1828
AKADÉMIAI KIADÓ

Journal of Behavioral Addictions

15 (2026) 1, 407–418

DOI:
10.1556/2006.2025.00104

FULL-LENGTH REPORT

Deriving lower-risk gambling limits from data collected in four cross-sectional Finnish surveys

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Received: June 30, 2025 • Revised manuscript received: October 29, 2025; December 19, 2025 • Accepted: December 23, 2025
Published online: February 11, 2026

ABSTRACT

Background: This article aims to examine the relationship between gambling participation and risk of gambling-related harms (GRHs) in Finland using four nationally representative cross-sectional datasets from 2011, 2015, 2019, and 2023. This study is linked with developing Lower-Risk Gambling Guidelines (LRGGs). *Methods:* Data consisted of 14,163 adults (51.8% men; median age = 52) who reported gambling during the past year. Lower-risk limits of gambling participation (gambling frequency, number of gambling types, gambling expenditure as percentage of personal net income [GEPI]) were calculated using GRH indicators. The data from years 2011 and 2015 were analysed together, and analyses were replicated with the 2019 and 2023 data. Gambling participation was measured with categorical variables and GRH indicators were derived from 7 items of the Problem Gambling Severity Index (PGSI). *Results:* The lower-risk limits were similar between datasets for gambling frequency (6 gambling days per month). For number of gambling types, the limit was lower in 2023 compared to other datasets (2 gambling types vs. 3 gambling types). For GEPI, the lower-risk limit was stricter in 2019 and 2023 (2.0%) compared to 2011–2015 (3.0%). *Conclusions:* Finnish 2019 and 2023 data revealed somewhat stringent risk limits for number of gambling types and GEPI compared to Finnish 2011–2015 data. However, according to the study testing the feasibility and acceptability of LRGGs in Finland, original LRGGs were considered suitable. These results can be considered when implementing LRGGs in Finland.

KEYWORDS

gambling harms, cross-sectional study, lower-risk gambling limits, problem gambling, prevention, risk curves

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INTRODUCTION

Gambling industry strategies and games are designed to encourage people to gamble, continue gambling and lose money, which may lead to diverse types of harm. Gambling products/games include online and land-based lotteries, electronic gaming machines (EGMs)

and scratch card games, but also sports betting, horse racing, table games (e.g., roulette, poker, blackjack) and bingo. Intensive gambling participation and high gambling expenditure (GE) are linked with gambling-related harms (GRHs) (Young et al., 2021, 2022). GRHs include financial, health, relationship, emotional/psychological, work/study harm, and social deviance harms (Langham et al., 2016). From a public health perspective, the societal impact of gambling is largely due to the harm experienced by people who gamble 'at-risk' levels, who greatly outnumber those with more severe forms of gambling problems (Browne & Rockloff, 2018; Browne, Volberg, Rockloff, & Salonen, 2020; Volberg, Zorn, Williams, & Evans, 2021). Based on a Canadian study, the most common gambling control strategies for gamblers were setting predetermined spending limits, keeping track of money spent and limiting alcohol consumption (Currie et al., 2020). Furthermore, gamblers who stayed within their gambling limits were less likely to report harm, even after controlling for other risk factors. Moreover, the findings of Flores-Pajot et al. (2021) highlight the importance of informing people who gamble about clear gambling limits, and the value of developing individual self-control strategies to limit the time and money spent on gambling.

Public health initiatives aiming to increase awareness of gambling impacts may be useful for preventive purposes. Prevention efforts targeting the whole population, rather than only to those with problem gambling, may be more effective because they can affect a larger group of people (Currie et al., 2006; Currie, Miller, Hodgins, & Wang, 2009). Many individuals not meeting the criteria for problem gambling still gamble regularly, which puts them at some risk for experiencing harms. In 2021, the Canadian Centre on Substance Use and Addiction (CCSA) published the Lower-Risk Gambling Guidelines (LRGGs) which are the first evidence-based informative gambling-related guidelines (Canadian Centre on Substance Use and Addiction [CCSA], 2025; Hodgins et al., 2023; Young et al., 2021; Young et al., 2022). The LRGGs consists of three limits, which all should be followed at the same time: 1) gamble no more than 1% of household gross income per month; and 2) gamble no more than four days per month; and 3) avoid regularly gambling at more than two types of games (Hodgins et al., 2023; Young et al., 2022). As a part of the development process, special risk populations and contextual factors were identified and included as part of the guidelines.

The target groups for the LRGGs include not only gamblers and those affected by someone's gambling, but also social and health care professionals, the policy makers, regulators, and gambling operators with an interest in reducing and preventing GRHs. The main purpose of the LRGGs is to prevent and reduce GRHs by increasing awareness and providing evidence-based information on the gambling limits one should not exceed (Currie & the Low Risk Gambling Guidelines Scientific Working Group [LRGG-SWG], 2019; Hodgins et al., 2023; Young et al., 2021). In practice, the LRGGs aim to help the general population make well-informed decisions about their gambling participation.

The LRGGs were developed during several phases in collaboration with an international expert panel (Currie & the LRGG-SWG, 2019; Hodgins et al., 2023; Young et al., 2021). The preparations of the LRGGs included, for example, validation via online surveys and interviews, but also summarizing scientific publications, such as a systematic literature review and meta-analysis (Allami et al., 2021; Currie et al., 2020; Currie & the LRGG-SWG, 2019; Flores-Pajot et al., 2021; Hodgins et al., 2023; Young et al., 2022), and consultations with a pan-Canadian multi-sectorial advisory committee. To develop the guidelines, risk curves describing gambling participation and experienced harms were developed based on population-representative high-quality datasets from eight countries (Currie & the LRGG-SWG, 2019; Hodgins et al., 2023). These curves permitted the establishment of ranges of lower-risk gambling limits. Following, contributing datasets were aggregated into a series of relative risk tables that were used for selecting the precise lower-risk limits (Young et al., 2022). Finland participated in this development process and two Finnish cross-sectional population-representative datasets contributed. However, information about household income, which is referred to in the first guideline, was not available in the Finnish datasets. The Finnish surveys asked about respondents' personal income instead of household income. Concerns about the applicability of the LRGGs in Finland led to a recent study formally examining their feasibility and acceptability within the Finnish cultural context (Palomäki et al., 2024). The study found that the guidelines were generally evaluated positively and that when the LRGGs referred to personal income instead of household income, people evaluated the guidelines somewhat more positively. Thus, the cultural context likely has an impact on the wider applicability of the LRGGs, and in Finland, unlike the original LRGGs model, the guideline on income limits specifically should reflect personal instead of household income.

This study aims to use methodology defined during development of the original LRGGs (Hodgins et al., 2023; Young et al., 2021) with existing Finnish population-based prevalence surveys to identify quantitative lower-risk gambling limits in Finland. Analyses were conducted for gambling frequency, number of gambling types, and gambling expenditure as percentage of personal net income (GEPI). Specifically, as a follow-up on Palomäki et al. (2024), we focused on formally defining lower-risk limits for the percentage of personal income (instead of household income as in the original LRGGs) used in gambling. Moreover, we sought to evaluate the temporal reliability of the guidelines by analysing and comparing data from different years. The LRGGs are based on time-bound empirical data, and subsequently collected new data may not reflect the original findings. Conflicting evidence from datasets collected at different times would cast doubt on the temporal reliability and stability of the relationship between gambling involvement and GRHs. Thus, we aimed to separately analyse the combined Finnish 2011–2015 data that were used in the process of defining the original LRGGs (Young et al., 2021), and newer 2019 and 2023 data, to compare the resulting lower-risk

limits. The null hypothesis assumed that time had no effect on LRGGs, a logical and testable premise aligned with the study design and underlying implementation plans. Given recent changes in gambling practices and environments, we sought to verify this assumption before adopting the guidelines in the Finnish context.

METHODS

Participants and procedure

Four nationally representative cross-sectional Finnish Gambling datasets including 15–74-year-old Finns living in mainland Finland collected in 2011, 2015, 2019, and 2023 were used in this study (Table 1). Computer Assisted Telephone Interviews (CATIs) were conducted in 2011–2019. In 2023, the data collection method changed to a combination of online and postal surveys. To assess the potential change in the methodology, part of the data (N = 1,250) was still collected using CATI. All studies were conducted in Finnish and Swedish. However, the time of the year, the organization conducting the data collection, average duration of the interview and use of incentives varied.

Measures

Number of gambling types was derived as the sum of individual game types played in the past year. Since the list of game types varied between years, the list was converted into 10 game types. Gambling frequency was derived as the sum of gambling days per month of 10 gambling types, derived from the survey questions 'How often have you played the following gambling type in the last year?'. In 2019–2023 the response

Table 1. Comparison of the research methods of four cross-sectional Finnish gambling datasets

	Finnish gambling 2011	Finnish gambling 2015	Finnish gambling 2019	Finnish gambling 2023
Data collected between	3 October 2011–14 January 2012	3 March 2015–8 June 2015	2 September 2019–13 December 2019	7 September 2023–10 December 2023
Data collected by	Taloustutkimus	Statistics Finland	Statistics Finland	Statistics Finland
Data collection method	CATI	CATI	CATI	Online and postal survey & CATI
Data collection language	Finnish or Swedish	Finnish or Swedish	Finnish or Swedish	Finnish or Swedish
Type of sampling	Random sample	Systematic random sample	Systematic random sample	Systematic random sample
Sample drawn from	The National Population Information System	The National Population Information System	The National Population Information System	The National Population Information System
Sample size (gross/actual)	16,000/15,999	7,400/7,297	7,800/7,695	16,250/16,215
Age range	15–74	15–74	15–74	15–74
Inclusion criteria	Finnish or Swedish mother tongue and resident in mainland Finland	Finnish, Swedish, or Sámi mother tongue and resident in mainland Finland	Finnish, Swedish, or Sámi mother tongue and resident in mainland Finland	Finnish, Swedish, or Sámi mother tongue and resident in mainland Finland
Exclusion criteria	Not specified	People living in institutions	People living in institutions	People living in institutions
Incentives	Not specified	Yes, three Apple iPads were drawn among the respondents	Yes, three Apple iPads were drawn among the respondents	No incentives
The average interview duration (75th percentile point)	19 min (not specified)	18 min (21 min)	24 min (29 min)	31 min (not specified)
Participants (response rate)	4,484 (28%)	4,515 (62%)	3,994 (52%)	5,977 (37%)
Weighting	Age, gender, and region of residence	Age, gender, and region of residence	Age, gender, and region of residence	Age, gender, and region of residence
Reference	Turja, Halme, Mervola, Järvinen-Tassopoulos, and Ronkainen (2012)	Salonen and Raisamo (2015)	Salonen et al. (2020)	Finnish Institute for Health and Welfare (THL) (2024)

Note: CATI = Computer Assisted Telephone Interview.

categories changed compared to 2011–2015 (Supplementary Table S1). GEPI was derived from monthly GE and monthly personal net income, where the phrasing of the GE question varied between years (Supplementary Table S2).

Items from the Problem Gambling Severity Index (PGSI) were used for measuring GRHs (Hodgins et al., 2023). Four binary GRH indicators were derived from seven PGSI items (Table 2) with previous research identifying them as valid indicators of GRHs across four harm domains (Currie et al., 2017; Dowling et al., 2021; Hodgins et al., 2023). GRH indicator was coded '0' if the values of all PGSI items were 'never', and '1' if the value of at least one PGSI item was 'sometimes', 'often', or 'always'. Binary PGSI indicators were derived with code '0' if the value of PGSI item was 'never',

Table 2. Description of background variables, gambling-related variables, and harm indicators using imputed datasets

	2011–2015	2019	2023	Total
Respondents	6,934	3,088	4,141	14,163
Gender				
Man	3,592 (51.8%)	1,646 (53.3%)	2,096 (50.6%)	7,334 (51.8%)
Woman	3,342 (48.2%)	1,442 (46.7%)	2,045 (49.4%)	6,829 (48.2%)
Age (years)				
Mean (SD)	48.5 (15.8)	49.5 (15.8)	50.8 (15.4)	49.4 (15.7)
Median	51	51	53	52
Marital status				
Married/common law	4,132 (59.6%)	2,154 (69.8%)	2,842 (68.6%)	9,128 (64.4%)
Single	1,855 (26.8%)	571 (18.5%)	789 (19.1%)	3,215 (22.7%)
Separated/divorced/widow	947 (13.7%)	362 (11.7%)	510 (12.3%)	1,819 (12.8%)
Socio-economic status				
Employed	3,906 (56.3%)	1,881 (60.9%)	2,495 (60.3%)	8,282 (58.5%)
Retired	1,644 (23.7%)	790 (25.6%)	1,016 (24.5%)	3,450 (24.4%)
Student	504 (7.3%)	164 (5.3%)	254 (6.1%)	922 (6.5%)
Unemployed	380 (5.5%)	102 (3.3%)	143 (3.5%)	625 (4.4%)
Disability	301 (4.3%)	80 (2.6%)	138 (3.3%)	519 (3.7%)
Other	199 (2.9%)	71 (2.3%)	95 (2.3%)	365 (2.6%)
Monthly personal net income (€)				
Mean (SD)	2034.1 (4059.8)	2241.7 (1484.1)	2460.6 (1492.0)	2204.1 (3043.0)
Median	1,800	2,000	2,300	2,000
Gambling frequency (gambling days per month)				
Mean (SD)	6.4 (10.9)	5.6 (9.4)	5.4 (9.6)	5.9 (10.2)
Median	4.0	2.8	2.2	3.0
Number of gambling types				
Mean (SD)	2.5 (1.5)	2.6 (1.5)	2.3 (1.4)	2.5 (1.5)
Median	2	2	2	2
Monthly gambling expenditure (GE) (€)				
Mean (SD)	42.3 (183.3)	44.8 (286.1)	52.3 (368.6)	45.8 (272.6)
Median	13.0	10.9	10.9	12.5
Gambling expenditure as percentage of personal net income (GEPI)[1]				
Mean (SD)	4.4 (40.3)	3.1 (34.7)	2.7 (14.5)	3.6 (33.4)
Median	0.8	0.6	0.5	0.6
Gambling-related harm (GRH) indicators				
Financial harm	243 (3.5%)	84 (2.7%)	192 (4.6%)	519 (3.7%)
Bet more than afford[2]	223 (3.2%)	80 (2.6%)	167 (4.0%)	470 (3.3%)
Borrowed money[2]	30 (0.4%)	9 (0.3%)	50 (1.2%)	89 (0.6%)
Financial problems[2]	54 (0.8%)	33 (1.1%)	84 (2.0%)	171 (1.2%)
Relationship harm	168 (2.4%)	67 (2.2%)	117 (2.8%)	352 (2.5%)
Criticized by others[2]	168 (2.4%)	67 (2.2%)	117 (2.8%)	352 (2.5%)
Emotional harm	305 (4.4%)	154 (5.0%)	325 (7.8%)	784 (5.5%)
Felt guilty[2]	204 (2.9%)	114 (3.7%)	250 (6.0%)	568 (4.0%)
Felt gambling problem[2]	215 (3.1%)	117 (3.8%)	229 (5.5%)	561 (4.0%)
Health harm	88 (1.3%)	56 (1.8%)	117 (2.8%)	261 (1.8%)
Health problems[2]	88 (1.3%)	56 (1.8%)	117 (2.8%)	261 (1.8%)
Two or more harms[3]	216 (3.1%)	101 (3.3%)	227 (5.5%)	544 (3.8%)

[1]Respondents with personal income equal to 0 or GEPI ≥1,500% were excluded: $N = 14,031$ ($N = 6,865$ in 2011–2015, $N = 3,063$ in 2019, and $N = 4,103$ in 2023).
[2]Problem Gambling Severity Index (PGSI) indicators.
[3]Two or more harms of the PGSI indicators.
Note: SD = Standard deviation.

and '1' otherwise. In addition, seven PGSI indicators were exploited to derive 'two or more harms' indicator, which in previous research has been used as an estimator of experiencing GRHs (Currie et al., 2009).

Statistical analysis

Finnish Gambling 2011, 2015, 2019, and 2023 survey datasets were restricted to 18-year and older respondents who had gambled during the past year resulting in final sample sizes of 3,379 in 2011, 3,555 in 2015, 3,088 in 2019, and 4,141 in 2023. Individuals aged 15–17 years were excluded, as gambling is legally restricted to those aged 18 or older in Finland and the LRGGs apply only to individuals of legal gambling age (CCSA, 2025). Two GE values were considered outliers and were replaced by the second largest value for that year. Multiple imputation (MI) with chained equations was utilized for handling missing data using the mice package in R (R Core Team, 2023; van Buuren & Groothuis-Oudshoorn, 2011). Five imputed datasets were generated under the assumption of missing at random (MAR). Survey year, gender, age, marital status, socio-economic status, personal income, gambling frequency, GE, number of gambling types, and nine PGSI items were included in the imputation models. Variables in the imputation model along with their types, imputation methods, and number of missing values are presented in Supplementary Table S4. All analyses were conducted separately for each imputed dataset before the results were pooled together. The data from 2011 to 2015 was analysed together, similarly to the original LRGGs analysis by Young et al. (2021), where results were combined for countries with data from multiple years.

GEPI, PGSI and GRH indicators, and 'two or more harms' indicator were derived from the imputed datasets. Gambling participation variables were categorized similarly to Young et al. (2021) except for GEPI where the two lowest categories (≤0.1 and 0.11–0.50) were combined, since there were no gamblers with GEPI ≤0.1% who experienced financial or relationship harms in 2019. Gamblers with personal income equal to 0 or GEPI ≥1,500% were excluded from the GEPI analysis. Receiver operating characteristic (ROC) analyses were performed to identify the lower-risk limits using three criteria: the Youden index (Youden, 1950), maximizing sensitivity (specificity ≥0.5), and maximizing specificity (sensitivity ≥0.5). Area under curve (AUC) values were calculated with AUC <0.70 indicating poor discrimination ability. Risks of experiencing each GRH was calculated for each gambling participation variable category relative to corresponding reference category (RC). Risk curves of gambling participation variables were plotted against PGSI indicators. The analysis was not pre-registered, and the results should be considered exploratory.

Ethics

The Ethics Committee of the Finnish Institute for Health and Welfare has approved the research protocol for each cross-sectional study (2011: 6/2011§350–361; 2015: 10/2011§404–418; 2019: THL/774/6.02.01/2019; 2023: THL/1700/6.02.01/2023). Participation was voluntary and participants gave informed consent. The survey data from each year is available for research purposes from the Finnish Society Science Data Archive (https://www.fsd.tuni.fi/en/).

RESULTS

There were more men respondents (51.8%), the mean age was 49.4 years, 64.4% were living in a marriage or common law relationship, and 58.5% were employed (Table 2). There were more married/common law respondents and employed respondents in 2019–2023 than in 2011–2015. The mean gambling frequency was 6.0 days per month, and the mean monthly GE was 45.8€ with the mean increasing (42.2€ in 2011–2015 vs. 52.2€ in 2023). The mean of GEPI was 3.6%. The prevalence of GRH indicators varied between 1.3 and 7.8%, and the prevalence of PGSI indicators between 0.3 and 6.0%. The prevalences of GRH and PGSI indicators were higher in 2023 compared to 2011–2019.

Lower-risk limits for gambling participation variables

For gambling frequency, the lower-risk limits for all GRH indicators were similar across datasets (Table 3). Youden index and maximizing sensitivity criteria resulted limits of 6 and 4 gambling days per month, respectively.

In 2011–2019, the lower-risk limits for number of gambling types using Youden index were 3 gambling types for all GRH indicators, expect for relationship harms in 2011–2015 where the limit was 2 gambling types. In 2023, the limit for financial, relationship, and emotional harms was 2 gambling types. Limits using maximizing sensitivity criteria were 2 gambling types for all GRH indicators for all datasets.

For GEPI, lower-risk limits using Youden index for financial, relationship and emotional harms were 2.0% in 2019–2023, whereas in 2011–2015 limits for relationship and emotional harms were 3.0%. For health harms the limits were higher: 4.0% in 2011–2015 and 2023, and 3.0% in 2019. Lower-risk limits with maximizing sensitivity were 1.0% in 2011–2019, and 0.5% in 2023.

Lower-risk limits for two or more harms were similar compared to GRH indicators. Risk curves were plotted to observe the association between gambling participation variables and PGSI indicators (Supplementary Figures S1–S3).

Relative risks

The risks of experiencing harms among those with 7–8 gambling days relative to those in RC (≤1 gambling day) varied between 4.1 and 21.5 while among those with 5–6 gambling days the variation was 1.6–5.2 (Table 4, Supplementary Table S5).

The lower-risk limits for number of gambling types varied between GRHs and datasets. The risks of experiencing harms in categories including lower-risk limits relative to those in RC (1 gambling type) varied between 2.0 and 15.0 while the risks in subsequent categories varied between 3.1 and 30.0 (Table 5, Supplementary Table S6).

Table 3. Lower-risk limits and related statistics for gambling frequency, number of gambling types, and gambling expenditure as percentage of personal net income (GEPI) using three criteria

		Youden index		Maximizing sensitivity		Maximizing specificity		AUC
		Cut-off	Sens/Spec	Cut-off	Sens/Spec	Cut-off	Sens/Spec	
Gambling frequency (gambling days per month)								
Financial harm	2011–2015	6	0.67/0.80	4	0.78/0.62	8	0.57/0.85	0.77
	2019	6	0.70/0.79	4	0.83/0.63	8	0.62/0.85	0.80
	2023	6	0.63/0.83	4	0.73/0.68	8	0.52/0.88	0.77
Relationship harm	2011–2015	6	0.74/0.79	4	0.85/0.62	8	0.68/0.85	0.81
	2019	6	0.70/0.79	4	0.79/0.62	8	0.61/0.85	0.79
	2023	6	0.70/0.82	4	0.79/0.67	8	0.63/0.87	0.81
Emotional harm	2011–2015	6	0.65/0.80	4	0.74/0.62	8	0.56/0.85	0.75
	2019	6	0.64/0.80	4	0.74/0.63	8	0.54/0.86	0.74
	2023	6	0.57/0.84	4	0.69/0.69	8	0.51/0.89	0.75
Health harm	2011–2015	6	0.72/0.79	4	0.81/0.61	8	0.52/0.84	0.78
	2019	6	0.68/0.79	4	0.82/0.62	8	0.59/0.85	0.78
	2023	6	0.63/0.82	4	0.71/0.67	8	0.55/0.87	0.75
Two or more harms[3]	2011–2015	6	0.76/0.80	4	0.83/0.62	8	0.67/0.85	0.81
	2019	6	0.72/0.80	4	0.82/0.63	8	0.61/0.86	0.80
	2023	6	0.67/0.83	4	0.76/0.68	8	0.60/0.88	0.79
Number of gambling types								
Financial harm	2011–2015	3	0.65/0.79	2	0.80/0.62	3	0.65/0.79	0.78
	2019	3	0.70/0.76	2	0.88/0.56	3	0.70/0.76	0.80
	2023	2	0.70/0.67	2	0.70/0.67	3	0.50/0.85	0.75
Relationship harm	2011–2015	2	0.85/0.61	2	0.85/0.61	3	0.67/0.79	0.80
	2019	3	0.73/0.75	2	0.86/0.56	4	0.54/0.89	0.80
	2023	2	0.68/0.67	2	0.68/0.67	3	0.51/0.84	0.74
Emotional harm	2011–2015	3	0.61/0.80	2	0.77/0.62	3	0.61/0.80	0.76
	2019	3	0.67/0.77	2	0.83/0.57	3	0.67/0.77	0.77
	2023	2	0.69/0.69	2	0.69/0.69	2	0.69/0.69	0.74
Health harm	2011–2015	3	0.65/0.78	2	0.80/0.61	3	0.65/0.78	0.77
	2019	3	0.75/0.75	2	0.91/0.56	4	0.52/0.89	0.82
	2023	3	0.47/0.84	2	0.64/0.67	2	0.64/0.67	0.69[1]
Two or more harms[3]	2011–2015	3	0.70/0.79	2	0.85/0.62	3	0.70/0.79	0.81
	2019	3	0.73/0.76	2	0.90/0.57	3	0.73/0.76	0.82
	2023	2	0.73/0.68	2	0.73/0.68	3	0.54/0.85	0.76
Gambling expenditure as percentage of personal net income (GEPI)[2]								
Financial harm	2011–2015	2.0	0.76/0.72	1.0	0.85/0.57	5.0	0.54/0.90	0.80
	2019	2.0	0.84/0.80	1.0	0.91/0.65	5.0	0.62/0.93	0.89
	2023	2.0	0.73/0.81	0.5	0.89/0.52	5.0	0.53/0.94	0.83
Relationship harm	2011–2015	3.0	0.73/0.81	1.0	0.92/0.56	5.0	0.61/0.89	0.84
	2019	2.0	0.85/0.80	1.0	0.90/0.64	5.0	0.65/0.93	0.87
	2023	2.0	0.76/0.80	0.5	0.90/0.51	5.0	0.58/0.93	0.83
Emotional harm	2011–2015	3.0	0.61/0.82	1.0	0.81/0.57	4.0	0.54/0.86	0.77
	2019	2.0	0.71/0.81	1.0	0.80/0.65	5.0	0.51/0.94	0.81
	2023	2.0	0.66/0.82	0.5	0.87/0.53	3.0	0.56/0.89	0.80
Health harm	2011–2015	4.0	0.70/0.85	1.0	0.86/0.56	5.0	0.62/0.89	0.81
	2019	3.0	0.79/0.86	1.0	0.86/0.64	5.0	0.66/0.93	0.87
	2023	4.0	0.60/0.90	0.5	0.88/0.51	5.0	0.56/0.93	0.81
Two or more harms[3]	2011–2015	3.0	0.73/0.81	1.0	0.90/0.57	5.0	0.59/0.90	0.83
	2019	2.0	0.85/0.81	1.0	0.91/0.65	5.0	0.64/0.94	0.89
	2023	2.0	0.74/0.82	0.5	0.92/0.52	5.0	0.53/0.94	0.85

[1]AUC <0.70 indicates poor discrimination ability.
[2]Respondents with personal income equal to 0 or GEPI ≥1,500% were excluded.
[3]Two or more harms of the PGSI indicators.
Note: Sens = Sensitivity, Spec = Specificity, AUC = Area under the curve.

Table 4. The relative risk of experiencing gambling-related harm by gambling frequency (gambling days per month)

Gambling frequency (gambling days per month)						
Risk relative to reference category (≤1 gambling day)		2	3–4	5–6	7–8	≥9
Financial harm	2011–2015	3.0 (1.4–6.5)	2.4 (1.3–4.5)	3.1 (1.6–5.8)[1]	9.1 (4.8–17.1)	17.4 (10.3–29.5)
	2019	3.0 (0.6–16.3)	3.2 (1.0–10.6)	5.2 (1.7–16.3)[1]	9.5 (2.8–32.1)	26.2 (9.5–72.0)
	2023	4.5 (2.2–9.2)	2.5 (1.4–4.6)	2.6 (1.4–5.0)[1]	9.1 (4.9–16.8)	15.5 (9.5–25.4)
Relationship harm	2011–2015	1.3 (0.3–6.2)	3.7 (1.5–8.9)	4.7 (2.0–11.3)[1]	8.7 (3.3–22.7)	33.7 (15.8–72.0)
	2019	6.0 (1.2–29.5)	4.3 (1.1–16.1)	4.0 (1.0–15.9)[1]	11.0 (2.8–43.6)	27.7 (8.6–89.0)
	2023	4.2 (1.2–14.2)	4.0 (1.6–10.0)	4.5 (1.8–11.6)[1]	9.5 (3.5–25.9)	31.0 (14.4–66.9)
Emotional harm	2011–2015	1.8 (0.9–3.5)	2.0 (1.2–3.2)	1.8 (1.1–3.0)[1]	4.9 (2.9–8.4)	11.7 (7.8–17.4)
	2019	0.9 (0.3–3.0)	1.1 (0.6–2.1)	1.6 (0.8–3.0)[1]	4.1 (2.2–7.8)	8.4 (5.3–13.3)
	2023	2.9 (1.7–5.0)	2.2 (1.4–3.4)	2.7 (1.8–4.1)[1]	4.4 (2.7–7.2)	11.7 (8.4–16.3)
Health harm	2011–2015	0	4.0 (1.4–11.3)	3.5 (1.1–10.7)[1]	21.5 (8.0–57.9)	20.5 (8.2–51.4)
	2019	1.5 (0.2–13.3)	2.0 (0.5–7.4)	3.8 (1.1–12.6)[1]	6.8 (1.8–25.1)	16.8 (6.0–47.2)
	2023	4.1 (1.7–9.7)	1.7 (0.8–3.7)	1.9 (0.8–4.4)[1]	6.0 (2.7–13.3)	13.6 (7.7–24.1)
Two or more harms[2]	2011–2015	2.8 (1.1–7.3)	2.6 (1.2–5.5)	2.6 (1.2–5.8)[1]	9.8 (4.6–20.9)	25.6 (13.5–48.4)
	2019	3.0 (0.8–11.5)	2.2 (0.8–6.0)	3.2 (1.2–8.4)[1]	10.0 (3.9–25.5)	21.0 (9.7–45.5)
	2023	3.5 (1.7–7.2)	2.2 (1.2–4.0)	2.5 (1.4–4.6)[1]	5.9 (3.1–11.1)	17.8 (11.4–27.9)

[1]Lower-risk limit using Youden index.
[2]Two or more harms of the Problem Gambling Severity Index (PGSI) indicators.

Table 5. The relative risk of experiencing gambling-related harm by number of gambling types

Number of gambling types						
Risk relative to reference category (1 gambling type)		2	3	4	5	≥6
Financial harm	2011–2015	2.0 (1.1–3.6)	3.8 (2.2–6.7)[1]	7.4 (4.3–12.7)	15.4 (9.1–26.1)	21.7 (13.0–36.2)
	2019	1.4 (0.4–4.9)	5.0 (1.7–15.0)[1]	8.2 (2.8–24.1)	17.4 (5.9–51.4)	29.0 (10.2–82.3)
	2023	2.5 (1.5–4.3)[1]	3.9 (2.3–6.7)	7.6 (4.5–12.9)	11.8 (6.8–20.4)	17.1 (10.0–29.3)
Relationship harm	2011–2015	2.2 (1.0–5.0)[1]	6.2 (2.9–13.5)	11.5 (5.4–24.7)	14.5 (6.6–32.1)	36.5 (17.5–76.1)
	2019	1.2 (0.3–4.5)	3.0 (0.9–9.7)[1]	6.0 (2.0–18.3)	10.8 (3.4–34.1)	30.2 (10.7–85.4)
	2023	2.2 (1.1–4.2)[1]	3.1 (1.6–6.1)	5.9 (3.0–11.6)	11.7 (6.0–22.8)	15.7 (8.1–30.6)
Emotional harm	2011–2015	2.1 (1.3–3.4)	3.7 (2.3–5.9)[1]	7.2 (4.6–11.3)	9.7 (6.0–15.6)	20.4 (13.3–31.3)
	2019	3.4 (1.4–8.4)	5.9 (2.4–14.3)[1]	14.4 (6.2–33.5)	19.4 (8.1–46.6)	28.3 (12.1–66.4)
	2023	2.2 (1.5–3.3)[1]	4.0 (2.7–5.9)	6.7 (4.6–9.9)	10.5 (7.1–15.6)	11.2 (7.4–16.9)
Health harm	2011–2015	1.2 (0.5–3.0)	2.8 (1.2–6.5)[1]	6.0 (2.7–13.3)	6.0 (2.5–14.7)	20.0 (9.5–41.9)
	2019	5.0 (0.6–44.6)	15.0 (1.9–118.1)[1]	30.0 (3.9–228.6)	54.0 (7.0–419.3)	110.0 (14.8–816.2)
	2023	1.5 (0.8–2.7)	2.0 (1.1–3.7)[1,2]	4.9 (2.7–8.8)	6.5 (3.4–12.3)	8.5 (4.5–16.2)
Two or more harms[3]	2011–2015	1.7 (0.8–3.4)	4.3 (2.3–8.2)[1]	10.2 (5.5–18.8)	15.3 (8.2–28.5)	31.3 (17.5–56.1)
	2019	4.5 (1.0–21.1)	14.5 (3.4–62.5)[1]	27.5 (6.5–115.8)	51.5 (12.1–219.2)	90.0 (21.7–372.5)
	2023	2.4 (1.4–4.0)[1]	4.3 (2.6–7.1)	9.4 (5.8–15.3)	14.3 (8.6–23.6)	18.5 (11.2–30.6)

[1]Lower-risk limit using Youden index.
[2]Area under the curve (AUC) value 0.69 indicating poor discrimination ability.
[3]Two or more harms of the Problem Gambling Severity Index (PGSI) indicators.

For GEPI, the risks of experiencing harms in categories including lower-risk limits relative to those in RC (GEPI ≤0.5%) varied between 2.0 and 13.0 with an increase of 2.1–23.0 percentage points compared to the risks in subsequent categories (Table 6, Supplementary Table S7).

DISCUSSION

We identified quantitative lower-risk gambling limits in Finland separately for combined 2011–2015 dataset and for 2019 and 2023 datasets using methodology defined during development of the original LRGGs (Hodgins et al., 2023; Young et al., 2021), based on gambling frequency, number of gambling types, and GEPI. The limit for gambling frequency was 6 days in all Finnish datasets, while limits for number of gambling types were stricter in 2023 compared to 2011–2019 (2 vs. 3 types). For GEPI, the limits in 2019–2023 were lower compared to 2011–2015 (2.0% vs. 3.0%). Finnish combined 2011–2015 dataset was used in the process of defining the original LRGGs (Young et al., 2021). In this study, the Finnish limits seemed to be not as strict as in the original LRGGs for both gambling frequency (6 vs. 4 days) and number of gambling types (3 vs. 2 types) (Young et al.,

Table 6. The relative risk of experiencing gambling-related harm by gambling expenditure as percentage of personal net income (GEPI)

GEPI[1] (%)							
Risk relative to reference category (GEPI ≤0.5%)		0.51–1.0	1.01–2.0	2.01–3.0	3.01–4.0	4.01–5.0	≥5.01
Financial harm	2011–2015	2.4 (1.3–4.6)	3.0 (1.6–5.5)[2]	5.3 (2.9–9.5)	5.7 (2.9–11.3)	8.4 (4.4–16.2)	22.6 (14.2–36.0)
	2019	10.0 (1.9–51.4)	13.0 (2.6–64.2)[2]	30.0 (6.1–147.6)	50.0 (10.2–245.1)	69.0 (14.1–336.9)	206.0 (50.5–840.7)
	2023	2.4 (1.2–4.7)	2.7 (1.4–5.2)[2]	4.8 (2.4–9.5)	9.6 (5.0–18.4)	8.1 (3.8–17.4)	29.6 (18.6–47.2)
Relationship harm	2011–2015	3.5 (1.2–10.4)	8.0 (3.2–20.2)	12.5 (4.9–31.8)[2]	18.5 (7.0–49.0)	18.0 (6.5–50.2)	62.0 (27.3–140.8)
	2019	2.0 (0.4–8.9)	2.0 (0.4–8.9)[2]	11.7 (3.5–39.6)	13.7 (3.7–50.4)	3.7 (0.4–32.8)	59.0 (21.4–162.8)
	2023	3.2 (1.4–7.5)	2.2 (0.8–5.9)[2]	6.6 (2.8–15.8)	7.6 (2.8–20.3)	9.0 (3.2–25.5)	39.8 (21.3–74.5)
Emotional harm	2011–2015	2.0 (1.2–3.4)	2.7 (1.7–4.3)	3.5 (2.1–5.8)[2]	5.4 (3.2–9.2)	5.6 (3.2–9.9)	14.8 (10.3–21.3)
	2019	1.8 (0.9–3.8)	2.3 (1.2–4.6)[2]	5.1 (2.6–10.2)	5.7 (2.6–12.3)	7.9 (3.7–16.9)	23.8 (14.7–38.6)
	2023	2.8 (1.8–4.3)	2.7 (1.7–4.2)[2]	5.7 (3.7–8.8)	6.0 (3.6–9.9)	10.7 (6.8–16.9)	18.9 (13.7–26.1)
Health harm	2011–2015	2.5 (0.8–7.9)	4.0 (1.5–11.0)	3.0 (0.9–10.2)	3.0 (0.6–14.4)[2]	14.0 (4.9–39.6)	32.5 (14.8–71.2)
	2019	12.0 (2.4–59.3)	4.0 (0.6–28.3)	10.0 (1.4–70.6)[2]	33.0 (6.1–178.4)	34.0 (5.8–200.8)	149.0 (36.1–614.3)
	2023	2.3 (1.0–5.2)	2.6 (1.2–5.8)	4.3 (1.8–10.2)	3.6 (1.2–10.8)[2]	6.4 (2.3–17.5)	26.9 (15.3–47.4)
Two or more harms[3]	2011–2015	2.5 (1.1–5.8)	4.5 (2.2–9.2)	6.5 (3.1–13.5)[2]	11.0 (5.1–23.6)	14.8 (7.0–31.3)	38.5 (21.4–69.2)
	2019	3.3 (0.9–12.2)	5.0 (1.5–17.0)[2]	15.0 (4.7–48.3)	16.7 (4.8–58.4)	23.0 (6.6–80.0)	86.0 (31.6–234.0)
	2023	4.0 (2.1–7.6)	4.5 (2.4–8.5)[2]	7.9 (4.1–15.3)	11.1 (5.6–22.1)	19.1 (10.0–36.4)	43.6 (26.6–71.5)

[1]Respondents with personal income equal to 0 or GEPI ≥1,500% were excluded.
[2]Lower-risk limit using Youden index.
[3]Two or more harms of the Problem Gambling Severity Index (PGSI) indicators.

2021). However, the recent feasibility study by Palomäki et al. (2024) found that the original LRGGs were considered sensible and 'just right' by the public in Finland.

While the original LRGGs were developed using 11 international population datasets collected between 2005 and 2016, few studies have evaluated their temporal reliability. Between 2011 and 2023, moderate-risk and problem gambling (PGSI ≥3) increased in Finland, particularly among men and younger adults, while low-risk gambling stabilized despite declining overall participation. This suggests intensified harm among active gamblers, driven by online and mobile platforms, greater accessibility, personalized marketing, and easy payment systems (Ghelfi, Scattola, Giudici, & Velasco, 2024; Harris & Griffiths, 2018; Marionneau, Ruohio, & Karlsson, 2023; Mihai, Aleca, & Iordache, 2025). Regulatory changes, including mandatory identification and potential marketing shifts post-license reform, may further influence risk distribution. These trends underscore the need for continuous monitoring and strengthened preventive measures such as LRGGs (Ghelfi et al., 2024; Harris & Griffiths, 2018).

In this study, the 2019–2023 data point towards more stringent risk limits than the 2011–2015 data. While the results do not suggest that the LRGGs should be substantially changed in Finland, it may nonetheless be better to err on the side of caution, particularly in terms of the LRGG limit on GEPI, when deciding on which LRGG limits to use for wider adoption. Palomäki et al. (2024) found that participants responded more favourably towards a personal income limit of 2% than a household income limit of 1% (the original LRGGs). This finding is in line with our current analysis, which resulted the lower-risk limit of 2.0% for GEPI in 2019–2023 and thus supports using the somewhat more restrictive proportional personal income limit of 2%. Moreover, personal income suits better to the Nordic countries, as couples typically manage their finances independently rather than sharing accounts with their spouses (Pepin & Cohen, 2021). Our current results together with the earlier positive response towards the feasibility and acceptability of the LRGGs (Egerer et al., 2025; Palomäki et al., 2024) provide strong evidence in support of widely adopting the LRGGs in Finland. The LRGG limit on income should, however, be changed to refer to personal- instead of household income.

The main implementation challenge of the LRGGs in Finland appears to stem from differences between target groups (e.g., individuals with gambling problems, prevention professionals, and public). Therefore, communication and promotion of the guidelines should be tailored to these distinct audiences. While people at risk of gambling-related harm represent a key target group—and could benefit most from adhering to the guidelines—earlier survey- and interview-based findings also indicate that they tend to view the guidelines' effectiveness more pessimistically (Palomäki et al., 2024). More broadly, prior research shows that many respondents perceived the guidelines as being intended for 'someone else' (Egerer et al., 2025). These challenges highlight the importance of targeted dissemination strategies and group-tailored engagement during implementation.

The LRGGs can help the general population make well-informed decisions about their gambling, but they also lend themselves well to monitoring population-level change in gambling. A recent study compared the prevalence of risky gambling based on the original LRGG limits in Finland between 2011, 2015, and 2019 (Grönroos, Kontto, Young, Hodgins, & Salonen, 2025). The study found that while gambling prevalence remained similar across the years, the prevalence of lower-risk gambling increased from 28.7% in 2011 to 39.3% in 2019. This positive trend indicates that more Finns are gambling in lower-risk level, potentially

supported by public promotion of the LRGGs. However, since lower-risk gambling was least common among those aged 60–74, this group may benefit most from targeted implementation.

In Finland, a shift from a gambling monopoly to a competitive licensing system is expected soon. As a result of this change and the expected increase in gambling availability and advertising seen in other countries (Young et al., 2024), there is an even greater need for guidelines such as the LRGGs, as it will likely be more difficult than present for individuals to monitor their own gambling activity. There is currently no universally accepted consensus or framework for LRGGs, which further complicates efforts to support individuals in monitoring their gambling behavior. If an individual gambles on more than one site, it may be more challenging to track the amount of money spent on gambling compared to using a single gambling site, where monitoring is easier. It is noteworthy that the LRGGs do not account for the number of player accounts across gambling sites. In other words, an individual may gamble on two types of games, but across several sites, leading to increased gambling activity. Prior research has shown that a high number of player accounts is associated with gambling problems (Salonen, Hagfors, Lind, & Kontto, 2020). However, the LRGGs state that some game types, such as many online forms of gambling, increase the risk of problems, as people can spend much money in a short time (CCSA, 2025).

Study limitations

Methodological differences among the surveys such as time of the year, the organization conducting the data collection, average duration of the interview, use of incentives, response rate, sample size, and number of missing values for personal income and GE might influence the comparability of the results between years (Table 1 and Supplementary Table S4).

Measurement of GRHs is an evolving methodology (Gooding, Allami, et al., 2024). Following the example of the original LRGGs, four GRH indicators were derived from PGSI items, which are not ideal measures of harms. These items correlate highly with items from the Short Gambling Harms Screen (SGHS), which supports their validity for this purpose (Hodgins et al., 2023). Moreover, an Australian study compared the low-risk gambling limits when GRH indicators were measured with PGSI items (financial and relationship harm) and the SGHS (Dowling et al., 2021): Both tools produced similar limits, indicating that PGSI-based limits represent robust thresholds with potential utility for preventive purposes. However, future research should also test the LRGGs using instrument assessing gambling-related harm more comprehensively than the SGHS.

Questions evaluating gambling behaviour, such as GE and number of gambling types varied slightly between years, which may limit the comparability of the study results. In addition, people who gamble, particularly those gambling excessively, tend to underestimate their gambling losses in surveys (Auer, Hopfgartner, Helic, & Griffiths, 2024; Braverman, Tom, & Shaffer, 2014; Murch et al., 2023; Wood & Williams, 2007). Therefore, self-reported GE is expected to be lower than in the reality. Based on a Norwegian register study, self-reported gambling losses correlate with register-based losses (Auer & Griffiths, 2017). In this study, we used 12-month time frame; however, self-reported losses have proved to be more accurate if the timeframe is shorter, such as 30 days, than past year (Auer et al., 2024). Auer et al. (2024) also noticed that men and women were able to estimate their deposits equally well; however, younger gamblers tended to overestimate them. Furthermore, following the methodology of the original LRGGs, overall gambling frequency was calculated by summing up the gambling type-specific frequencies converted into days. This derivation assumes no overlapping days between gambling types and thus potentially overestimates gambling frequency.

Individuals who do not currently gamble were excluded from the analyses. This approach may restrict the generalizability of the findings and prevent insights into potential risks associated with initiating gambling or comparisons with abstinent individuals. Moreover, as Abbott (2017) has noted, gambling cannot be considered risk-free, and even low levels of gambling cannot guarantee the absence of harm; this is why the guidelines refer to 'lower-risk' rather than 'low-risk' gambling.

This study used cross-sectional data whereas the original LRGGs included data that came from both cross-sectional and longitudinal designs. Conceptually, the LRGGs are meant to predict risk of both current and future harm. Predictive validity over time has been demonstrated in several studies (Currie et al., 2017; Currie, Hodgins, Williams, & Fiest, 2021). Most recently, Gooding, Young, and Hodgins (2024) replicated the LRGGs in recent Canadian longitudinal data, collected over one year. Overall, the lower-risk limits were similar for gambling frequency and number of gambling types, but, like this current study, the limits for percent of income were significantly higher in this more recent and longitudinal data set. This study reinforces the notion that improved measurement, and the use of prospective samples will be important in future research refining these limits.

CONCLUSIONS

Finnish 2019 and 2023 data indicated to somewhat stringent risk limits for number of gambling types and GEPI compared to Finnish 2011–2015 data. Furthermore, according to the study testing the feasibility and acceptability of LRGGs in Finland, original LRGGs were considered suitable. Also, the proportion of Finnish gamblers following LRGGs has increased. The development of LRGGs can support clinical practice by offering evidence-based thresholds for identifying risky gambling behavior and setting goals in non-abstinent based treatment (Andersland, Dow, Ginley, Whelan, & Pfund, 2025). Beyond the individual level, LRGGs can serve as a neutral and science-based framework for gambling companies and policymakers,

particularly in the context of consumer protection and regulatory decision-making.

Funding sources: The study was funded by the Ministry of Social Affairs and Health, Finland, within the objectives of the §52 Appropriation of the Lotteries Act. Daily work of the authors AHS, JK, JP, and TG at the Finnish Institute for Health and Welfare (THL) was also funded by the Ministry. The Ministry had no role in the study design, analysis, or interpretation of the results of the manuscript or any phase of the publication process.

Authors' contribution: JK, AHS, MMY and DCH conceived, designed, and planned the study; the data were analysed by JK. JK, TG and AHS interpreted the results and wrote the first draft of the article. JP, MMY, and DCH elaborated the interpretations and critically revised the article for its important intellectual content. All authors approved the final draft.

Conflict of interest: Jukka Kontto has worked at the Finnish Institute for Health and Welfare in projects funded the European Union. He has also been funded by the Ministry of Social Affairs and Health, Finland, within the objectives of the §52 Appropriation of the Lotteries Act. He declares no conflicts of interest in relation to this manuscript. Jussi Palomäki's work at the Finnish Institute for Health and Welfare is funded by the Ministry of Social Affairs and Health, Finland, within the objectives of the §52 Appropriation of the Lotteries Act. He declares no conflicts of interest in relation to this manuscript. Tanja Grönroos's full time work at the Finnish Institute for Health and Welfare is funded by the Ministry of Social Affairs and Health, Finland, within the objectives of the §52 Appropriation of the Lotteries Act. She declares no conflicts of interest in relation to this manuscript. David C. Hodgins's position at the University of Calgary is partially funded by the Alberta Gambling Research Institute, a provincial government funded research agency. He declares no conflicts of interest in relation to this manuscript. Matthew M. Young is Chief Research Officer at Greo Evidence Insights (Greo). Greo is a not-for-profit research and knowledge exchange organization that has received funds in the last five years from the New Zealand Ministry of Health, the Ontario Ministry of Health and Long-Term Care, Health Canada, and Canadian non-profits, charities, and post-secondary institutions. Greo has also received funds from social responsibility arms of Canadian crown corporations (i.e., state monopolies) that conduct and manage provincial/territorial gambling, regulatory settlement funds (Great Britain), third-sector charities (Great Britain), and international regulators. Greo has not received funding from the gambling industry either directly or indirectly through voluntary donations. He declares no conflicts of interest in relation to this manuscript. Anne H. Salonen's daily work at the Finnish Institute for Health and Welfare is funded by the Ministry of Social Affairs and Health, Finland, within the objectives of the §52 Appropriation of the Lotteries Act. She declares no conflicts of interest in relation to this manuscript.

SUPPLEMENTARY MATERIAL

Supplementary data to this article can be found online at https://doi.org/10.1556/2006.2025.00104.

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