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QUANTITATIVE RESEARCH

Predictors of gambling and problem gambling in Canada

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Abstract

Objectives The purpose of this study is to provide an updated profile of gamblers and problem gamblers in Canada and to identify characteristics most strongly associated with problem gambling.

Methods An assessment of gambling participation and problem gambling was included in the 2018 Canadian Community Health Survey and administered to 23,952 individuals 18 years and older. Descriptive statistics provided a demographic profile for each type of gambling involvement as well as category of gambler (non-gambler, non-problem gambler, at-risk gambler, problem gambler). A logistic regression identified characteristics that best distinguished problem from non-problem gamblers.

Results Gambling participation and problem gambling both varied as a function of gender, income, educational attainment, and race/ethnicity. However, multivariate analysis identified electronic gambling machine (EGM) participation to be the primary predictor of problem gambling status, with race/ethnicity, presence of a mood disorder, male gender, casino table game participation, older age, a greater level of smoking, participation in speculative financial activity, instant lottery participation, lower household income, and lottery or raffle ticket participation providing additional predictive power. Provincial EGM density and EGM participation rates are also very strong predictors of provincial rates of at-risk and problem gambling.

Conclusion Problem gambling has a biopsychosocial etiology, determined by personal vulnerability factors combined with the presence of riskier types of gambling such as EGMs. Effective prevention requires a multifaceted approach, but constraints on the availability and operation of EGMs would likely have the greatest single public health benefit.

Résumé

Objectifs Présenter un profil actualisé des joueurs et des joueurs pathologiques au Canada et cerner les caractéristiques les plus fortement associées au jeu pathologique.

Méthode Une évaluation de la participation au jeu de hasard et du jeu pathologique figurant dans l'Enquête sur la santé dans les collectivités canadiennes de 2018 a été administrée à 23 952 personnes de 18 ans et plus. Le profil démographique de chaque type de participation au jeu de hasard et la catégorie de joueur (non-joueur, joueur non pathologique, joueur à risque, joueur pathologique) ont été établis par statistique descriptive. Une régression logistique a permis de cerner les caractéristiques qui distinguaient le mieux les joueurs pathologiques des joueurs non pathologiques.

Résultats La participation au jeu de hasard et le jeu pathologique variaient tous les deux en fonction du sexe, du revenu, du niveau d'instruction et de la race/l'ethnicité. L'analyse multivariée a cependant déterminé que l'utilisation d'appareils électroniques de jeu (AÉJ) était la principale variable prédictive du jeu pathologique, et que la race/l'ethnicité, la présence d'un trouble de l'humeur, le sexe masculin, la participation aux jeux de table dans les casinos, l'âge avancé, le tabagisme important, la

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participation à des activités financières spéculatives, la participation aux loteries instantanées, le faible revenu du ménage et l'achat de billets de loterie ou de tirage au sort amélioraient le pouvoir de prédiction. La densité provinciale des AÉJ et les taux d'utilisation des AÉJ étaient aussi de très fortes variables prédictives des taux provinciaux de jeu à risque et de jeu pathologique. **Conclusion** Le jeu pathologique présente une étiologie biopsychosociale déterminée par des facteurs de vulnérabilité personnels combinés à la présence de types de jeu de hasard plus risqués, comme les AÉJ. Une prévention efficace nécessite une démarche pluridimensionnelle, mais l'imposition de limites à la disponibilité et à l'utilisation des AÉJ serait probablement la solution la plus avantageuse sur le plan de la santé publique.

Keywords Gambling · Problem gambling · Demographics · Canada · Biopsychosocial · EGM

Mots-clés Jeu de hasard · jeu pathologique · démographie · Canada · biopsychosocial · appareils électroniques de jeu

Introduction

There have only ever been two published national prevalence studies of gambling and problem gambling conducted in Canada, the first in 2000 by Ferris and Wynne (2001) and the second in 2002 by Statistics Canada as part of the annual Canadian Community Health Survey (CCHS 1.2) (Statistics Canada 2002). In addition to establishing prevalence rates, these national studies provide a detailed picture of who gambles, what they gamble on, and the types of gambling associated with gambling-related harm. This information, in turn, has important public health implications concerning who should be prioritized for problem gambling prevention and treatment and which types of gambling should be closely regulated.

Worldwide, certain segments of society have been repeatedly identified to be at higher risk for problem gambling. Most typically these are males, non-Caucasians, those having a lower educational attainment, and those in a lower income bracket (Hing et al. 2016; Welte et al. 2017; Williams et al. 2012a). In the 2002 Canadian CCHS study, the variable most strongly associated with problem gambling was male gender (Afifi et al. 2010). Other significant predictors were not being married, negative coping abilities, lower educational attainment, and lower household income (Afifi et al. 2010).

Worldwide, certain types of gambling have also been repeatedly identified as having a higher risk profile. In general, the "continuous" types of gambling (e.g., electronic gambling machines, casino table games) that allow for ongoing betting have been most strongly associated with harm (Binde et al. 2017; MacLaren 2016; Storer et al. 2009; Williams et al. 2012b). Similarly, in Canada, the 2002 CCHS study found the highest rates of problem gambling to be in provinces with the highest density of video lottery terminals per capita (Cox et al. 2005).

The purpose of the present study is to provide an updated national profile of gambling and problem gambling in Canada. In cooperation with Statistics Canada, a brief assessment of gambling behaviour and problem gambling was developed and included in the 2018 administration of the annual Canadian Community Health Survey (CCHS). This set of questions is known as the "Gambling Module". The prevalence rates of gambling and problem gambling in 2018 and how these rates have changed since 2002 have recently been reported by Williams et al. (in press). The specific research objectives of the present paper are to identify and discuss the following:

- The demographic profile of gamblers and problem gamblers in Canada in 2018.
- The demographic, mental health, and game play patterns most strongly associated with problem gambling.
- The policy implications that derive from the above findings.

Method

Sample

The CCHS annually collects information from a target population of 65,000 Canadians aged 12+ who reside in one of Canada's 10 provinces and 3 territories. The sample excludes people living on First Nations reserves and other Indigenous settlements, full-time members of the Canadian Forces, youth aged 12 to 17 living in foster homes, the institutionalized population, and people living in the Quebec health regions of Nunavik and Terres-Cries-de-la-Baie-James. Altogether, these exclusions represent less than 3% of the target population (Statistics Canada 2019a).

The adult (18+) sample is roughly proportionate to provincial and territorial population size while also ensuring reliable estimates for provincial health regions. Each province is divided into geographic areas consisting of 100 to 600 dwellings ("clusters"). Households are sampled within each cluster and an individual is randomly selected from each household, with ages 18–35 and 65+ being given a higher probability for selection (Statistics Canada 2019a).

CCHS interviews were conducted between January and December 2018 by computer-assisted telephone interviews (75%) and computer-assisted face-to-face interviews (25%). The interview was available in both English and French with interpretation services available for several other languages (Statistics Canada 2019a). However, the CCHS containing the Gambling Module was only fielded for a 6-month period (July–December 2018) and only in the provinces (no territories). A total of 45,636 households were eligible. Of these, 30,995 households agreed to participate, and CCHS surveys were ultimately obtained from 26,648 individuals (58.4% overall response rate). Because the Gambling Module was restricted to ages 15 and older and did not permit proxy respondents, a smaller number of individuals were actually eligible (25,639), with 24,982 CCHS Gambling Module surveys ultimately obtained, 23,952 of these being from adults (18+) (Statistics Canada 2019b).

Survey

The CCHS is a survey of health determinants, health status, and health care use. Some sections are administered to all participants (27 min), some sections are only administered to provinces and territories selecting these additional topics (8 min), and some sections, such as the Gambling Module, are designed and paid for by external organizations for administration to the provinces (2 min per module). The total length of the average CCHS survey is 40 to 45 min (Statistics Canada 2019a).

Gambling Module The first part of the Gambling Module was an assessment of past year frequency of engagement in eight different types of gambling using an abbreviated and modified version of the Gambling Participation Instrument (Williams et al. 2017). Respondents were asked about their frequency of in-person or online engagement in each of the following: *instant lottery tickets* (scratch tickets, break-open or pull-tabs, instant online games), *lottery or raffle tickets*, *electronic gambling machines* (slot machines, video lottery terminals, electronic blackjack, electronic roulette, video poker), *casino table games* (excluding electronic versions) (e.g., poker, blackjack, baccarat, roulette), *sports betting* (including horse race betting, sports lottery tickets, fantasy sports, bets between friends), *bingo*, *other forms of gambling*, and *speculative financial market activities* (e.g., day trading, penny stocks, shorting, options, currency futures). Response options were: never, less than once a month, once a month, 2–3 times a month, once a week, and several times a week. Individuals who gambled at least once a month on one or more types of gambling were asked whether their engagement was in person, online, or both. Time constraints precluded asking questions about gambling expenditure and time spent gambling.

Respondents who gambled once a month or more on one or more types of gambling were asked the nine questions from the Problem Gambling Severity Index (PGSI), which produces a composite score ranging from 0 to 27 (Ferris and Wynne 2001). Note that research shows that a mildly restrictive frequency threshold of gambling once a month or more on any type of gambling appears optimal in excluding some false positives while not inadvertently excluding people with genuine gambling-related harm (Stone et al. 2015; Williams and Volberg 2009, 2012). These composite scores were used to group individuals into one of three categories using the PGSI scoring recommendations of Williams and Volberg (2014), as these provide the best demarcation of problem gambling in the general population: 0 = non-problem gambling, 1–4 = at-risk gambling, 5+ = problem gambling. (While the traditional 8+ PGSI demarcation of problem gambling has good correspondence to clinically assessed problem gamblers in treatment, it has poor correspondence to problem gamblers in the general population (Ferris & Wynne 2001; Ladouceur et al. 2005; Williams and Volberg 2014). There are several reasons for this but one of the central ones is because the PGSI was normed on a small group of treatment-seeking problem gamblers who tend to have a more pervasive and severe set of problems compared with problem gamblers in the general population).

Substance use and mental health Four variables pertaining to substance use and mental health were included in the analyses as they were asked of all CCHS participants. They were: current frequency of cigarette smoking (daily, occasionally, not at all); frequency of past year alcohol consumption (< 1/month, 1/month, 2–3/month, 1/week, 2–3/week, 4–6/week, every day); currently having "a mood disorder such as depression, bipolar, mania, or dysthymia" (yes, no); and currently having "an anxiety disorder such as a phobia, obsessive-compulsive disorder or panic disorder" (yes, no).

Demographics The demographic variables used in the present analysis were gender, age group, household income group, level of educational attainment, and race/ethnicity. Race/ethnicity was ascertained with the question "You may belong to one or more racial or cultural groups on the following list. Are you…?" (up to four categories could be endorsed). In the present analysis, the categories of West/Central Asian, Korean, and Japanese were combined with "Other" due to small cell sizes for the gambling type × race/ethnicity cross-tabulations. Note also that the Indigenous category encompasses First Nations, Métis, and Inuk (Inuit).

Data editing

Statistics Canada undertakes data editing prior to data release. This includes replacing inconsistent values with "not stated"

and imputing missing household income using the values of the nearest neighbours. Master survey weights are also created to adjust for age group × gender × health region differences from the population census.

Results

Demographic profile of gamblers

The demographic profile of people who engage in each type of gambling in 2018 is presented in Table 1. Data suppression occurred whenever there was a cell size of less than five. As seen, gambling participation varies as a function of gender, income, educational attainment, and race/ethnicity.

Lottery and raffle tickets are most popular among those ages 50–64; instant lottery tickets, among people with household incomes of $80,000 and higher; electronic gambling machines, among Indigenous people; casino table games, among South-East Asians; sports betting, among males; bingo, among Indigenous people; and speculative financial activities, among people with an Arab or multiple ethnicity heritage.

Demographic profile of different types of gambler (non-gambler, non-problem gambler, at-risk gambler, problem gambler)

Table 2 presents gambling categorizations in 2018 as a function of demographics. Due to small cell sizes, the at-risk and

Table 1 Prevalence of past year gambling among adults (18+) in 2018 by demographics (weighted)

		Lottery or raffle tickets (%)	Instant lottery tickets (%)	Electronic gambling machines (%)	Casino table games (%)	Sports betting (%)	Bingo (%)	Other types (%)	Speculative financial (%)	Any past year gambling (%)	Online gambling (%)
Gender	Male	57.4	32.2	13.3	10.5	12.1	2.1	3.2	5.9	70.5	9.3
	Female	50.0	35.9	12.7	5.0	3.8	5.8	2.0	1.5	62.2	3.7
Age	18–29	32.3	35.2	16.8	12.4	11.2	4.0	4.0	4.3	57.3	7.6
	30–49	55.6	36.4	12.4	9.7	9.9	3.3	2.7	4.7	66.1	8.8
	50–64	65.2	35.6	12.3	5.0	5.7	3.9	2.0	3.1	73.7	4.7
	65+	55.5	27.2	11.3	3.3	4.1	5.3	1.7	1.9	65.4	3.5
Household income	< $20 K	35.2	26.2	10.4	4.6	5.3	6.6	1.6	3.8	52.9	8.0
	$20–$39.9 K	48.5	33.4	10.9	5.5	4.4	5.3	1.6	1.4	60.8	3.2
	$40–$59.9 K	51.9	33.7	12.9	6.1	6.1	4.1	2.4	2.2	64.2	5.6
	$60–$79.9 K	54.6	34.0	13.4	8.2	8.9	5.5	2.8	3.1	66.7	5.3
	$80–$99.9 K	57.9	36.8	13.1	6.7	8.8	4.1	2.0	3.5	70.8	7.3
	$100–$149.9 K	57.8	38.2	13.9	8.1	8.5	3.1	3.2	4.0	71.0	6.9
	$150 K+	57.0	32.1	14.0	11.1	10.3	2.2	3.1	6.0	68.2	8.3
Highest educational attainment	< Secondary school	50.1	33.6	10.8	3.8	3.9	6.6	1.6	0.9	62.1	3.1
	Secondary school	50.9	35.1	15.8	7.0	7.5	4.8	2.6	3.0	65.7	6.1
	Post-secondary certificate/diploma < Bachelor's	61.6	39.2	14.9	9.0	9.1	4.4	2.9	3.5	72.6	7.1
	Bachelor's degree	51.4	30.0	11.1	9.4	9.2	2.0	2.5	5.7	65.6	8.0
	Certificate/diploma/degree > Bachelor's	40.1	22.4	5.7	5.8	5.1	1.3	2.3	4.7	50.4	5.6
Race/ethnicity	Indigenous	55.2	45.5	20.4	6.5	8.5	10.0	5.9	1.8	75.3	6.5
	White	58.4	36.	14.3	7.5	8.7	4.3	2.5	3.2	71.0	6.1
	South-East Asian	57.1	41.5	10.2	13.4	7.3	2.6	3.2	3.4	66.9	8.1
	Latin American	45.0	32.9	5.6	2.9	1.7	–		4.2	59.8	5.9
	Black	43.3	26.4	6.2	4.3	6.7	–		2.9	58.4	5.2
	Chinese	35.4	21.1	7.2	10.8	6.2	4.4	1.4	4.0	46.2	5.8
	South Asian	31.7	17.0	7.1	7.7	5.8	1.4	3.7	6.9	40.7	6.6
	Arab	19.2	14.3	–					8.2	26.9	8.9
	Other	44.4	25.7	13.3	6.8	2.7	0.8	1.4	2.0	55.3	5.4
	Multiple ethnicities	44.2	25.2	11.0	12.1	6.3	2.4	5.9	8.6	57.6	11.6
Entire sample		53.6	34.1	13.0	7.7	7.9	4.0	2.6	3.6	66.2	6.4

problem gambling rate had to be combined for certain race/ethnicities and the at-risk and problem gambling rate had to be collapsed for the four Atlantic provinces. As seen, the highest rates of problem gambling are found in: males, those ages 18–29, those with household incomes between $40,000 and $80,000, those with educational attainment below a Bachelor's degree, Indigenous people, and people residing in the Prairie provinces (Manitoba, Saskatchewan, Alberta); and the lowest rates are found in: females, those ages 50+, those with household incomes > $150,000, those with educational attainment at a Bachelor's level or higher, Latin Americans, and people residing in the provinces of Ontario and British Columbia.

Multivariate prediction of problem gambling

A stepwise binary logistic regression was conducted to identify the variables that best independently differentiated problem gamblers (PGSI 5+) from non-problem gamblers (non-gamblers and gamblers with PGSI < 5). Total sample size was 23,144. A classification cut point was employed that corresponded to the prevalence of problem gambling within the sample. Variable entry order was determined by the size of the Wald statistic, with a minimum entry level of $p = 0.05$ and a removal level of $p = 0.01$. Eleven predictor variables were used:

- Province (Newfoundland the reference category)
- Gender
- Age
- Household income
- Educational attainment
- Race/ethnicity (multiple race/ethnicities the reference category)
- Past year participation or non-participation in each of the eight individual types of gambling
- Frequency of cigarette smoking (daily, occasionally, not at all)
- Frequency of past year alcohol consumption
- Current mood disorder
- Current anxiety disorder

Optimal model fit occurred with a constant and 11 predictor variables. A test of the full model with the 11 predictors against a constant-only model was statistically significant (χ^2 (19df, $N = 23{,}144$) = 406.84, $p < 0.001$), indicating that the 11 predictors reliably distinguished between problem and non-problem gamblers. The variance accounted for was modest however, with Nagelkerke R squared = 26.1%. A total of 98.4% of non-problem gamblers were correctly classified and 28.7% of problem gamblers were correctly classified.

Table 3 shows the regression coefficients, Wald statistics, and odds ratios for each of the 11 significant predictors. As shown, EGM participation is overwhelmingly the most important predictor of problem gambling status, although there is additive predictive power with race/ethnicity, presence of a mood disorder, male gender, casino table game participation, older age, a higher frequency of cigarette smoking, participation in speculative financial activity, instant lottery participation, lower household income, and lottery or raffle ticket participation.

Electronic gambling machines

There are a few other observations that also implicate EGMs as an important determinant of problem gambling. As seen in Table 4, the combined at-risk and problem gambling rate for each province or region is strongly predicted by the number of EGMs per 1000 people in 2018 ($r = 0.93$, $p = 0.002$, $N = 7$) as well as the provincial/regional rates of EGM participation in 2018 ($r = 0.94$, $p = 0.002$, $N = 7$). It is also the case that Ontario and British Columbia are the only two provinces that do not permit EGMs outside of dedicated gambling venues (casinos, horse race tracks, bingo halls), and these are the two provinces with the lowest rates of problem gambling (0.3%). (EGMs per 1000 people was derived from each province's annual report for fiscal 2017/2018).

Discussion

The purpose of this paper was to provide an updated profile of gamblers and problem gamblers in Canada and to identify the characteristics that best predict problem gambling.

Univariate cross-tabulations established that overall level of *gambling participation* was higher for males, those with household incomes > $20,000, those having an educational attainment below a graduate degree, and those with an Indigenous, White, or South-East Asian background. The demographic subgroup with the highest level of participation for each individual type of gambling was as follows: age group 50–64 for lottery and raffle tickets; household income of $80,000+ for instant lottery tickets; Indigenous heritage for electronic gambling machines; South-East Asian heritage for casino table games; males for sports betting; Indigenous heritage for bingo; and Arab heritage or having a multiple ethnic heritage for speculative financial activities.

Univariate cross-tabulations established that the highest rate of *problem gambling* was in: males, those ages 18–29, those with household incomes between $40,000 and $80,000, those with educational attainment below a Bachelor's degree, Indigenous people, and people residing in the Prairie provinces of Manitoba, Alberta, and Saskatchewan. The lowest problem gambling rate within each demographic category

Table 2 Gambling categorizations among Canadian adults (18+) in 2018 by demographics (weighted)

		Non-gamblers (%)	Non-problem gamblers (PGSI = 0) (%)	At-risk gamblers (PGSI = 1–4) (%)	Problem gamblers (PGSI = 5+) (%)
Gender	Male	29.5	66.4	3.3	0.7
	Female	37.8	59.6	2.2	0.4
Age	18–29	42.7	53.4	3.0	0.8
	30–49	33.9	63.0	2.5	0.6
	50–64	26.3	71.2	2.1	0.4
	65+	34.6	61.3	3.7	0.4
Household income	< $20 K	47.1	48.4	4.1	0.4
	$20–$39.9 K	39.2	56.7	3.4	0.6
	$40–$59.9 K	35.8	59.9	3.5	0.8
	$60–$79.9 K	33.3	63.5	2.5	0.8
	$80–$99.9 K	29.2	67.1	3.1	0.6
	$100–$149.9 K	29.0	68.3	2.2	0.5
	$150 K+	31.8	66.0	1.9	0.2
Highest educational attainment	< Secondary school	37.9	57.3	4.2	0.7
	Secondary school	34.3	61.8	3.2	0.7
	Post-secondary certificate/diploma < Bachelor's	27.4	68.9	3.0	0.7
	Bachelor's degree	34.4	63.7	1.7	0.2
	Certificate/diploma/degree > Bachelor's	49.6	49.2	0.9	0.2
Race/ethnicity	Indigenous	24.7	68.4	4.8	2.0
	Black	41.6	52.8	4.8	0.8
	Latin American	40.2	54.1	5.7	0.0
	Chinese	53.8	41.6	--------4.6--------	
	South-East Asian	33.1	62.4	--------4.5--------	
	White	29.0	68.2	2.4	0.4
	South Asian	59.3	39.1	--------1.6--------	
	Arab	73.1	–		
	Other	44.7	48.6	--------6.7--------	
	Multiple race/ethnicities	42.4	53.2	--------4.4--------	
Province	Newfoundland	23.9	72.9	2.7*	0.6*
	Prince Edward Island	30.4	67.6		
	Nova Scotia	31.9	65.0		
	New Brunswick	25.9	70.3		
	Quebec	29.3	67.8	2.2	0.7
	Ontario	36.1	61.0	2.6	0.3
	Manitoba	34.9	59.1	4.8	1.2
	Saskatchewan	26.7	67.8	4.6	0.8
	Alberta	33.1	63.3	2.5	1.1
	British Columbia	39.5	56.7	3.5	0.3
Entire sample		33.8	62.9	2.7	0.6

* For all of the Atlantic provinces combined

was in: females, those ages 50+, those with household incomes > $150,000, those with educational attainment at a Bachelor's level or higher, those with Latin American heritage, and those residing in the provinces of Ontario and British Columbia.

Variables are often strongly correlated with one another (e.g., educational attainment and income). Consequently, univariate cross-tabulations do not identify whether there may be specific attribute(s) underlying a range of univariate

Table 3 Logistic regression of characteristics differentiating problem from non-problem gamblers

	Regression coefficients	Wald statistic	*p*	Odds ratio	Odds ratio 95% CI
EGM participation	2.72	137.33	0.000	15.14	9.61–23.85
Race/ethnicity groups		26.94	0.001		
White	− 1.02	2.54	0.111	0.36	0.10–1.27
Black	1.016	1.88	0.171	2.88	0.63–13.10
South Asian	− 0.69	0.51	0.474	0.50	0.08–3.31
Chinese	− 0.68	0.50	0.479	0.51	0.08–3.32
Indigenous	− 0.46	0.44	0.506	0.63	0.16–2.45
Arab	0.27	0.05	0.822	1.32	0.12–14.27
South-East Asian	0.13	0.02	0.880	1.14	0.21–6.34
Latin American	− 15.96	0.00	0.995	0.00	
Other	− 0.86	0.79	0.374	0.42	0.06–2.81
Current mood disorder	1.12	24.19	0.000	0.33	0.21–0.51
Gender (male = 1; female = 2)	− 0.98	23.11	0.000	0.38	0.25–0.56
Casino table game participation	0.86	15.81	0.000	2.37	1.55–3.61
Age	0.02	11.15	0.001	1.02	1.01–1.03
Level of cigarette smoking	− 0.33	8.57	0.003	0.73	0.60–0.90
Speculative financial participation	0.77	6.25	0.012	2.15	1.18–3.92
Instant lottery participation	0.51	5.94	0.015	1.66	1.11–2.50
Household income	− 0.11	4.36	0.037	0.90	0.82–0.99
Lottery or raffle participation	0.53	4.27	0.039	1.70	1.13–2.81
Constant	− 2.72	9.60	0.002	0.07	

associations. The *relative* importance of different variables is better established in a stepwise multivariate analysis where variables having the strongest association with the dependent variable enter the model first, and other variables only enter the model if they add additional predictive power beyond their shared variance. The *multivariate analysis* undertaken showed that problem gambling was overwhelmingly best predicted by EGM participation. Other variables that contributed to the multivariate prediction of problem gambling were race/ethnicity, presence of a mood disorder, male gender, casino table game participation, older age, a higher frequency of cigarette smoking, participation in speculative financial activity, instant lottery participation, lower household income, and lottery or raffle ticket participation.

Further evidence of the role of EGMs in problem gambling is seen in the fact that provincial rates of at-risk and problem gambling are very strongly predicted by EGM density and EGM participation rates. It is also the case that the 45% decrease in the Canadian rate of problem gambling in the CCHS from 2002 to 2018 (1.1% to 0.6%) reported in Williams et al. (in press) is coincident with a 45% decrease in Canadian EGM participation rates over this same time period (23.8% to 13.0%). Of final note, similar to the 2002 CCHS findings (i.e., Cox et al. 2005), the two provinces without any EGMs outside of dedicated gambling venues (i.e., Ontario, British Columbia) currently have the lowest problem gambling rates in Canada.

Although it seems clear that EGMs are an important determinant of problem gambling, there are three important observations that qualify the above findings. The first is that these data are primarily cross-sectional, rather than longitudinal, which weakens causal attributions.

The second important caveat is that not all the etiological predictors of problem gambling were examined in the present study. Hence, the importance of the present predictors has not been fully contextualized. The two major longitudinal studies

Table 4 Relationship between EGM density, EGM participation, and combined at-risk plus problem gambling rates

Province/region	EGMs per 1000 adults (18+) in 2018	Past year adult (18+) participation in EGMs in 2018	Combined 2018 adult (18+) at-risk + problem gambling rates
Ontario	2.0	12.2	2.9
Quebec	2.6	10.8	2.9
Atlantic provinces	4.0	10.2	3.3
British Columbia	3.3	13.4	3.8
Alberta	6.1	15.4	3.6
Saskatchewan	8.0	25.1	5.4
Manitoba	9.2	22.9	6.0

EGMs per 1000 people were derived from each province's annual report for fiscal 2017/2018

of gambling in Canada, the Leisure, Lifestyle, Lifecycle Project (el-Guebaly et al. 2015) and the Quinte Longitudinal Study (Williams et al. 2015), examined a much more comprehensive set of potential etiological predictors in both a cross-sectional and prospective context. Both studies did find increased EGM frequency to be an important predictor of future problem gambling. However, even more important was having a past history of at-risk or problem gambling. Other important future predictors of problem gambling were: having a big win in the past year; increased frequency of casino table game participation; family members being regular gamblers; having close friends/family with gambling problems; gambling to escape or to win money; having more gambling fallacies; and gambling being identified as a top leisure pursuit. Beyond these gambling-related variables, the other variables robustly adding multivariate predictive power were: impulsivity; having a concurrent behavioural addiction; a lifetime history of addiction to drugs or alcohol; and a family history of mental health problems (el-Guebaly et al. 2015; Williams et al. 2015).

The third important caveat is that the rates of problem gambling reported in Table 2 are an underestimate of the level of gambling-related harm in the population. Many more people are harmed by gambling compared with the number of people who have a gambling disorder (Langham et al. 2015). This includes members of the problem gambler's family as well as people who have experienced significant adverse consequences from their gambling but do not meet the full criteria for the disorder. While there is less agreement on the measurement of gambling-related harm compared with the measurement of problem gambling (Delfabbro and King 2019), there is no disagreement that gambling-related harm is a more important concept and area of focus from a public health perspective (Griffiths et al. 2020).

Conclusion

Problem gambling has a biopsychosocial etiology with multiple risk and protective factors. Individual vulnerability due to family history, personality, comorbid mental health and substance use problems, and adverse personal circumstances creates risk, as does the presence and participation in riskier types of gambling. Similarly, successful prevention requires a multifaceted approach that combines comprehensive educational initiatives (especially targeting vulnerable groups) along with policy changes that constrain the availability and operation of riskier types of gambling (Williams et al. 2012b). That said, constraints on the availability and operation of EGMs would arguably have the greatest single public health benefit in recognition that this is the most modifiable of all the important risk factors, as well as the fact that educational efforts are known to have a modest impact on preventing problem gambling (Williams et al. 2012b)

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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