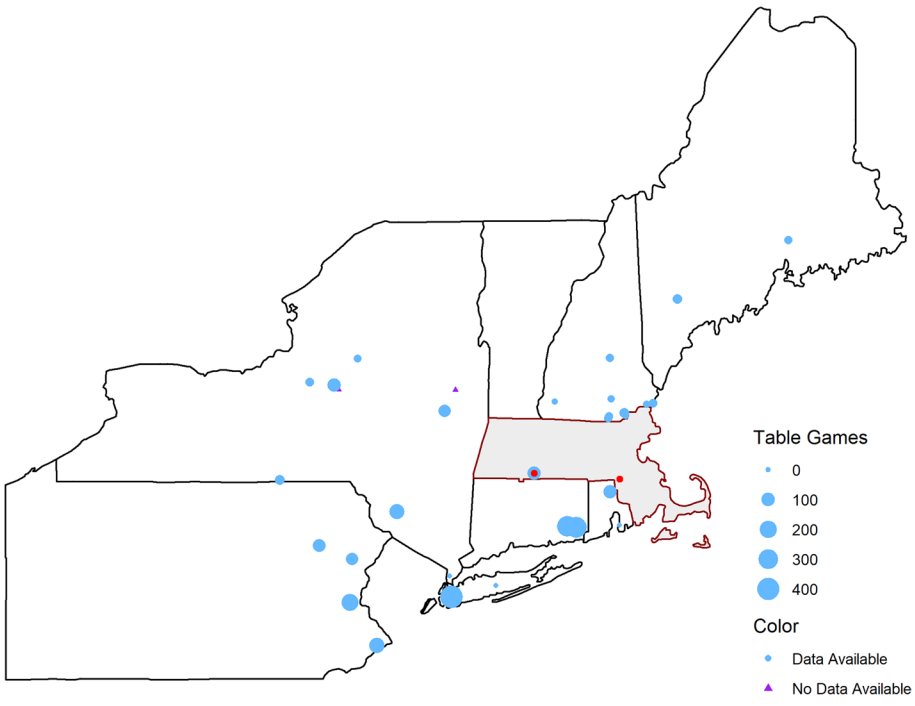

Fig. 2 Locations of venues with table games in the greater New England area within 200 miles of the Massachusetts border through 2018 (outlined in red and shaded gray). The size of the blue circle is proportional to the number of table games for that specific venue (purple triangles indicate no data available). Red dots indicate Massachusetts venues in Plainville and Springfield

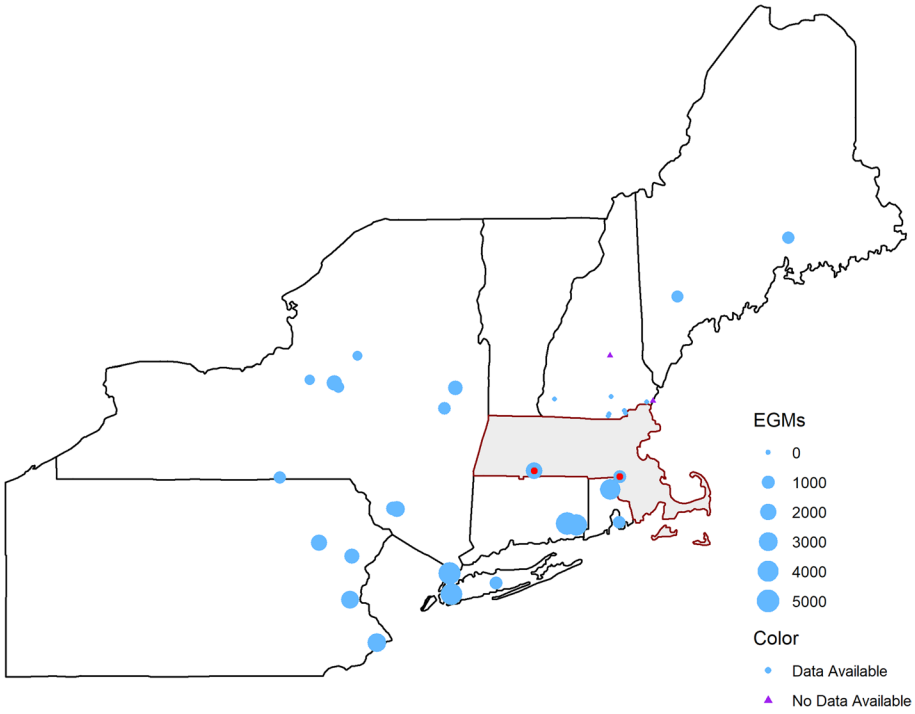

Fig. 3 Locations of venues with EGMs in the greater New England area within 200 miles of the Massachusetts border through 2018 (outlined in red and shaded gray). The size of the blue circle is proportional to the number of EGMs for that specific venue (purple triangles indicate no data available). Red dots indicate Massachusetts venues in Plainville and Springfield

relationship was significant. While the odds ratio estimate for Wave 5 table games was 1.254 (95% CI: 0.697–2.254), it is not statistically significant suggesting no difference between gambler types related to the amount of table games within a 1-h drive (Fig. 5).

Discussion

We sought to determine the relationship between individuals experiencing gambling problems and the availability of venues offering EGMs and/or table games for Massachusetts residents within multiple waves of a cohort study. First, the current study investigated whether a relationship existed between gambler status (as defined by PPGM) and the estimated driving distance for MAGIC participants to their closest venue containing EGMs and/or table games. No relationship was found for any wave of the cohort study. Second, logistic regressions were carried out to determine the strength of the relationship between at-risk or problem gambling to the number of table games and/or EGMs within a 1-h drive. Again, no significant differences were found with the density of EGMs and/or table games. The present results indicate that proximity to EGMs and/or table games does not necessarily pose an increased risk of problem or at-risk gambling in Massachusetts.

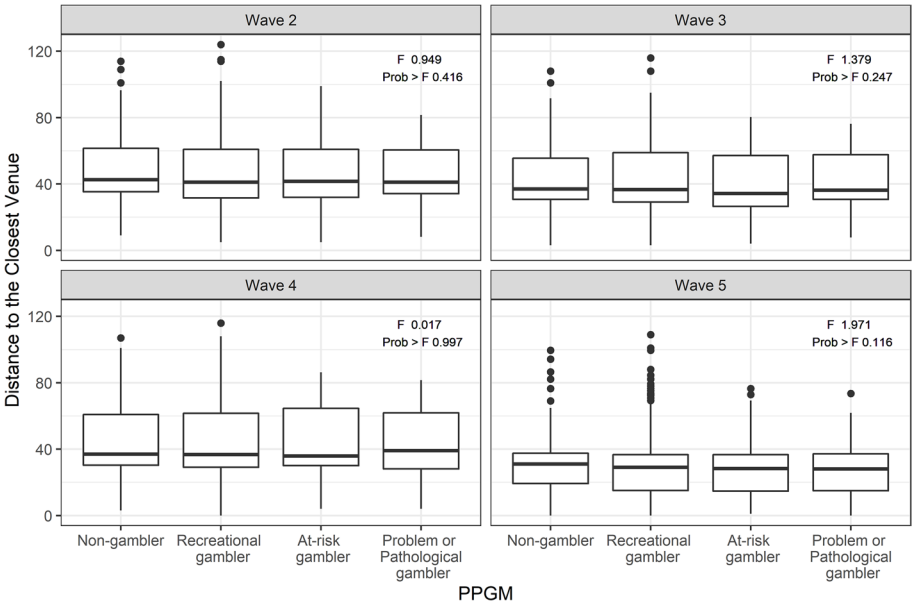

Fig. 4 Box plots representing the ranges and median values of the distance to the closest venue offering EGMs and/or table games (in minutes) by type of gambler for each wave of the cohort with statistical test results from one-way ANOVAs

Table 1 Logistic regressions by wave for at-risk gambler/problem gambler[a] by gambling venue activity within a 1-h drive

	Activity	Wald chi-square	*p*-value
Wave 2	Table games	1.6881	0.430
	EGMs	3.6202	0.164
Wave 3	Table games	0.9567	0.620
	EGMs	2.7108	0.258
Wave 4	Table games	4.1244	0.127
	EGMs	1.1965	0.550
Wave 5	Table games	7.2896	0.026
	EGMs	0.7057	0.703

[a]This analysis uses non-gambler/recreational gambler as the reference

Historically, gambling research suggested that the expansion of gambling opportunities in a given population would inevitably result in an increase in gambling-related harms in that population, specifically in problem gambling prevalence (Abbott et al., 2004). However, as the volume of research into gambling availability and individual- or population-level harm expands, so does the complexity in the interpretation of the outcomes (LaPlante et al., 2018). In a review of the relationship between the availability of gambling opportunities and subsequent gambling problems, Abbott (2006) was unable to show a linear relationship between gambling availability and problem gambling prevalence due to substantial variability in the methodology across gambling studies, especially in the methodology used to measure exposure and the duration of gambling

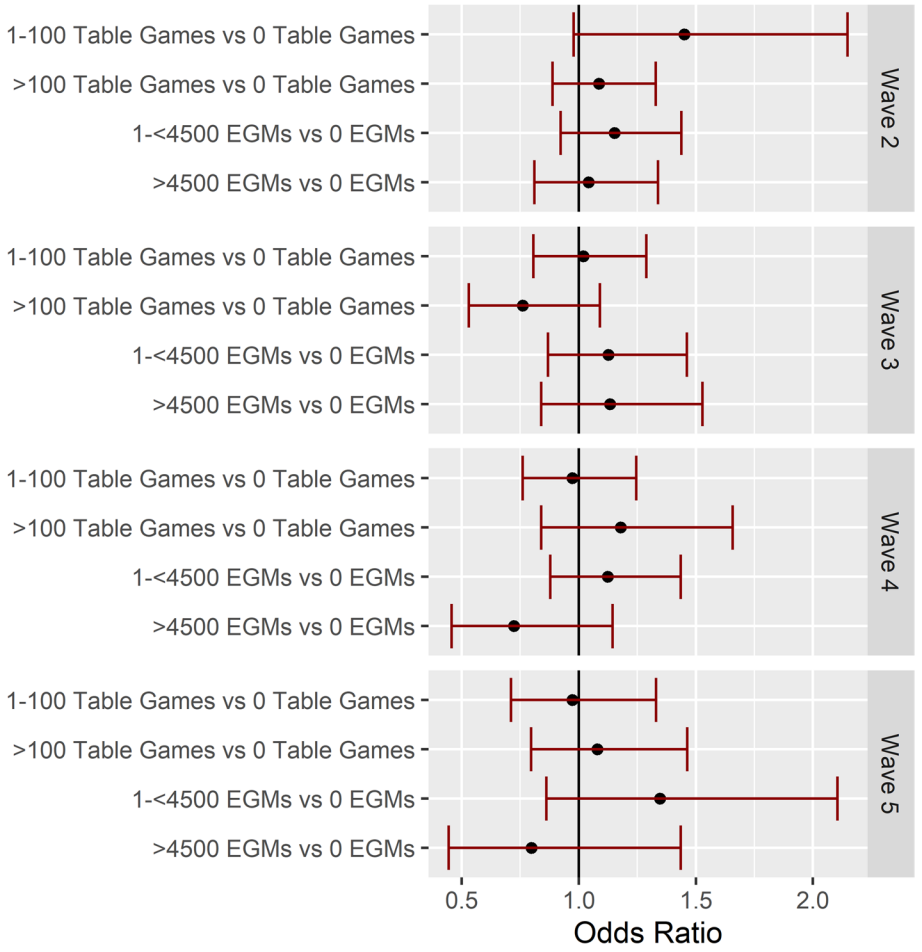

Fig. 5 Odds ratio estimates and associated confidence intervals for at-risk gambler/people experiencing a gambling problem for each wave of the cohort

problems. Subsequent research found that the existence of an initial increase in problem gambling prevalence which occurred with the introduction of a new gambling opportunity to a gambling-naïve population resulted in gambling-related harms waning over time (LaPlante & Shaffer, 2007; Storer et al., 2009; Volberg & Williams, 2014).

Our findings suggest that the MAGIC study participants are far from naïve when it comes to opportunities to gamble at venues offering EGMs and/or table games, and the MAGIC study found no increase in the rate of individuals experiencing gambling problems. Although Massachusetts introduced casino gambling in 2015, bordering states had been offering casino gambling for decades prior. Indeed, even with the introduction of casinos to the state, MAGIC participants continued to visit out-of-state venues for the duration of the study (Supplementary Table 4). This suggests the potential effects from the initial exposure to casinos decades ago subsided over time, and, therefore, the adapted population would not experience a significant impact from a local expansion of casinos. Population adaptation may explain the lack of an increase in gambling problems found in the MAGIC

study. Gambling problems in Massachusetts residents were not measured in the decades prior to the expansion of casino gambling in the state leaving speculation as to the rationale for this finding.

Although the results of the MAGIC cohort study found little indication that exposure of the Massachusetts population to in-state gambling venues increased their risk of developing gambling problems, other contributing factors may have led to this perceived adaptation. Concurrent with the introduction of casino gambling to the state, Massachusetts adopted policies around problem gambling advocacy and responsible gambling programming. Public awareness campaigns, disseminated throughout the state and strengthened by public health messaging regarding the pervasiveness of gambling harms, may have dissuaded some recreational or at-risk gamblers from becoming more heavily involved. Treatment programs for individuals experiencing gambling harms were also expanded throughout the state providing an opportunity for recovery and relapse prevention. The Massachusetts Gaming Commission, charged with regulating gambling in the state, in cooperation with the venue operators, introduced a voluntary self-exclusion program as well as other responsible gambling measures, such as the GameSense program, to encourage individuals to gamble more safely and to assist them in preventing or reducing gambling harms. In addition to the adaptation to increases in gambling opportunities observed in the population, such programs and policies adopted by the state during the introduction of casino gambling may have contributed to the stability of gambling problems found in the five waves of the MAGIC study.

Limitations

As with all cohort studies, inherent limitations exist such as sampling biases and self-reporting. In addition, it should be noted that the results of cohort studies are not representative of the general population but of the cohort respondents. Although the PPGM has a high level of reliability and validity in population research (Williams & Volberg, 2010, 2014), it is used less frequently than other instruments, thus limiting comparability to other analogous studies.

The current study was unable to investigate whether the density of table games and/or EGMs was higher in socioeconomically disadvantaged areas of Massachusetts given that only three venues offering EGMs and/or table games exist state-wide. Finally, Google Maps zip code distance and time calculations may vary depending upon the time of day the calculation was made as well as the specific location of the participant as only the zip code, not street address, was utilized for this analysis. While a driving distance of 1 h was used for the analysis, a driving distance of more or less than 1 h may impact the results.

Conclusion

Proximity to gambling opportunities leading to increased gambling harms in an exposed population has been heavily debated over many years and has significant policy implications for jurisdictions planning to introduce casino gambling. The results of this study contribute to existing research on this topic. In Massachusetts, the investigation into the relationship between gambler status and distance to venues offering EGMs and/or table games found no significant correlation between type of gambler, as determined by the

PPGM, and number of or distance to either table games and/or EGMs for any waves of the MAGIC study suggesting that the population has adapted to the local increase in gambling availability.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11469-022-00861-7.

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Author Contribution VE is the lead author of the manuscript. MZ was responsible for data management, data cleaning, and data analysis. RV and RW were primary investigators on the MAGIC study, proposed the manuscript topic, and assisted in drafting and editing the manuscript. All authors approved the final submission.

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Data Availability Data from the MAGIC study is available by request through the Massachusetts Gaming Commission's data repository, MODE (https://massgaming.com/about/research-agenda/#access).

Code Availability Not applicable.

Declarations

Ethics Approval The survey protocol was reviewed and approved by NORC at the University of Chicago's Institutional Review Board and by the University of Massachusetts Amherst Institutional Review Board (reference number: 2015–2368).

Consent to Participate Participants provided consent by voluntarily participating in the survey after agreeing to the confidentiality statement. Language included in the questionnaire stated: "The University of Massachusetts is conducting a longitudinal study about gambling in Massachusetts. This survey is private and confidential. We have a Federal Certificate of Confidentiality that is designed to protect the confidentiality of your research data from a court order or subpoena. We can provide you with more information if you would like. You don't have to answer any question you don't want to, and you can stop at any time. Almost everyone will be able to finish the survey within 15 to 20 min."

Consent for Publication Not applicable.

Conflict of Interest VE and MZ declare no conflict of interest. RV and RW have no financial or non-financial conflicts of interest to declare during the past 3 years with the exception of a small grant/contract to RW from Unibet Ltd.

Informed Consent "All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all [individuals] being included in the study." Participants provided consent by voluntarily participating in the survey after agreeing to the confidentiality statement. Language included in the questionnaire stated: "The University of Massachusetts is conducting a longitudinal study about gambling in Massachusetts. This survey is private and confidential. We have a Federal Certificate of Confidentiality that is designed to protect the confidentiality of your research data from a court order or subpoena. We can provide you with more information if you would like. You don't have to answer any question you don't want to, and you can stop at any time. Almost everyone will be able to finish the survey within 15 to 20 minutes."

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