



# Are There Riskier Types of Gambling?

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## Abstract

Gambling-related harm is a public health issue requiring market regulation and efforts aimed at prevention and treatment. An important consideration for the regulation of gambling is whether certain types of gambling are intrinsically more harmful than others. The present study was a comprehensive investigation of this issue in a nationwide sample of 10,199 Canadian adult gamblers that included 1346 individuals with problem gambling. We investigated (a) the univariate cross-sectional association between individual types of gambling and problem gambling; (b) the cross-sectional association between individual gambling types and problem gambling when controlling for breadth of gambling involvement; (c) the prospective/lagged relationship between participation in different gambling types and future problem gambling; and (d) the self-reports of people with gambling problems concerning the types and modalities they consider to be most problematic. Our collective results indicate that breadth of gambling involvement is a stronger predictor of gambling problems than involvement in any particular type, but that involvement in certain types (electronic gambling machines in particular, and casino table games and online gambling to a lesser extent) does confer additional risk.

**Keywords** Problem gambling · Gambling formats · Gambling involvement · Gambling participation

## Introduction

Gambling-related harm is widely recognized as a public health issue and as such, requires market regulation and initiatives for prevention and treatment (Gainsbury et al., 2014; Korn & Shaffer, 1999; Volberg, 1994). Though only a small minority of Canadians meet criteria for problem gambling (Williams et al., 2021a, 2021b) a large amount of gambling-related

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harm occurs in people who are below the clinical threshold (Browne et al., 2020). An important consideration for mitigating gambling-related harm is whether certain types and modalities of gambling have a greater contribution to the risk of gambling harm than others.

### **Strong Univariate Associations Between Certain Gambling Types/Modalities and Problem Gambling Status**

Population surveys provide consistent evidence that gambling-related harm is higher among individuals participating in certain types of gambling compared to other types (Allami et al., 2021; Binde, 2011; Williams et al., 2012, 2022, Appendix G). More specifically, electronic gambling machines (EGMs) and casino table games consistently have had the strongest associations with problem gambling (PG), while types such as lotteries, tend to have weak associations. The basis of this association is thought to be because EGMs and casino table games are ‘continuous’ types of gambling that can be repeatedly engaged in and provide a high frequency of reinforcement (Haw, 2008; Leino et al., 2015; Linnert et al., 2010; Parke & Griffiths, 2007). The use of multi-line EGMs further increases the rate of reinforcement (Harrigan et al., 2011; Templeton et al., 2015) as do ‘losses disguised as wins’ where the amount ‘won’ is less than the amount wagered, but nonetheless trigger winning sounds (Dixon et al., 2010, 2014).

Population surveys have also provided strong evidence that gambling-related harm is higher among individuals accessing gambling via an online modality (Allami et al., 2021; Binde, 2011; Welte et al., 2009; Wood et al., 2012). The basis for this association is thought to be because of its 24-h accessibility, the ability to play while intoxicated, enhanced anonymity, and the online provision of continuous types of gambling (Griffiths, 2003; Wood & Williams, 2009; Wood et al., 2012).

### **Confound with Breadth of Gambling Involvement**

An important confound with the above results is that people who engage in EGMs, casino table games, and access gambling online do not restrict their involvement to these specific types or modalities. Indeed, most gamblers participate in more than one type of gambling, with people having gambling problems being especially likely to participate in a wider variety of types and modalities relative to people without gambling problems (Holtgraves, 2009; Phillips et al., 2013; Wardle et al., 2011; Williams et al., 2021a, 2021b). The number of different gambling types an individual participates in is referred to as their breadth of gambling involvement.

LaPlante et al. (2013) found that after controlling for both frequency and breadth of involvement there were no specific types of gambling with a significant association to problem gambling among Las Vegas casino patrons. Similarly, an analysis by Philander and MacKay (2014) found after controlling for breadth of involvement that online gambling was associated with a *lower* risk of problem gambling in British adults as well as Ontario online panelists. However, most other studies have found that while breadth and/or frequency of involvement has a stronger association with problem gambling, certain types do confer some additional risk. For example, a study of Swedish adults found EGMs to pose additional risk when controlling for breadth of involvement (Binde et al., 2017). Similarly, casino gambling was found to confer additional risk both in a study of Massachusetts adults (Mazar et al., 2020) as well as in a study on U.S. young adults (14–21) (Welte et al.,

2009). LaPlante et al. (2011) found that online EGMs posed additional risk among British adults. Afifi et al. (2013) also found EGMs and casino gambling to pose additional risk in Canadians aged 15+ in 2002, along with instant win lottery tickets, bingo, card and/or board games, horse racing, sports lotteries, and games of skill. Finally, LaPlante et al. (2014) found that live action sports betting posed additional risk among European patrons of the bwin.com online gambling website.

## Longitudinal Research

The above research has established that the association between gambling-related harm and certain types and modalities of gambling is due to people with gambling-related problems having a greater breadth of involvement, but that involvement in certain types of gambling does pose additional risk. However, a limitation of the above results is that they are cross-sectional in nature. While it may be the case that engagement in certain types or modalities is associated with some additional *concurrent* risk, it does not a) identify the directional nature of this relationship (i.e., it is possible these additional types/modalities are sought out after gambling problems have developed); and it b) does not speak to whether engagement in certain types/modalities are more or less likely to subsequently lead to future gambling problems. Longitudinal research that examines the relationship between current participation in different types/modalities and *future* problem gambling can shed light on this issue.

The large majority of longitudinal studies have only looked at the concurrent relationship between types of gambling and problem gambling over time. However, three studies have also conducted a lagged/prospective analysis. In the Quinte Longitudinal study in Ontario (QLS; Williams et al., 2015) multivariate prediction of next year PG status was associated with previous year participation in EGMs, online gambling, and instant lottery tickets (in addition to level and breadth of gambling involvement). In the Leisure, Lifestyle, and Lifecycle Project in Alberta (LLLP; el-Guebaly et al., 2015), multivariate prediction of next year PG was associated with previous year participation in EGMs, casino table games, bingo, and sports betting (in addition to breadth of gambling involvement). In the Massachusetts Gambling Cohort Study (MAGIC; MAGIC Research Team, 2021), multivariate prediction of next year PG was associated with previous year online gambling, daily lottery games, out-of-state casino participation, traditional lottery games, and instant lottery participation (note that within-state EGMs and casino table games had very limited availability during the course of this Massachusetts study).

## Self-Report

A final consideration is whether people with gambling problems self-report there to be particularly problematic types or modalities of gambling. Across different jurisdictions and periods of time, EGMs are the type of gambling that treatment seekers and helpline callers most often indicate as being problematic (Hodgins & el-Guebaly, 2000; Ledgerwood et al., 2005; Potenza et al., 2005; Stea et al., 2015). While these results are informative, they are somewhat limited by the fact that individuals seeking help are a non-representative minority of people with gambling problems.

Another source of data are self-reports of individuals with problem gambling collected in the context of population surveys. In six population surveys in Ontario (2), Alberta, Massachusetts, Canada, and internationally (primarily U.S.) all individuals identified

as having problem gambling were asked whether they were particular types of gambling that have contributed to their problems more than others, and if so, to identify the specific one(s) (MAGIC Research Team, 2021; Williams & Volberg, 2013; Williams et al., 2011, 2015; Wood & Williams, 2009). The percentage reporting there to be a particular problematic type averaged 45% across studies [ranging from 29.8% (Ontario) to 58.3% (Canada)]. When specifying which one(s) those were, EGMs were identified as the most problematic type in all of these studies, with instant lottery tickets being identified as problematic in two of these studies.

## The Present Study

Converging lines of evidence indicate that certain types of gambling do confer additional risk of harm relative to other types. However, these findings may be somewhat jurisdictionally and time-period specific. Thus, the purpose of the present paper is to re-examine this issue in the national study of gambling and problem gambling that was recently conducted in Canada. More specifically, the present investigation will examine individual types and modalities of gambling with respect to their:

- a. univariate cross-sectional association with problem gambling
- b. cross-sectional association with problem gambling after controlling for breadth of gambling involvement
- c. prospective/lagged relationship with future problem gambling
- d. identification as problematic types/modalities in the self-reports of people with gambling problems

## Methods

### Sampling and Recruitment

The present investigation is a secondary analysis of data from the online panel survey that was part of the Alberta Gambling Research Institute's (AGRI) National Project (ANP). The Baseline Online Panel Survey was administered to 10,199 Canadians by Leger Opinion (LEO) between August 16 and October 10, 2018. LEO is Canada's largest online panel, consisting of over 400,000 active members who receive financial compensation for completing online surveys. The email solicitation to panelists was nonspecific and simply indicated that it was "a very important academic study." However, eligibility to complete the survey was restricted to people who completed an initial screening question indicating they had gambled on one or more types of gambling once a month or more in the past year. Repeated email solicitations were sent out until an achieved sample of at least 10,000 with an equal number from each province or region was achieved (i.e., 1400 each from the provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, and 1400 from the four Atlantic provinces combined).

Between Aug 20 and Nov 30, 2019, people who had completed the Baseline Survey were re-contacted and asked to take the Follow-Up Survey. A total of 4707 complied,

representing 82.5% of those who had agreed to be re-contacted, and 46.2% of all Baseline participants.

## Questionnaire

The survey was available in both English and French and took an average of 19.5 min to complete. The primary focus of the survey was on gambling (i.e., attitudes, past year participation, motivation, fallacies, social exposure, responsible gambling, family history, problem gambling), but comprehensive information was also collected on demographics, mental health, substance use, and personality. Pertinent to the present investigation were the following instruments and questions:

## The Gambling Participation Instrument

The Gambling Participation Instrument (GPI; Williams et al., 2017) assesses all dimensions of gambling participation in a past year time frame: types of gambling engaged in, gambling provider, means of access, frequency of gambling, time spent gambling, and gambling expenditure. Eight specific types of gambling are assessed: lottery and raffle tickets, instant games, electronic gambling machines (EGM), casino table games, sports betting, bingo, ‘other’ types of gambling, and speculative financial market activity. (Note that ‘other’ types and speculative financial activities are not included in the present analysis). If the person engaged in any type via online access they were identified as an online gambler. The total number of gambling formats a respondent participated in on a monthly basis (i.e., breadth of gambling involvement) was calculated along with three aggregate measures meant to approximate gambling intensity: gambling frequency; total time spent gambling; and total gambling expenditure. Depending on the specific domain, the test–retest coefficients of the GPI are fair to excellent (0.46–0.84), and the validity coefficients are good to excellent (0.60–0.91) (Williams et al., 2017).

## Problem and Pathological Gambling Measure

Problem gambling was assessed with the Problem and Pathological Gambling Measure (PPGM; Williams & Volberg, 2010, 2014), which classifies individuals into four main categories of non-gambler, recreational gambler, at-risk gambler, and problem/pathological gambler using a past 12-month time frame. To be classified as PG, the PPGM usually requires an individual to endorse symptoms indicative of both impaired control and significant negative consequences resulting from this impairment. However, the PPGM attempts to limit false negatives (problem gamblers in denial) by (a) allowing individuals to be classified as PGs if they have any pattern of problem gambling symptomatology combined with a gambling frequency or expenditure equivalent to unambiguously identified problem gamblers; and (b) allowing for others to identify the presence of harms and/or impaired control (i.e., the person is asked whether other people would indicate harm or impaired control had occurred, independent of whether they believed it themselves).

The PPGM has good internal consistency (Cronbach’s  $\alpha=0.76\text{--}0.81$ ) as well as one month test–retest reliability ( $r=0.78$ ) (Williams & Volberg, 2010, 2014). It has superior construct validity (Christensen et al., 2019), as well as better sensitivity, positive predictive

power, diagnostic efficiency, and overall classification accuracy in the population assessment of PG compared to instruments such as the DSM-IV and Problem Gambling Severity Index (Williams & Volberg, 2010, 2014).

### Self-Reported Contribution of Gambling Types/Modalities to Gambling Problems

All participants identified as having problem gambling were asked “Are their particular types of gambling that have contributed to your problems more than others?” If they responded “yes” then they were asked “Which types of gambling have contributed to your problem?” with the instruction to “check all that apply”. They were then asked whether their problems were mostly with land-based gambling, online gambling, or both.

### Analysis

To test the univariate cross-sectional association between types of gambling and PG, we calculated the proportion of individuals participating in each type of gambling on a monthly or more frequent basis who met criteria for problem gambling.

To evaluate the cross-sectional association between monthly or more participation in each gambling type and problem gambling after controlling for breadth of gambling involvement, the prevalence of PG was plotted for each type of gambling across increasing breadth of involvement to determine whether any individual plot line(s) showed consistently higher problem gambling prevalence rates compared to other plot lines.

The prospective/lagged association between engagement in different individual types of gambling and future PG was evaluated using logistic regression. A separate logistic regression analysis was conducted for each individual format using three separate blocks. In the first block, monthly engagement in a specific format was used to predict future PG. In the second block, breadth of monthly gambling involvement was added. In the final block, aggregate measures of gambling intensity (i.e., gambling frequency, time spent gambling, gambling expenditure) were added. Odds ratios (ORs) and adjusted odds ratios (aORs) with 95% confidence intervals (95% CIs) are reported along with Nagelkerke’s  $R^2$  for each block.

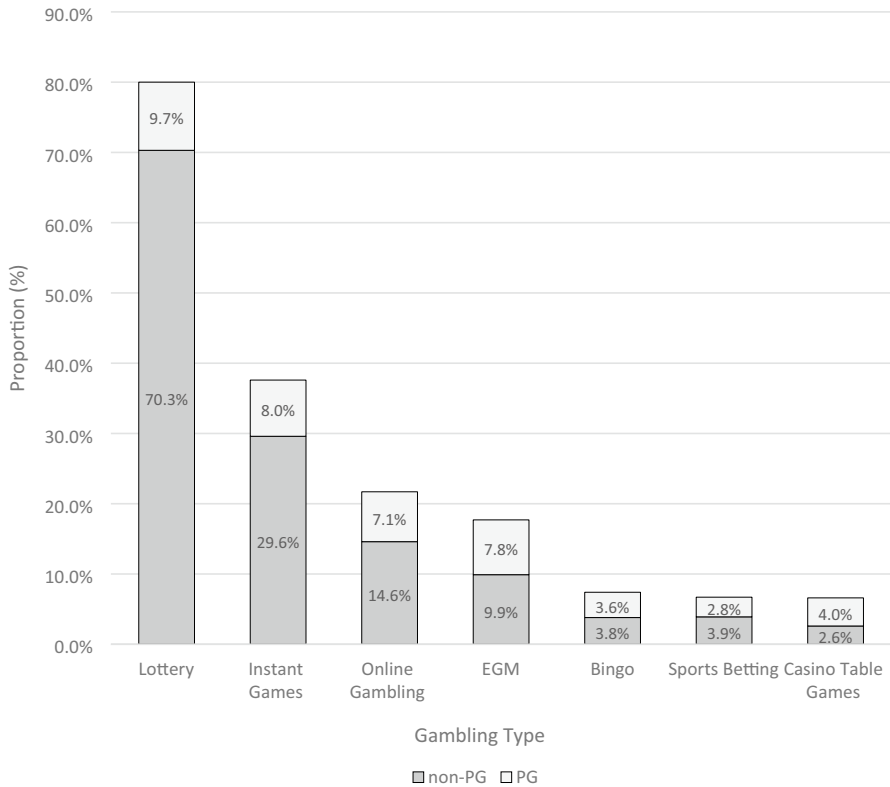
Finally, the proportion of problem gamblers who indicated that a specific type and/or modality of gambling contributed to their gambling problems is reported along with the specific type/modality identified.

All analyses were conducted in SPSS version 27.0 and corresponding figures were produced via the R package *ggplot2* (Wickham, 2016).

### Results

Among the 10,199 participants, 145 (1.4%) were classified as Non-Gamblers,<sup>1</sup> 7320 (71.9%) were Recreational Gamblers, 1388 (13.6%) were At-Risk Gamblers, and 1346 (13.2%) were Problem/Pathological Gamblers.

<sup>1</sup> These were people who reported no involvement for any type of gambling, despite having indicated being a monthly gambler on the initial screening question.



**Fig. 1** Univariate cross-sectional relationships between problem gambling and monthly or more participation in each type of gambling

### Univariate Cross-Sectional Associations Between Individual Types of Gambling and Problem Gambling

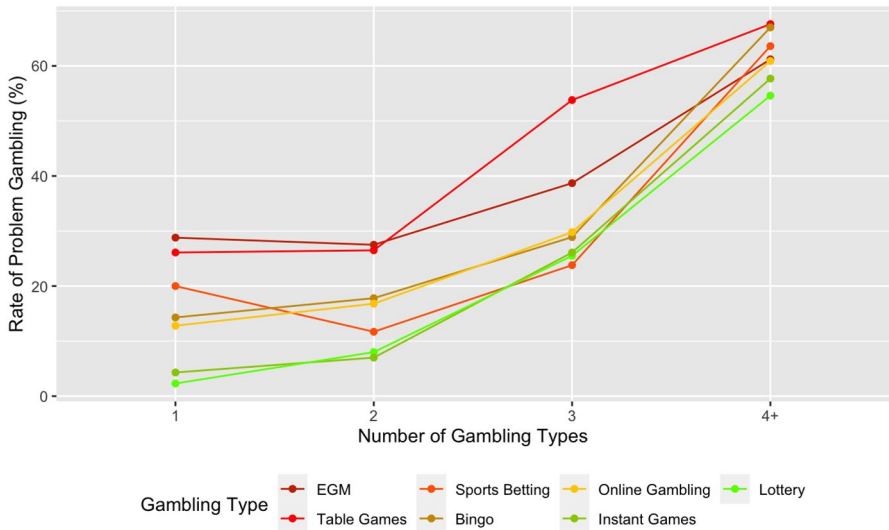
Figure 1 shows the percentage of people who participated in each type of gambling as well as the portion of participants who also met criteria for problem gambling. The percentage of people who participated monthly or more in each type of gambling was 80.0% for lotteries and raffles, 37.6% for instant games, 21.7% for online gambling, 17.7% for EGMs, 7.4% for bingo, 6.7% for sports betting, and 6.6% for casino table games. The proportion of people who participated in each type monthly or more often and met criteria for problem gambling was 12.1% for lotteries, 21.3% for instant lotteries, 32.7% for online gambling, 44.0% for EGMs, 48.6% for bingo, 41.8% for sports betting, and 60.6% for casino table games.

What Fig. 1 also illustrates is that the problem gambling rate for each type of gambling is very strongly associated with the overall participation rate for each type ( $r = -0.88$ ), with the most patronized types having the lowest proportion of individuals with problem gambling and the least patronized types of gambling having the highest proportion. The implication of this finding is that less popular types of gambling will always tend to have higher rates of problem gambling independent of their inherent

**Table 1** Association between breadth of gambling involvement, intensity of gambling involvement, and problem gambling

	# Types	Total frequency	Total time	Expenditure	PPGM category
# Types	1.00	.785*	.400**	.271*	.576*
Total frequency	.785*	1.00	.446**	.312*	.585*
Total time	.400*	.446*	1.00	.286*	.405*
Expenditure	.271*	.312*	.286*	1.00	.348*
PPGM category	.576*	.585*	.405*	.348*	1.00

\* $p < .001$



**Fig. 2** Proportion of problem gamblers relative to participation in each gambling type and breadth of gambling involvement

risk profile simply because individuals with problem gambling have a greater breadth of involvement.

**The Relationship Between Gambling Types and Problem Gambling Adjusting for Breadth of Involvement**

The mean number of gambling types engaged in for all participants was 1.8 compared to 3.2 for people meeting criteria for problem gambling. The association between breadth involvement and PPGM category was statistically significant ( $r=0.576$ ;  $p < 0.01$ ). The strong association between breadth of involvement and problem gambling likely has to do with (a) problem gamblers being intrinsically more interested in a wider variety of gambling types, and (b) a greater breadth of gambling involvement normally entailing greater overall frequency, time and expenditure, which increases the risk of gambling-related harm. As an illustration of this latter point, Table 1 shows a robust association between



breadth of involvement and all aggregate measures of gambling intensity ( $r=0.271$  for expenditure;  $r=0.400$  for time;  $r=0.785$  for frequency).

Figure 2 shows the problem gambling rate for each type of gambling as a function of breadth of gambling involvement. Each line represents a different type of gambling, and changes along the x-axis indicate an increasing breadth of involvement. For example, the first point on the EGM line represents the proportion of individuals with PG who gambled exclusively on EGMs, the second point on the line represents the proportion of individuals with PG who participated in EGMs and one other type of gambling, and so on. As a result, the lines are not independent beyond the first level, and the same participant may be represented at different points (e.g., someone who participated in EGMs + bingo is represented both in the EGM line at 2 types of involvement and the bingo line at 2 types of involvement). What Fig. 2 illustrates is that both breadth of gambling involvement and specific type of gambling involvement are related to problem gambling. As seen, problem gambling rates steadily go up as breadth of gambling involvement increases, with the majority of people who participate in four or more types of gambling being problem gamblers. However, it is also evident that certain types of gambling have consistently higher rates of problem gambling at almost all levels of involvement. More specifically, EGMs and casino table games have the highest proportion of individuals with problem gambling when participating in either one, two, or three types of gambling.

Among individuals who participated in only one type of gambling, a chi-square test revealed significant differences in the proportion of individuals with PG engaged in each type ( $\chi^2 = 386.06, p < .0001$ ). Follow-up comparisons indicated that: (1) a greater proportion of individuals participating in EGMs, casino table games, sports betting, and online gambling met criteria for PG relative to those participating in lottery/raffle tickets and instant games; (2) a greater proportion of EGM gamblers met criteria for PG relative to online gamblers; and (3) a greater proportion of individuals participating in bingo met PG criteria relative to individuals participating in lottery or raffle tickets.

### Lagged/Prospective Relationship Between Engagement in Different Gambling Types at Baseline and Future Problem Gambling

The odds ratios for future PG associated with participation in each individual format are displayed in Table 2. As shown, the greatest odds were observed for EGMs (OR = 1.92), casino table games (OR = 1.80), and instant games (OR = 1.60). Non-overlapping confidence intervals indicate that regular participation in any of these three formats was associated with significantly greater odds of future PG than any other format and that EGM participation was associated with significantly higher odds of future PG than instant game participation. In contrast, the odds ratio for lottery participation was less than one (OR = 0.65), likely due to the high rate of lottery participation among respondents not experiencing problem gambling (70.3% of the sample).

After adjusting for breadth of gambling involvement, the odds of future PG changed directions for instant games (aOR = 0.84), bingo (aOR = 0.96), and sports betting (OR = 0.94), with bingo and sports betting becoming non-significant predictors of future PG. Still, the greatest odds were observed for EGM (aOR = 1.39) and casino table game (aOR = 1.19) participation. The implication of these findings is that most game-specific associations with future PG are attenuated or eliminated when breadth of gambling involvement is controlled for. However, EGM and casino table game participation still conferred additional risk. Interestingly, the amount of variance in future PG status explained by participation in these formats was much larger than any other format,

**Table 2** Sequential Logistic Regression Predicting Problem Gambling One Year Later ( $n=4,707$ )

	Block 1 (Format only)		Block 2 (Breadth)		Block 3 (Breadth and intensity)	
	OR	Nagelkerke $R^2$	Adjusted OR	Nagelkerke $R^2$	Adjusted OR	Nagelkerke $R^2$
Lottery	0.65 (0.52, 0.80)	0.7%	0.27 (0.21, 0.34)	22.3%	0.27 (0.21, 0.35)	27.0%
Instant games	1.60 (1.46, 1.75)	4.2%	0.84 (0.74, 0.95)	18.8%	0.89 (0.79, 1.01)	23.7%
EGMs	1.92 (1.80, 2.05)	14.1%	1.39 (1.28, 1.52)	20.6%	1.32 (1.21, 1.44)	25.0%
Table games	1.80 (1.68, 1.92)	10.8%	1.19 (1.09, 1.30)	19.0%	1.17 (1.06, 1.28)	23.9%
Bingo	1.32 (1.26, 1.38)	5.0%	0.96 (0.90, 1.02)	18.5%	0.96 (.090, 1.03)	23.6%
Sports betting	1.31 (1.24, 1.39)	3.4%	0.94 (0.87, 1.01)	18.5%	0.94 (0.87, 1.02)	23.7%
Online gambling	1.24 (1.21, 1.28)	9.3%	1.09 (1.05, 1.12)	19.3%	1.08 (1.05, 1.12)	24.3%

OR = Odds Ratio with 95% confidence interval

resulting in smaller relative increases when breadth of gambling involvement was added to the model. Further adjusting for gambling frequency, time, and expenditure resulted in only minor changes in the odds of PG associated with participation in each format.

### Self-Reported Contribution of Types to Gambling Problems

Among respondents meeting criteria for problem gambling at Baseline, only 37.3% indicated that there were particular types of gambling that contributed to their problems more than others. For those that did say yes, 61.7% identified EGMs; 29.1% lottery or raffle tickets; 23.6% instant lotteries; 13.1% casino table games (other than poker); 12.6% sports betting; and 11.3% poker. In terms of modality, 51.8% said their problems were mostly with land-based gambling, 31.1% said online gambling, and 17.1% said their problems were with both land-based and online modalities.

### Discussion

The present study comprehensively investigated the relationship between different types of gambling and problem gambling in the context of the AGRI National Project's online panel survey. We investigated (a) the univariate cross-sectional association between individual types of gambling and problem gambling; (b) the cross-sectional association between individual gambling types and problem gambling when controlling for breadth of gambling involvement; (c) the prospective/lagged relationship between participation in different gambling types and future problem gambling; and (d) the self-reports of people with gambling problems concerning the types and modalities they consider to be most problematic.

Results showed breadth of gambling involvement to be a much stronger predictor of problem gambling than involvement in any specific type. Plotting problem gambling rates as a function of individual type and total number of types engaged in illustrated that engaging in three or more types of gambling was associated with considerably more risk than engagement in any individual type. This association can be partly explained by a greater breadth of involvement normally entailing greater gambling intensity in terms of gambling frequency and time and money spent gambling. In addition, lagged multivariate analysis showed reductions in the odds of PG associated with involvement in each type of gambling when adjusting for breadth of gambling involvement. Subsequently adjusting for frequency, time, and money spent gambling resulted in only minor changes in the aORs, likely reflecting shared variance between breadth and intensity. Finally, when asking individuals with problem gambling directly (who averaged 3.2 types of gambling engagement), 62.7% indicated that no specific type of gambling contributed to their problems more than any other type.

The strong relationship between breadth and intensity of involvement and problem gambling is highly consistent with the prior literature (Holtgraves, 2009; Phillips et al., 2013; Wardle et al., 2011; Williams et al., 2021a, 2021b). People with a keen interest in gambling tend to engage in a wider variety of gambling types. This broader engagement, in turn, normally entails a greater overall frequency of engagement, as well as more time and money spent gambling. Higher levels of gambling involvement, in turn, are associated with a greater risk of gambling-related harm. Indeed, level of gambling involvement is the basis of the newly developed Canadian Lower Risk Gambling Guidelines, which were derived from an extensive analysis of all international longitudinal and cross-sectional data sets (Young et al., 2021, 2022). These guidelines provide recommended limits for an individual's breadth of gambling involvement (i.e., no more than two formats on a monthly basis), their gambling frequency (i.e., less than four days a month), and their gambling expenditure (i.e., no more than 1% of monthly income).

Results also showed that despite breadth of involvement having the strongest relationship to problem gambling, engaging in certain types and modalities of gambling did confer additional risk. It was found that EGMs and casino table games had the highest proportion of individuals with problem gambling when participating in either one, two, or three types of gambling. In addition, lagged multivariate analysis showed that participation in EGMs, casino table games, or online gambling (albeit to a lesser extent) was associated with the greatest odds of future PG after adjusting for breadth of gambling involvement. Finally, for the 37.3% of problem gamblers who did indicate there was a particularly problematic type, a) EGMs were identified to a much greater extent (by 61.7%) compared to any other type, and b) online gambling was implicated to some extent, with 31.1% saying their problems were associated with online gambling and an additional 17.1% saying their problems were associated with both online and land-based gambling.

These above results are also consistent with the prior literature, which has identified EGMs, casino table games, and online gambling to be most problematic. The relationship between EGMs, table games, and problem gambling is likely due to their ability to facilitate rapid play and provide a high frequency of reinforcement (Haw, 2008; Leino et al., 2015; Linnet et al., 2010; Parke & Griffiths, 2007). This is analogous to drug addiction, where the speed of the effect (e.g., injection or inhalation versus ingestion) and drug half-life are potent determinants of the dependency-forming potential of different substances (Nutt et al., 2007). Other features contributing to the association between EGMs and problem gambling may be their wide availability (Meyer et al., 2011) and ability to produce dissociative states (Dixon et al., 2014). The relationship between problem gambling and

online gambling is due to its 24-h accessibility, the ability to play while intoxicated, enhanced anonymity, and the online provision of continuous types of gambling (Griffiths, 2003; Wood & Williams, 2009; Wood et al., 2012).

The present investigation has some limitations. First, our analysis was limited to Canadian adults in 2018. There are features of the gambling context, such as availability and treatment access, that vary by country and time period and may therefore limit generalizability to other jurisdictions and other time periods. However, the concordance between the results of the present investigation and those of the broader literature increases confidence in the findings. Second, our results do not speak to whether there are certain combinations of gambling types that create greater risk than other combinations. Given that gambling formats vary in their structural characteristics, and that these variations provide different motivation for gambling participation (Binde, 2013), it would be valuable to understand the risk associated with the various combinations of gambling types.

## Conclusion

The present study was a comprehensive investigation of the relationship between gambling formats and problem gambling in a large sample of Canadian adult (18+) gamblers. Our results demonstrate that there is a strong association between problem gambling and breadth of gambling involvement, due, in part to the association between breadth of involvement and level of involvement. Despite this association, converging evidence indicates that certain types and modalities of gambling do confer additional risk. More specifically, EGMs were robustly associated with problem gambling in all of our analyses, with casino table games and online gambling being implicated to a somewhat lesser extent. These findings provide valuable insight for the provision and regulation of gambling, and for public health initiatives aimed at prevention and treatment.

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**Data Availability** The dataset generated by the AGRI National Project's online panel surveys is available through Gambling Research Exchange Ontario (GREO), [https://www.springer.com/journal/10899/submission-guidelines#Instructions%20for%20Authors\\_Research%20Data%20Policy%20and%20Data%20Availability%20Statements](https://www.springer.com/journal/10899/submission-guidelines#Instructions%20for%20Authors_Research%20Data%20Policy%20and%20Data%20Availability%20Statements).

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