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Lower-risk gambling limits: linked analyses across eight countries

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ABSTRACT

A common public health initiative in many jurisdictions is provision of advice to people to limit gambling to reduce the risk of gambling-related harm. The purpose of this study is to use consistent methodology with existing population-based prevalence surveys of gambling and related harms from different countries to identify quantitative limits for lower risk gambling. Risk curve analyses were conducted with eleven high quality data sets from eight Western countries. Gambling indicators were monthly expenditure, percentage of income spent on gambling, monthly frequency, and number of different types of gambling. Harm indicators included financial, emotional, health, and relationship impacts. Contributing data sets produced limit ranges for each gambling indicator and each harm indicator, which were compared. Gender differences in limit ranges were minor. Modal analysis, an assessment of the mean of the upper and lower range limits, indicated that the risk of harm increases if an individual gambles at these levels or greater: \$60 to \$120 CAD monthly, five to eight times monthly, spends more than 1 to 3% of gross monthly income or plays three to four different gambling types. This study provides further evidence that lower-risk gambling guidelines can be based upon empirically derived limits.

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Gambling; responsible gambling; risk curves; lower risk guidelines; gambling-related harms

Introduction

The purpose of this project is to identify levels of gambling involvement that predict increased risk of experiencing gambling-related harms. Although the gambling industry

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provides employment, leisure opportunities, and tax revenue, significant concerns about deleterious individual, family and community impacts exist (Goyder et al., 2020; Hodgins et al., 2011). A detailed examination of the range of harms in Australia led to the development of a framework and comprehensive taxonomy of harms to the individual, family, and community (Langham et al., 2016). The Victoria framework contains seven dimensions of individual harm: financial; relationship disruption, conflict, or breakdown; emotional or psychological distress; physical health harms (e.g. reduced levels of self-care, drinking, smoking, illegal substances); cultural harm (e.g. reduced engagement in the community, not meeting social expectations); reduced performance at work or study; and social deviance. Harms can be general, related to a crisis, or represent legacy impacts that last beyond an individual's gambling (e.g. family inheritance).

A variety of gambling harm minimization strategies have been proposed and implemented in various jurisdictions (Christensen, 2020; Drawson et al., 2017; Tanner et al., 2017). These initiativesinclude changes to and restrictions on how gambling products are provided, including limiting operating hours, age restrictions, and slowing down the speed of electronic gambling machines (EGMs; e.g. slot machines). Many jurisdictions also provide individually focused interventions such as the opportunity for customers to 'self-exclude' from gambling venues or online sites for various periods of time. Customers are also able to set personal spending and time limits with some types of gambling. Other initiatives have focused on educating the consumer by providing information about payout odds for different types of gambling, and the typical gambling-related cognitive distortions that can lead to heavy gambling.

Although some of these harm minimization strategies have shown some promise, empirical evidence of effectiveness is generally lacking to date (Christensen, 2020; Drawson et al., 2017; Harris & Griffiths, 2017; McAuliffe et al., 2021). It is recognized, however, that effective minimization of harm will require a multifaceted and coordinated set of initiatives (Abbott, 2020; Christensen, 2020; Hing et al., 2019).

One initiative that is common across jurisdictions is provision of advice to consumers to limit the amount of time and money spent gambling (Currie et al., 2019; Hing et al., 2019). To date, this public health messaging tends to be general with messages such as 'set a budget,' 'do not gamble more than you can afford' and 'gamble responsibly.' In contrast, in other health areas such as alcohol consumption, general advice is typically accompanied with specific quantitative guidance that has been empirically derived from research evidence (Paula et al., 2020). However, due in part to the absence of international coordination to standardize the methodology and agreement on how to define 'low-risk' and a standard drink, there is large variation in what are considered safe drinking limits across countries. In a recent review of lower-risk drinking guidelines for 68 countries (Paula et al., 2020), daily recommendations ranged dramatically from 16 to 60 g per day for men and 8 to 40 for women.

This type of public health advice as a single strategy has variable impact on individual behavior. Evidence is positive in some health areas such as nutrition, smoking, road safety, and physical activity (Bala et al., 2017; Wakefield et al., 2010). In the alcohol area, only short-term impact on drinking awareness and intentions has been found (Holmes et al., 2016, 2020; Stevely et al., 2018), although investigations into how to craft more effective messaging is advancing (Brennan et al., 2021; Vallance et al., 2017). However, quantitative limits are also useful for ethical policy-setting, regulation, and monitoring potential health impacts. They can also be useful in contexts such as primary care, social services, and gambling venues where it is important to identify and intervene with people at risk of harms. The utility of guidelines, however, is limited by their reliability and validity as predictors of risk of harm.

The purpose of this study is to use the best quality international population-based prevalence surveys of gambling involvement and related harms to identify quantitative limits for lower and higher risk gambling. Although the research on establishing drinking limits is more extensive, a growing body of literature in the gambling area exists. Our team and others have refined a methodology for deriving guidelines using cross-sectional and longitudinal population prevalence data in Canada (Currie et al., 2006, 2009, 2012, 2017) and other countries (Brosowski et al., 2015; Dowling et al., 2021). The basic methodology involves developing dose–response (risk) curves of the proportion of people experiencing harm at different levels of gambling involvement and using receiver operating characteristic analyses (ROC) to identify optimal cut points. A variety of indicators of gambling involvement (e.g. frequency of gambling, monthly expenditure, expenditure as a proportion of income) and harm (e.g. harm-related items from gambling screens) have been used with generally consistent results. A review of studies in Canada, Germany, and Australia found limits of gambling of no more than 0.63 to 5 times per month, spending no more than USD $93–$720 per year, spending of no more than 1–3% of household income, and gambling on no more than 2–4 types of gambling (Dowling et al., 2021). Research has found that the credibility of derived limits among stakeholder groups including the public, researchers and clinicians is good (Currie et al., 2008; Dowling et al., 2021), and has demonstrated that they have predictive validity in longitudinal samples (Currie et al., 2012; Dowling et al., 2018). As well, research has examined limits derived for specific types of gambling versus limits derived for overall gambling. Limits that incorporate all the gambling of individuals, including riskier and less risky types of gambling, demonstrate the most statistically robust dose–response risk curves compared to limits derived for specific types of gambling (Currie et al., 2006, 2009, 2012, 2017) and are simpler to communicate to the public.

Previous research and the current study used a subset of the Problem Gambling Severity Index (PGSI; Ferris & Wynne, 2001) items that measure specific negative consequences of gambling as harm indicators. Although these items have face validity, they do not capture all possible aspects of harm (Langham et al., 2016) and, to date, they have not been validated against more robust measures. In this project, a validation substudy was conducted using data that included both the PGSI and a comprehensive set of harm indicators.

One methodological issue that is unresolved is whether optimal limits should be identified where sensitivity and specificity are both optimized (minimizing both false negatives and positives) or whether one or the other is more heavily weighted. Dowling et al. (2018) noted that although conceptually minimizing false negatives is arguably the most ethical approach (i.e. to avoid missing any positive cases), they concluded that balancing sensitivity and specificity is most appropriate in the absence of a consensus. This approach is common in health research. On the other hand, the number of false positives has an important relationship to the credibility of any derived lower-risk gambling limit. Currie et al. (2017) found that maximizing specificity while maintaining sensitivity of at least .70, leads to more reliable, conservative, and credible limits. In this study, both Currie's criteria and balancing sensitivity and specificity were used to establish lower and upper and limits (i.e. more and less conservative limits) across harm indicators, gambling parameters and datasets.

Some of the previous research has examined whether limits differ for men and women, as they do for alcohol drinking (Currie et al., 2008; Dowling et al., 2021). In contrast to alcohol, there are no clear biological sex differences in how people respond to gambling, although research is limited (Grant & Chamberlain, 2022). Nonetheless, men and women gravitate toward different types of gambling, and have different financial means for gambling on average. There are also differences in the prevalence and course of gambling disorder between men and women (Hodgins et al., 2011) and some evidence that men have slightly better outcomes after psychological treatment than women (Merkouris et al., 2016) but have similar responses to pharmacotherapy (Grant & Chamberlain, 2022). Although previous research has not found meaningful differences in gambling limits for men and women (Currie et al., 2008; Dowling et al., 2018), the diverse set of datasets in this study represented an opportunity to confirm this finding.

The specific goals of this project were to:

(1) Conduct coordinated and standardized risk curve analyses to compare cross-national similarity and differences in lower-risk limits, using high-quality population-based prevalence surveys of gambling and related harms internationally.
(2) Explore whether gender differences exist that warrant generation of separate lower-risk limits.

These analyses of international datasets are part of a larger project to establish a set of lower risk gambling guidelines for Canada (Currie et al., 2019; Young et al., 2022).

Methods

Identification of high quality datasets

A search for published and gray literature prevalence survey datasets yielded 11 assessed as suitable for risk curve analyses on the basis of cross-dataset consistency of measurement of gambling and gambling-related harms, national or state population representativeness of samples, and sample size adequacy (see Table 1) (Currie et al., 2019). The investigators associated with each agreed to participate in the project. Of note, five of the datasets were longitudinal, which allowed gambling at baseline to predict subsequent harm. The other six were cross-sectional so that behavior and harm measures were concurrent.

Gambling indicators

Three self-reported gambling involvement domains were available in most of the datasets: Expenditure (gambling losses per month in the past year aggregated over all forms of gambling; expenditure expressed as a proportion of gross monthly household income); frequency (typical number of days per month aggregated over gambling types); and

Table 1. Datasets identified for risk curve analyses assessing the association between gambling involvement and development of harm.

Dataset	Region	Year	Survey Design & Sampling (Total N)†	ROC Sample N††	% of ROC sample scoring 5–7 and 8+ on PGSI
The Leisure, Lifestyle, and Lifecycle Project (LLLP) and the Quinte Longitudinal Study (QLS) (datasets merged)	Alberta, Ontario, Canada	2009–2012	Longitudinal, random population sample + oversampling of at-risk gamblers (5929)	4930	3.0% 2.0%
Icelandic Gambling Project	Iceland	2005, 2007, 2011	Cross-sectional, random population sample (3358, 3004, 1531)	4817	0.6% 0.8%
Finnish Gambling Population Survey	Finland	2011, 2015	Cross-sectional, random population sample (4484, 4515)	6934	0.9% 0.6%
SWELOGS	Sweden	2008–2014	Longitudinal, random population sample + oversampling of at-risk gamblers (8827)	3132	1.3% 1.0%
Enjeu 2014- Enquête nationale sur les jeux d'argent et de hasard	France	2014	Cross-sectional, random population sample (15635)	8652	2.2%††† 0.5%†††
e-Enjeu - Enquête nationale sur les jeux d'argent et de hasard en ligne	France	2012	Cross-sectional, random population sample (4042)	3860	0.5% 0.5%
ENHJEU-Quebec	Quebec, Canada	2012	Cross-sectional, random population sample (12008)	7983	0.6% 0.5%
Victorian Gambling Study	Australia	2008–2012	Longitudinal, random population sample + oversampling of at-risk gamblers (15000)	3719	3.0% 1.0%
New Zealand 2012 National Gambling Study	New Zealand	2012	Cross-sectional, random population sample (6251)	4950	1.3% 0.9%
The Massachusetts Gambling Impact Cohort (MAGIC Study)	Massachusetts, United States	2013–2015	Longitudinal, random population sample + oversampling of at-risk gamblers (3139)	2617	1.8% 1.1%
Consolidated gambling prevalence surveys from Canadian provinces[1]	Ontario, Manitoba, New Brunswick, Newfoundland and Labrador, Canada	2005–2016	Cross-sectional random population sample (19936)	15765	1.1% 1.3%

†Includes total sample size. If longitudinal design this represents sample size at time 1.

††Survey respondents ≥ 18 years and who indicated they gambled in past year. Note. For each data set, ROC analyses were conducted for each gambling indicator (4), for each harm indicator (4) and by gender (2). Thus for each contributing dataset, 32 ROC analyses were conducted. Due to differing patterns of missing data across each of these analyses, the sample size presented should not necessarily be understood to be that associated with each ROC analysis conducted.

†††Note. These prevalence numbers refer to the full sample.

Datasets from provincial gambling prevalence surveys conducted in Ontario (2005), Manitoba (2006, 2013, 2016), New Brunswick (2009, 2014), and Newfoundland and Labrador (2005, 2009) were merged to create a consolidated data source for the project. Datasets from other provinces could not be used because we could not obtain access from the data custodian or the survey data was considered too old (i.e. pre-2005). Based upon earlier comparative analyses, two Canadian longitudinal datasets were combined into one sample to maximize sample size. The datasets from Finland and Iceland also represented the merging of two or more cross-sectional surveys conducted at different time points.

number of gambling types. A set of decision rules was established by consensus of the investigators to standardize these indicators across datasets where methodological details differed (see Appendix S.A). Expenditure amounts in local currency were converted to Canadian dollars using purchasing power parity conversion rates (OECD, & Eurostat, 2012) for the year each survey was conducted.

Harm indicators

None of the datasets included a comprehensive measure of harm that maps completely onto the Victoria framework adopted for the project. Because all the datasets included the nine-item Problem Gambling Severity Index (PGSI) (Ferris & Wynne, 2001), it was selected as the core measure of gambling harms. Following previous research (Currie et al., 2012, 2017; Dowling et al., 2021), the seven PGSI items that assessed a type of negative consequence from gambling were used as indicators of four of the harm categories – financial (3 items), emotional (2 items), relationship (1 item) and health harms (1 item). As in previous research, responses to the items were dichotomized (not at all = 0, sometimes, most of the time, always = 1). In addition, an index that indicated two or more positive items was computed, which in previous research had strong psychometric properties in predicting harm (Currie et al., 2009). Although these harm indicators have been used effectively in past risk curve analyses (Dowling et al., 2018, 2021), we also conducted additional analyses of their validity as indicators of harm. Lack of validation of these items was considered a limitation of previous research (Dowling et al., 2021).

Analyses

Validation of harm indicators

To confirm that the set of indicators derived from the PGSI items used in previous research (Currie et al., 2017; Dowling et al., 2018) are valid harm indicators, we conducted validation analyses using a separate dataset that included both the PGSI and the harm items that were the basis of the Victoria framework (Langham et al., 2016). The dataset (N = 4,027) was collected as part of two linked investigations of the burden of harm related to gambling, one in Australia and one in New Zealand (Murray Boyle et al., 2021). In both Australia (State of Victoria) and New Zealand, participants were recruited through online panels to ensure that individuals with a range of gambling involvement were included (see Table S.1).

Spearman rank order correlations were computed between the PGSI-derived harm indicators and the harm domains from the Victoria model (Langham et al., 2016). It was expected that correlations among harm indicators and domains would be moderately correlated (i.e. .30 and greater; Cohen, 1988) and that the correlations between conceptually similar domains would be slightly higher than dissimilar domains. The harm domains were summed item totals for each of the six harm domains – finance, relationships, emotional, health, work, and social deviance. In addition, an aggregate score from the Short Gambling Harm Scale (SGHS) was calculated, which is a 10-item brief measure of degree of harm (Murray Boyle et al., 2021). The SGHS, developed from the 72-item pool to maximize sensitivity and content coverage of harms, is a unidimensional scale with high internal reliability. All items assessed harm within the past 12 months, the same reporting window as the PGSI.

Risk curve and receiver operating characteristic methodology

Statistical methods from previous studies on the gambling dose–response relationship (Currie et al., 2017; Dowling et al., 2021) were used to identify optimal limits or thresholds for discerning the relationship between gambling involvement and risk of harm. First, risk curves were generated for the selected datasets. Risk curves are largely a qualitative method to visualize the dose–response relationship but cannot be used to identify an optimal limit when the slope of the curve begins to increase. For this purpose, receiver operating characteristic (ROC) analysis was used to examine the performance of various limits over the complete range of non-zero values for the four parameters of gambling involvement. The area under the curve (AUC with 95% confidence intervals) provided an overall measure of accuracy (DeLong et al., 1988). Analyses yielding AUC of >.70 for cross-sectional data sets and >.60 for longitudinal datasets were considered sufficiently strong for inclusion (Currie et al., 2017). For each included analysis, two criteria for optimal performance were used to identify the bottom and top of the range of potential limits. The lower range criterion (1) attempted to maximize the sensitivity and specificity without giving weight to either. This approach is quantified by the Youden Index (Ruopp et al., 2008). To establish a higher limit, the higher range criterion (2) was the limit that maximized specificity while ensuring that sensitivity was fixed at 0.7 or higher (Currie et al., 2017; Dowling et al., 2018).

Identical analyses were conducted for each of the 11 datasets according to specific prespecified parameters. Participants not gambling in the past year were excluded. Risk curves and ROC analyses were conducted separately for each gambling and harm indicator pairing. For cross sectional datasets, the gambling and harm indicators referred to the past year whereas for longitudinal datasets, the gambling indictors at the baseline assessment were used to predict the harm indictors at the first follow-up (one year later). To assess gender differences, all analyses were also conducted separately for men and women and the AUC 95% CIs were statistically compared (Hanley & MacNeil, 1982). The final determination of the lower-risk gambling limits was based on a modal examination for each potential cut-point of the percentage of datasets where the upper and lower threshold range for that analysis included that cut-point and an assessment of the mean of the upper and lower range thresholds.

Results

Validation of harm indictors

The correlations in Table 2 show that our various harm indicators were moderately correlated with the harm domain measures overall. The relationship between specific domains is bolded, and generally these correlations were as high or slightly higher than correlations between different domains. Importantly, all the indicators correlated moderately with the SGHS total score, indicating that they are all reasonable proxies of harm.

Table 2. Spearman correlations between risk curve harm indicators and harm domains (N = 4,027).

	Harm Domains					
PGSI Harm Indicators	Financial	Relationships	Emotional	Health	Work	SGHS
Financial harm- any	**.44**	.34	.40	.38	.25	.41
Bet more than afford	.42	.31	.38	.35	.20	.41
Borrowed money	.43	.44	.39	.42	.42	.31
Financial problems	.53	.46	.49	.49	.34	.47
Emotional harm- any	.36	.32	**.41**	.33	.23	.40
Felt like you had problem	.33	.33	.45	.34	.25	.38
Felt guilty	.43	.44	.39	.42	.42	.31
Health	.43	.46	.53	**.51**	.35	.46
Relationship	.28	**.43**	.32	.35	.38	.24
Two or more harms	.43	.37	.44	.40	.26	**.45**
Total harms (0–7)	.55	.58	.60	.57	.48	.50

SGHS = Short Gambling Harm Scale. PGSI = Problem Gambling Severity Index item. All correlations significant at $p < .00001$.

Risk curve and receiver operating characteristic methodology for determining limits

Most risk curves displayed a discernable point along the curve when the risk of harm sharply increases that corresponded to the quantitative limit ranges identified below. Due to the volume of risk curves produced, only a few examples are included in Appendix S.B.

Expenditure

Total gambling expenditure for the five harm indicators and optimal limit ranges according to criteria 1 and 2 were available for all datasets (see Table S2). These analyses yielded a total of 66 ranges that met the AUC inclusion criterion. It also includes the number and percent of limit ranges that included each specific amount of spending per month. The limit range represents the optimal lower limit using criteria 1 and optimal upper limit using criteria 2 calculated for each analysis individually. For example, for financial harms among the 27 limit ranges, eight (or 30%) included CAD $60 per month within that survey's range of the optimal limits for monthly expenditure. Good convergence in criteria was defined a priori as values identified in 40% or more of the analyses (color coded red in Table S2). Examination of these modal percentages across harm parameters indicated that risk of gambling-related harm was likely to increase if an individual gambled approximately CAD $60 to $120 or more per month.

We also examined the means of the lower and upper limits provided by those contributing limit ranges (see Table 3). All lower range scores were above CAD $55. However, many of the upper ranges were in excess of CAD $120.

Percentage of income

Percentage of income represented the proportion of gross monthly household income (when available) spent on all forms of gambling in a typical month. The surveys that collected only personal or net income were excluded. These analyses yielded a total of 64 limit ranges according to criteria 1 and 2. As shown in Table S3, risk of harm was likely to increase if an individual gambled 1.0% to 3.0% or more of monthly gross income. Table 3

Table 3. Mean upper and lower limits by harm category.

Harms	Expenditure		Percentage of Income		Frequency		Number of Types	
	Criterion 1	Criterion 2	Criterion 1	Criterion 2	Criterion 1	Criterion 2	Criterion 1	Criterion 2
Financial	$65.90	$140.90	1.8	5.0	6.0	8.3	3.2	3.7
Relationship	$62.50	$145.00	1.6	4.3	7.3	9.2	3.0	3.9
Emotional	$56.80	$117.80	1.5	3.3	5.5	7.8	2.9	3.4
Health	$72.80	$119.40	1.8	3.4	5.3	7.5	2.8	3.4
Two or more	$46.7	$114.2	1.6	4.4	5.8	7.3	3.2	3.9

Mean expenditure was calculated from the risk curves compiled for each of the 11 datasets. Criterion 1 provides the lower and Criterion 2 the upper boundary. CAD $.

presents the mean percent of income according to the two criteria across the surveys. All lower range scores were between 1.5% and 2.0%. The mean upper ranges were between 3.3% and 5.0%.

Frequency

Frequency (in days gambled per month) limit ranges were available for all datasets. These analyses yielded a total of 56 ranges that met inclusion criteria. As shown in Table S4, risk was likely to increase if an individual gambled five to eight days or more per month. As shown in Table 3, the mean limit range scores fell between 5 and 8.5 days per month, with the exception of gambling related relationship harms (upper range 9.2).

Number of gambling types

Analyses of the relationship between the number of game types played in the last year and risk of harm yielded a total of 56 limits (see Table S5). Based on this modal analysis, risk was likely to increase if an individual gambled on three to four different game types. As shown in Table 3, the mean lower limits were between 2.8 and 3.2 types and the upper ranges were between 3.4 and 3.9.

Gender differences

All ROC analyses were conducted separately for participants identifying as male or female. The results across the gambling indicators revealed only small differences. Figure S.1 provides an example of the risk curves by gender. In the 224 ROC analyses that met inclusion criteria, statistically significant gender differences in AUC (5%) were found for 54 (24%). The percentage ranged from 19% for monthly expenditure to 28% for percentage of income. In most analyses (80%), slightly higher limits were found for men versus women, although the consistency among the harm indicators showing differences was low. Specific results are provided in the supplementary materials.

Discussion

This study revealed consistency both across harm indicators and datasets in the range of lower-risk gambling limits. This convergence of findings was encouraging given differences in survey countries and years conducted, language, culture, survey design, sampling strategy, etc., employed by each of the contributing surveys. Overall, individuals who, per month, gamble five to eight times or more, spend CAD $60 to $120 or more, spend 1 to 3% or more of gross household income or play three to four or more gambling types are at greater risk of experiencing gambling-related harm compared to people who gamble below these limits. Exceeding any of these limits elevates risk of harm. These different relationships were consistent regardless of the specific indicator of harm, and across the various cross-sectional and longitudinal datasets. These limits also align well with previous analyses conducted in specific jurisdictions (e.g. Canada, Australia) with the exception of the actual expenditure ranges which are lower in the current results (Dowling et al., 2018). The percentage of household income limits, however, were identical, which may be less vulnerable to survey time period and cross-national economic differences than expenditure amounts.

The absence of robust differences between men and women in the optimal lower-risk limits was not an unexpected finding given previous research also showed no gender effects (Currie et al., 2006; Dowling et al., 2021). In virtually all gambling prevalence studies, men with gambling problems outnumber women by a factor of three or four (Hodgins et al., 2011). Nonetheless, it appears that the dose–response relationship between gambling activity and harm is comparable for men and women. This finding is not surprising when one considers the harms measured were largely psychosocial in nature. For alcohol, despite physiological differences between men and women, recent guidelines recommend the same number of drinks for both sexes, mainly since at low levels of consumption, the differences only have a small impact on lifetime risk of harm (National Health and Medical Research Council, 2020).

This study has both strengths and limitations. First, the data were all self-reported survey data, which are more reliable and valid at the aggregate than at the individual level. However, the databases were chosen for inclusion as they used optimal measurement of gambling behavior (Williams & Volberg, 2010). Moreover, self-reported gambling aligns with the self-perceptions that gamblers rely on in evaluating themselves against lower-risk gambling advice (Currie et al., 2019). The same issue exists for other behavioral guidelines such as lower risk drinking guidelines.

The PGSI, although a well-validated standardized measure, assesses a limited number of problems that does not provide full coverage of the dimensions of individual harm advanced by the Victorian taxonomy (Langham et al., 2016). Nonetheless, the PGSI seems to have reasonable concurrent validity with a direct measure of the Victorian harm dimensions. Moreover, Dowling and colleagues (Dowling et al., 2021), using an Australian sample, recently compared risk curves derived from the PGSI items to those from the SGHS, finding that the limits were 'remarkably similar' and concluding that findings using the PGSI items as harm indicators are robust. Nonetheless, optimal measurement of harm from gambling is an area of debate and research focus that will have implications for research in lower risk limits (Dowling et al., 2021).

Our Western sample of high-income countries, unfortunately, did not include data from any countries outside of North America, Europe, Australia, and New Zealand. Whether similar or different ranges would be generated from Asian, African, or South American countries and middle- and low-income countries is unknown. It is also important to note that our datasets were from surveys conducted from 2005 to 2016. Gambling availability, participation and problem rates vary over time, and, in general, the relative popularity of online gambling is increasing, and the prevalence of problematic gambling is falling (Williams et al., 2021). Regular updating of risk curves with the most recent data is advisable.

Risk of harm to the individual does vary by game type, ranging from lower risk for lotteries to higher risk for continuous play formats such as electronic gambling machines. It is tempting to conclude that game-specific guidelines would be necessary. In previous publications by our team and other groups (Currie et al., 2006, 2012, 2017; Dowling et al., 2021, 2021) examining risk across all the types together provides the optimal prediction of risk. Analyses of limits for specific types of gambling are limited by the absence of a harm measure specific to that type of gambling and comparatively small sample sizes of individuals who gambling on each type of gambling. Furthermore, the number of gambling types is a robust predictor of harm (people who gamble on more types experience more harm, harm is not limited to the riskiest types) and it is known that individuals who engage in continuous play formats are also likely to gamble on less risky forms. Individuals who only play the lottery would typically fall well below the risk thresholds proposed by this evidence. As an alternative to game-specific limits, lower risk gambling guidelines can incorporate special messaging that highlights the elevated risk associated with continuous play formats (notably, EGMs, online gambling). The Lower-Risk Cannabis Guidelines adopted this approach whereby higher THC-content products are identified as having a higher risk of adverse consequences (Fischer et al., 2017).

Although the analyses conducted for this study resulted in a range of lower-risk gambling limits, the ranges still needed refinement in order to be integrated into clear, effective public health messaging (Young et al., 2022). The next steps in refining the ranges were aimed at seeking convergence among several additional qualitative (Flores-Pajot et al., 2021) and quantitative investigations (Young et al., 2022). For this project, which focused on developing Canadian lower-risk limits, these inputs included seeking information from individuals with a diverse range of gambling involvement regarding what steps they take naturally in limiting their gambling involvement and what limits they self-impose (Currie et al., 2020). A Canadian national online panel (N = 10,054) confirmed that setting personal expenditure and frequency limits were common strategies and were perceived as helpful. The specific amounts were variable – the median spending limit (CAD $69/month) fell into the range limits identified in this study and the median frequency (4 days/month) was slightly below. These results provide a sense that the relative risk values that we derived quantitatively align with subject values of absolute risk. Our risk curves confirm that risk begins to increase at any level of gambling.

Another critical set of inputs into refining the ranges is direct feedback from stakeholders, including individuals who gamble, professionals working with individuals with gambling problems, researchers and industry regulators and operators (Currie et al., 2019). Guidelines, especially if they promote behaviors that are at odds with current norms, must be reasonably credible to be considered.

Previous research has indicated strong support for the concept of lower-risk gambling advice in North America (Currie et al., 2008) and Australia (Dowling et al., 2021) from clinicians, policy-makers and the public. In this project, feedback was received from focus groups and from participants in a national online panel. In general, people who gamble support guidelines, and found these ranges acceptable. These studies provided initial feedback on how to effectively communicate refined limits in an understandable, concise, and clear fashion. It is preferable to provide messages oriented to different sub-populations, even if the quantitative limits are identical (e.g. men and women, various cultural groups, older adults, EGM players).

In summary, effective public health approaches to reducing harms must include an array of coordinated harm minimization approaches, one of which is evidence-based lower-risk guidelines. Public health messaging can increase awareness for all citizens and provide consumers with direction on how to reduce their overall risk of harm while gambling. This information can also be useful for regulators and operators in setting reasonable parameters for gambling products (e.g. mandatory limit-setting), help identify individuals at risk of harm, and as benchmarks for surveillance of harm. These findings reveal that such guidelines can be based upon empirically derived lower-risk limits.

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Review exempted because project used only completed secondary analyses with deidentified data

Author contributions

All authors contributed to the study methodology and data analyses and reviewed drafts of the manuscript. DH wrote the first draft. SC, MY and DH verified the data and aggregated the data results across collaborators.

Competing interests

DH, MA, RB, NB, JMC, MD, SK, DOUR, AS, RV, LN, and SC report receiving personal fees from the Canadian Centre for Substance Use and Addiction during this project. MY, CP, and MCFP have no conflicts to report.

Data availability statement

Requests for access to the data in which proposed use aligns with public good purposes will be considered individually by the author(s) from each jurisdiction (country) providing prevalence survey data. Access will be according to local regulation.

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