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META-ANALYSIS

The influence of age on gambling problems worldwide: A systematic review and meta-analysis of risk among younger, middle-aged, and older adults

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ABSTRACT

Background and Aims: Problem gambling (PG) represents a significant public health concern with widespread effects in various cultures and regions globally, with younger individuals and males at a particularly higher risk. This disparity is attributed to a mix of cultural, developmental, and biological influences. To date, there has not been a comprehensive examination to determine whether this risk pattern holds consistently across different jurisdictions. *Methods:* We performed a systematic review and meta-analysis using the PRISMA framework, identifying 21 eligible studies from 18 countries, encompassing 156,249 participants (47.6% male and 52.4% female). *Results:* The studies varied considerably by region (Asia: 19%, Europe: 52%, Oceania: 19%, North America: 10%), the diagnostic criteria for PG, and participation rates in gambling (ranging from 12% to 92%). Data on PG prevalence was categorised by gender and three age groups (young: 18–35, middle: 30–55, and older: 45–65). Using a random-effects meta-analysis, we found a global PG prevalence of 1.9%. Europe reported a significantly lower prevalence (1.3%) compared to North America (5.3%). Men were found to be 3.4 times more likely than women to engage in problem gambling, although the gap narrows in North America. The young demographic showed a 1.51 times higher likelihood of reporting PG compared to the middle-aged group, whereas older adults were 0.80 times less likely to report PG. Notably, age-related effects varied significantly across regions. *Conclusions:* Our findings confirm that age and gender significantly influence PG risk across cultures, with significant heterogeneity observed across jurisdictions.

KEYWORDS

problem gambling, pathological gambling, gambling disorder, gambling addiction, prevalence

INTRODUCTION

It has previously been estimated globally via systematic review that up to 7.6% of individuals are affected by problem gambling (PG), although precise estimates are difficult due to variation in methodological procedures, instruments, cut-offs, and time frames (Calado & Griffiths, 2016). Whilst the baseline prevalence of PG prevalence may be heavily determined by idiosyncratic regulatory, cultural and methodological factors, the same is not necessarily true of the relative prevalence of PG among men and women, and younger and older persons. Young adults aged 18–35 years are known to be more susceptible to PG, with a markedly higher risk among young men compared to their female counterparts (Abbot et al., 2004; Gotestam & Johansson, 2003; Kun, Balázs, Arnold, Paksi, & Demetrovics, 2012; Park et al., 2010; Sassen et al., 2011; Wardle, D'souza, & Farrell, 2009; Welte, Barnes, Tidwell, Hoffman, & Wieczorek, 2015). The cross-cultural and cross-jurisdictional consistency of these effects are of theoretical and practical interest, but no study has yet attempted to assess this.

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Current research exploring the cultural dimensions of gambling behaviour often concentrates on culturally and linguistically diverse cohorts within a single jurisdiction, leaving the consistency of risk-factors *between* culturally diverse jurisdictions largely unexplored (Oei, Raylu, & Loo, 2019; Raylu & Oei, 2004; Subramanium et al., 2015). In contrast, emerging studies into the biological and neurobiological factors which influence gambling behaviour suggest that impulsivity and sensation-seeking (SS) play significant roles in engagement in gambling activities (Bergh, Eklund, Södersten, & Nordin, 1997; Coming et al., 1996; Joutsa et al., 2012); traits that are in turn known to be influenced by gender and age, with young men at greatest risk (Chase et al., 2017; McCabe, Louie, & King, 2015). However, local cultural norms and expectations associated with this demographic present an alternative explanation for this effect. Thus, the relative consistency or otherwise of these demographic effects across diverse regions will shed some light as to the degree to which they may be more attributable to biological factors, as opposed to cultural contexts, or moderated by cultural contexts.

In their 2016 review, Calado and Griffiths explored the cross-jurisdictional prevalence of PG among 69 studies which indicated a consistent association between being male, younger, and higher levels of PG. A supplementary review and meta-analysis by Gabellini, Lucchini, and Gattoni (2023) examined 23 recent studies related to PG prevalence worldwide and included subgroup analyses relating to the methods of data collection among included studies. These studies provide foundational insights into the global consistency of findings in PG research, however, they do not include comprehensive meta-analyses or comparison of relative risks (RR) across various demographics. This omission underscores the unique contribution of our study. By delving into these unexplored areas, our research not only fills a significant void in the existing body of knowledge but also offers novel perspectives on the implications of demographic variations. This exploration is pivotal, as it amplifies the relevance and applicability of our findings, making this study an essential read for those seeking a more nuanced understanding of the association between age, gender, and PG.

We conducted a systematic review for population-representative surveys of PG, with the criterion that they provided summary statistics of prevalence with respect to age and gender. From data extracted from these studies, we conducted meta-analyses of the relative risk (RR) of PG using mixed effects models that incorporated estimates of heterogeneity across studies. This appears to be the first study to conduct a global meta-analysis of PG, or to assess the consistency of age and gender effects.

Our aim was to assess the following parameter estimates with standard errors:

1. The global average PG rate
2. The RR for men versus women, and variation in RR across global region (Asia, Europe, Oceania, and North America)
3. The RR for young (18–35), and older (45–65) versus middle (30–55) aged participants, and variation in RR across global region.

In this manuscript, we use the term 'problem gambling' (PG) to encompass a range of gambling behaviours that result in harmful consequences to individuals, significant others, and the community, without necessarily fulfilling the diagnostic criteria of gambling disorder. This definition is deliberately broad and practical, acknowledging the variability in how problem gambling is conceptualised and measured across different jurisdictions. Such variability reflects the diverse legal, cultural, and research landscapes that inform gambling studies globally. By adopting this encompassing definition, we aim to capture the full spectrum of problematic gambling behaviours as reported in the literature, facilitating a comprehensive analysis of its prevalence and impacts across varied contexts.

Our systematic review and meta-analysis aim to focus on uncovering global PG prevalence trends by age, driven by the need to understand the biological, cultural, and sociological risk factors that influence these patterns. By mapping out PG prevalence and dissecting the contributing risk factors, our work seeks to inform stakeholders on crafting effective prevention and intervention strategies to combat PG.

METHODS

Search strategy

The review was conducted using the guidelines presented in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement (Page et al., 2021). A broader search beyond peer reviewed articles was required since many prevalence survey are reported in grey literature including government reports. We took the studies identified by Calado and Griffiths (2016) as a starting point. A further search of the databases psycINFO, psycArticles and Academic Search Ultimate was conducted from July 2023 to September 2023. Search terms were categorised in to two groups, with results requiring one term from each; 1) problem gambling/problem-gambling/pathological gambling/pathological-gambling/gambling disorder/gambling-disorder, AND 2) prevalence/rate/frequency. The search was limited to include studies from 2000 to 2022. Search terms were required in the title, keywords or abstract of articles. The search strategy has been illustrated in Fig. 1.

Inclusion criteria

All articles included for review were quantitative observational (cross-sectional) studies. Articles were included if they reported the prevalence of PG in the general population of a jurisdiction, and also reported PG prevalence within gender groups (male and female) and across different age groups including that of young adults. Included studies and their

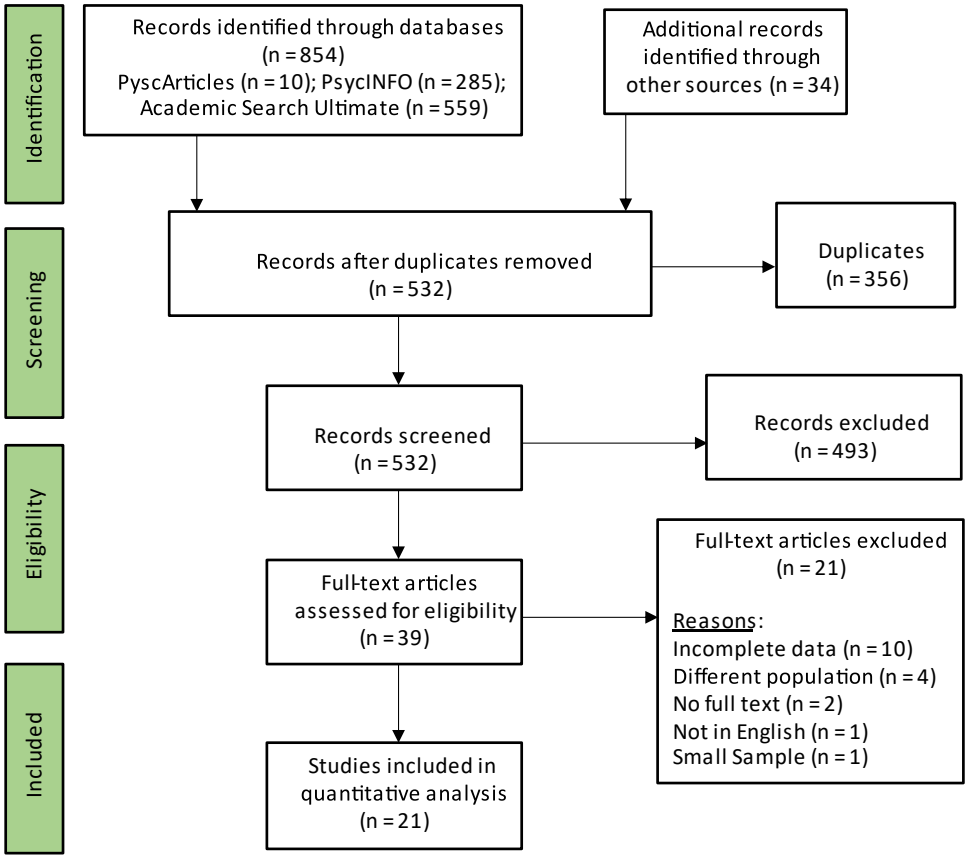

Fig. 1. PRISMA diagram of the study selection process

prevalence rates can be found in Table 1. Articles in any language were included provided they could be translated to English for review purposes. Articles were excluded if the relevant age group for young adults included people below the legal gambling age of the relevant jurisdiction or exceeded the age of 35 years.

In this systematic review, the Joanna Briggs Institute (JBI, 2020) Critical Appraisal Checklist for Studies Reporting Prevalence Data was employed to assess the methodological quality of included studies. This checklist is specifically designed to evaluate the validity and reliability of prevalence data, ensuring that our synthesis is based on robust evidence. It addresses key aspects such as sampling technique, data collection methods, and appropriate statistical analysis, providing a thorough framework for assessing the trustworthiness of the reported prevalence rates. Based on the checklist assessments, decisions were made to include studies, exclude them, or seek further information to resolve ambiguities in reporting or methodology.

The included articles reported PG prevalence in age groups, however specific age ranges varied per study. Therefore, some "fuzzy" matching was required to standardise age bands and to reduce to three categories: young (18–35 years), middle (30–55 years) and older (45–65 years). Validated measures of PG were utilised in all included studies; the specific measures and scores used to indicate PG are detailed in Table 1.

The research focused on cross-sectional studies to obtain a snapshot of PG prevalence across various jurisdictions. This approach facilitated comparison across different populations and time periods, bypassing the complexities of longitudinal studies. Studies with fewer than 1,000 participants were excluded to ensure the robustness and representativeness of the data. Duplicate studies were carefully removed, and the analysis acknowledged the variety of tools used to assess problem gambling, such as PGSI and DSM criteria. Exclusion criteria also encompassed studies with incomplete data—specifically, those lacking in detailed demographic information, or the specific outcomes measured —and those focusing on particular sub-populations that might not reflect the general population's problem gambling prevalence accurately. Additionally, any articles that were either not retrievable or inaccessible were excluded, ensuring that only verifiable and comprehensively reviewed studies were incorporated into the final analysis.

The task primarily involved descriptive statistics, focusing on accurately capturing data on problem gambling prevalence rates and demographic details from each study. Given the objective nature of this information, the potential for coder bias was inherently lower compared to analyses requiring subjective judgment.

To further ensure the accuracy and reliability of our data extraction process, the second investigator performed periodic checks on the data collected. These checks were

Table 1. Summary of characteristics from included studies of problem gambling prevalence and research methodologies

Region	Country	Study	Measure of problem gambling	Sample size	Gambling participation	Problem gambling prevalence	Legal gambling age
North America	Canada	Schrans and Schellinck (2008)	PGSI: score of 3+	2,500	87.0%	2.4%	18–19 years (varied among states)
	USA	Tracy and Schluterman (2020)	NODS: Score of 3+	6,000	92.3%	8.6%	21 years
Asia	South Korea	Park et al. (2010)	DSM-4: 1+ criteria	5,333	39.5%	3.8%	20 years
	Hong Kong	Wan et al. (2012)	DSM-4 (modified Chinese version): 3+ criteria	2,024	62.4%	3.3%	18 years
		The Hong Kong Polytechnic University (2017)	DSM-5 (modified Chinese version): 4+ criteria	2,045	61.5%	0.9%	
	Thailand	Assanangkornchai, McNeil, Tantirangsee, Kittirattanapaiboon, and Thai National Mental Health Survey Team (2016)	DSM-4-TR: 1+ criteria	4,727	76.8%	1.72%	20 years
Europe	Austria	Buth et al. (2017)	DSM-5: 2+ criteria	10,000	40.9%	1.5%	14–18 years (varied by gambling activity and region)
	Denmark	Kragelund, Ekholm, Larsen, and Christensen (2022)	Lie/Bet: Score of 1+	14,022	n/a	1.5%	18 years
	Estonia	Faktum Uuringukeskus (2004)	SOGS: score of 2+	3,519	12.0%	5.0%	16–21 years (varied by gambling activity)
	France	Costes, Eroukmanoff, Richard, and Tovar (2015)	PGSI: score of 3+	15,635	56.2%	2.7%	18 years
	Germany	Sassen et al. (2011)	DSM-4: 1+ criteria	8,006	48.0%	2.5%	18 years
	Great Britain	Seabury and Wardle (2014)	PGSI: score of 8+ DSM-4: 3+ criteria	10,872	56.0%	0.5%	16–18 years (varied by gambling activity)
	Hungary	Kun et al. (2012)	SOGS: score of 3+	2,710	42.1%	3.3%	18 years
	Northern Ireland	Department for Social Development Northern Ireland (2016)	PGSI: score of 8+	1,032	75.0%	7.5%	18 years
	Norway	Gotestam and Johansson (2003)	DSM-4: 3+ criteria	2,014	68.8%	0.6%	18 years
	Slovenia	Makarovic (2010)	SOGS: score of 3+	10,031	35.5%	1.9%	18 years
	Spain	Becona (2004)	NODS: score of 3+	1,624	n/a	0.6%	18 years
Oceania	Australia	Armstrong and Carroll (2017)	PGSI: score of 3+	17,606	49.0%	7.9%	16–18 years (varied by gambling activity and region)
		Browne et al. (2020)	PGSI: score of 3+	10,012	53.0%	3.8%	
		Rockloff et al. (2020)	PGSI: score of 3+	10,638	69.0%	3.1%	
	New Zealand	Ministry of Health (2009)	PGSI: score of 3+	12,488	32.4%	1.7%	16–18 years (varied by gambling activity)

Note. Abbreviations used in measure of problem gambling column: PGSI - Problem Gambling Severity Index; NODS -National Opinion Research Center; DSM Screen for Gambling Problems; DSM-4 - Diagnostic Statistical Manual of Mental Disorders 4th Edition; DSM-5 - Diagnostic Statistical Manual of Mental Disorders 5th Edition; SOGS - South Oaks Gambling Screen

designed to confirm the correct application of the methodology, rather than to assess interrater reliability, as the nature of the data extraction did not lend itself to significant subjective interpretation. This procedural step was critical for maintaining the quality and consistency of our data extraction efforts.

The extracted data included publication details, study design, sample characteristics (age and gender); PG measure, and main findings (prevalence of PG and gambling participation). Where contact details were available, the corresponding author of eligible studies was contacted if relevant data were missing; however only one response was received advising that this data could not be provided.

Analysis

We calculated the range, mean and odds ratios of outcomes relating to PG of specified groups for each study for descriptive purposes. A random-effects model was employed for the meta-analyses, as substantial heterogeneity was anticipated across the included studies due to variability in methodological approaches, measurement tools, and cultural contexts. The random-effects model accounts for both within-study and between-study variance, providing a more conservative estimate of the overall effect size and wider confidence intervals compared to a fixed-effect model (Borenstein, Hedges, Higgins, & Rothstein, 2009). ORs were chosen as the effect size measure to quantify the relative risk of problem gambling across demographic groups, as ORs are commonly used in prevalence studies and are easily interpretable (Higgins & Green, 2011).

The meta-analyses were conducted using the metafor package (Viechtbauer, 2010) in the R statistical programming environment (R Core Team, 2020). to determine the global PG prevalence rate, evaluate gender- and age-based differences, and measure the level of heterogeneity between studies. Heterogeneity across studies was assessed using the Q statistic and the I^2 statistic, with values of $I^2 \geq 50\%$ indicating substantial heterogeneity (Higgins & Green, 2011). Potential sources of heterogeneity were explored through subgroup analyses and meta-regression, where the effects of covariates such as geographical region were examined.

RESULTS

Systematic review

An initial 34 records were identified through the Calado and Griffiths (2016) review. The database searches identified a total of 854 records (PyscArticles = 10; PsycINFO = 285; Academic Search Ultimate = 559). Duplicate records (n = 356) were removed, and the remaining studies were assessed on the basis of the title and abstract with a further exclusion of 493 irrelevant studies. A total of 39 studies were eligible for full text assessment. Two of the studies were excluded due to the unavailability of the full-text, one study was excluded due to small sample size, one study was excluded as it could not be translated to English, four studies were excluded due to examining a different population and 10 studies were excluded as they did not specify age groups in relation to PG prevalence.

The remaining 21 studies were included in the systematic review with detailed characteristics illustrated in Table 1. Of the 21 included studies, 10 were identified from the Calado and Griffiths review, and 11 were identified through our additional literature searches. The studies were published between 2000 and 2022. The total number of participants in the included studies was 156,249, with an average of 7,440 participants (range: 1,032 to 17,606).

Participants. The age of respondents ranged from 14 years to over 75 years. All studies were comprised of both genders (males = 47.6% and females = 52.3%) with one study including the option 'Other' (<0.01%). Four (19%) of the included studies were conducted in Asia (Hong Kong, South Korea and Thailand), eleven (52.4%) in Europe (Austria, Denmark, Estonia, France, Germany, Great Britain, Hungary, Northern Ireland, Norway, Slovenia and Spain), four (19%) in Oceania (Australia and New Zealand) and two (9.5%) in North America (Canada and United States of America). All included studies used random sampling techniques for participant inclusion.

Sampling methods varied across studies and included random-digit-dialling, and random stratified sampling of residential addresses listed with local government bodies. Data were weighted in the majority of the included studies to be representative of the gender and age of the population. Data was collected through telephone interviews, online questionnaires, postal surveys, face-to-face interviews and a combination of two or more of these methods. The response rate varied significantly from 6% to 91.6%. Two of the included studies did not report the response rate, of which one also did not report on sampling methods.

Assessment of problem gambling. A total of seven different measures were used across the 21 studies to determine PG including: the Problem Gambling Severity Index (PGSI), the Diagnostic and Statistical Manual of Mental Disorders 4th Edition (DSM-4) diagnostic criteria, the Diagnostic and Statistical Manual of Mental Disorders 4th Edition (DSM-5) diagnostic criteria, the South Oaks Gambling Screen (SOGS), the National Opinion Research Center DSM Screen for Gambling Problems (NODS), the International Statistical Classification of Diseases and Related Health Problems 10th Edition (ICD-10) diagnostic criteria, and the Lie/Bet. Fourteen studies (66.7%) utilised self-report survey instruments, and seven studies (33.3%) employed DSM and ICD criteria to evaluate problem gambling. The scoring used in each study for its respective measure is included in Table 1.

Prevalence of Problem Gambling. Among the included studies, gambling participation of the population varied from 12% to 92% (mean of 55.7%) and was defined as engaging in gambling activities at least once within the last 12 months. The definition of 'gambling activities' varied across studies as jurisdictions categorised gambling activities

differently. The prevalence of PG across studies ranged from 0.5% to 8.6% (mean of 3.1%) (see Table 2). Young adults indicated higher prevalence for PG than other age groups in majority of the studies (shown in Fig. 2), and males were at higher risk of PG than females among all studies (shown in Fig. 3). Young males (18–24 years) were identified as being higher risk of PG than other combined age/gender groups in three of the included studies which estimated that PG affected 4%–8.1% of all young men.

Meta analyses

A random effects model was used in all analyses due to the variation observed among studies. The meta-analysis on PG in the general population utilised data from 20 studies encompassing 76,321 participants, with results categorised by age bands and gender. The combined PG estimate was 1.9% (CI 0.013 to 0.037), with regional differences evident: Europe (1.3%, CI 0.009 to 0.018), Oceania (2.2%, CI 0.014 to 0.036), Asia (2.2%, CI 0.013 to 0.037), and North America (5.3%, CI 0.026 to 0.102) (shown in Fig. 4). There was significant variation in effects between studies due to heterogeneity (Q = 1441.12 18, $p < 0.01$; I^2 = 98.39%).

A separate meta-analysis examined the effect of gender on PG included 19 studies and 136,170 respondents of any age. Males were 3.44 times (CI 2.60, 4.56) times more likely than females to indicate PG. This finding was consistent among all regions, and statistically significant in Asia, Europe and Oceania, but not North America, with high levels of between-study heterogeneity (I^2 Measure = 71.73) (see Fig. 5). These results were confirmed through a multivariate meta-regression analysis, indicating that the model showed a reasonable fit when comparing gender and gender by region (Fig. 6).

Finally, a meta-analysis compared PG prevalence across young, middle, and older age groups, involving 20 studies with 79,559 participants. Results showed that middle-aged adults were 0.80 times less likely to experience PG compared to older adults (CI 0.66, 0.96), and younger adults were 1.51 times more likely than middle-aged adults to indicate PG (CI 1.23, 1.84, $p < 0.001$). Moderate to substantial heterogeneity was observed across regions (I^2 = 54.2% for older vs middle; I^2 = 66.3% for younger vs middle). A regional comparison revealed that older adults were less likely to indicate PG in all regions, but this was statistically significant only in North America (OR 0.43; CI 0.216, 0.863; p = 0.0175). Younger adults showed a significantly higher likelihood of PG than middle-aged adults in Europe and North America, and a higher but not statistically significant prevalence in Oceania. Conversely, in Asia, middle-aged adults had a higher PG prevalence than both younger and older adults. Despite heterogeneity, the prevalence of PG was consistently higher in younger adults compared to middle-aged adults across Europe, North America, and Oceania, and consistently lower in older adults (see Table 3).

Table 2. Summary of problem gambling prevalence by age and gender groups

Region	Country	Study	Age group ranges (years)			Problem gambling prevalence (%)				
			YA	MA	OA	YA	MA	OA	Male	Female
North America	Canada	Schrans and Schellinck (2008)	19–24	35–44	45–54	4.27	2.89	2.55	3.52	1.50
	USA	Tracy and Schluterman (2020)	18–34	35–54	55+	3.83	1.72	0.31	10.60	6.90
Asia	South Korea	Park et al. (2010)	18–29	40–49	50–59	3.45	4.20	3.97	5.21	0.74
	Hong Kong	Wan et al. (2012)	18–29	40–49	50–64	3.87	3.55	2.86	5.22	1.70
		The Hong Kong Polytechnic University (2017)	18–29	30–49	50–64	1.07	1.00	2.02	2.55	0.46
	Thailand	Assanangkornchai et al. (2016)	18–34	35–54	55+	2.09	2.55	1.21	3.10	1.00
Europe	Austria	Buth et al. (2017)	18–26	36–50	51+	6.74	2.22	2.28	5.04	2.19
	Denmark	Kragelund et al. (2022)	25–34	35–44	45–54	2.90	1.60	1.20	2.30	0.70
	Estonia	Faktum Uuringukeskus (2004)	20–29	30–39	50–59	12.00	12.00	7.00	1.7	0.20
	France	Costes et al. (2015)	25–34	35–44	45–54	2.95	1.85	1.76	1.32	0.58
	Germany	Sassen et al. (2011)	18–29	30–49	50–64	6.07	2.48	2.07	2.86	0.26
	Great Britain	Seabury and Wardle (2014)	25–34	35–44	45–54	0.60	0.50	0.50	1.00	0.20
	Hungary	Kun et al. (2012)	18–24	35–44	45–54	5.00	2.60	3.70	5.30	1.20
	North Ireland	Department for Social Development Northern Ireland (2016)	18–29	35–44	45–54	4.10	2.53	1.56	4.00	0.50
	Norway	Gotestam and Johansson (2003)	18–30	31–50	50+	1.80	0.40	nil	1.00	0.20
	Slovenia	Makarovic (2010)	18–30	31–55	55+	5.38	1.51	1.16	0.82	0.18
	Spain	Becona (2004)	18–30	31–45	46–64	1.79	1.29	1.06	1.42	nil
Oceania	Australia	Armstrong and Carroll (2017)	18–29	30–49	50–64	1.34	1.02	1.33	1.46	0.79
		Browne et al. (2020)	18–24	35–44	45–54	14.90	9.20	5.40	5.60	2.10
		Rockloff et al. (2020)	18–24	35–44	45–54	5.90	3.20	3.50	4.40	1.90
	New Zealand	Ministry of Health (2009)	25–34	35–44	45–54	1.94	2.43	2.00	2.50	1.20

Note. Abbreviations used in age group ranges and problem gambling prevalence columns are as follows: Younger Adults (YA), Middle-aged Adults (MA), and Older Adults (OA).

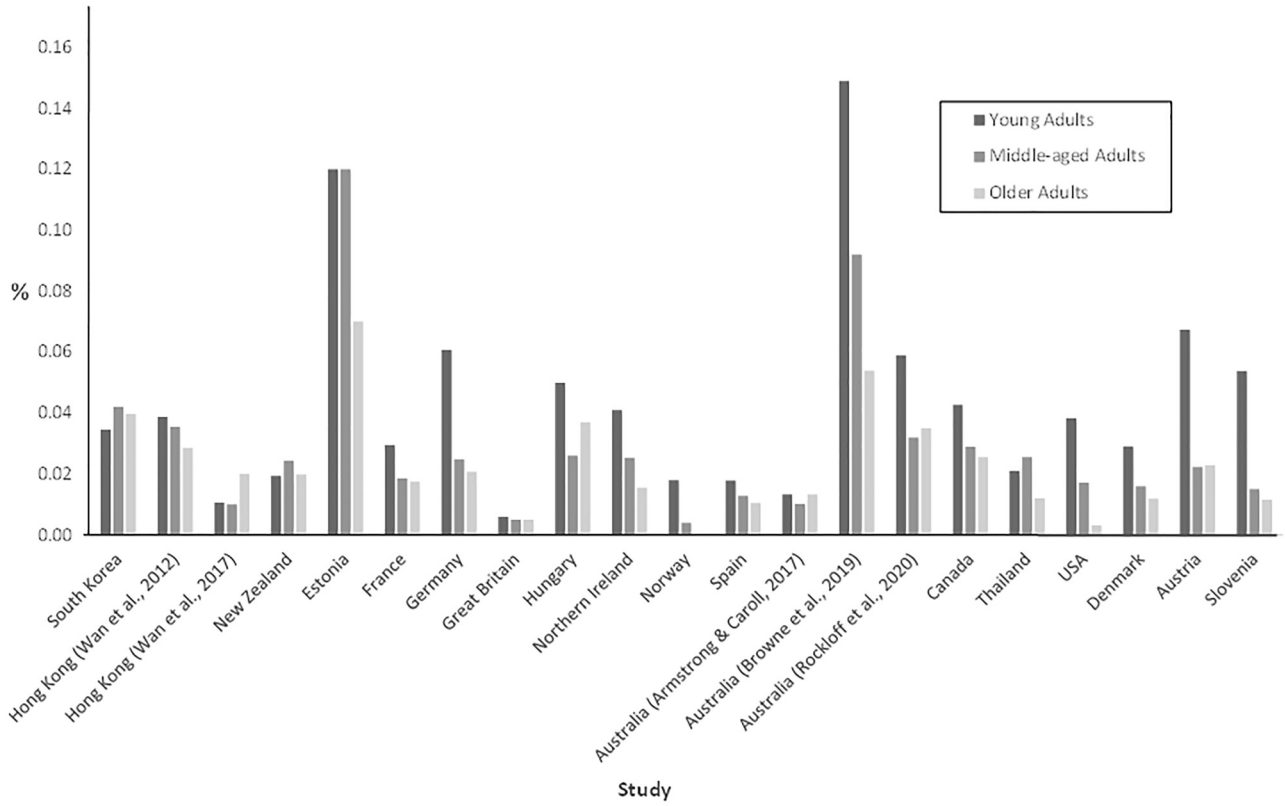

Fig. 2. Prevalence of problem gambling by age group and study

Note. Studies are identified by country in this graph and corresponding authors can be found in Table 1. Countries where multiple studies were included are identified by author in this graph. Studies are ordered according to region and country.

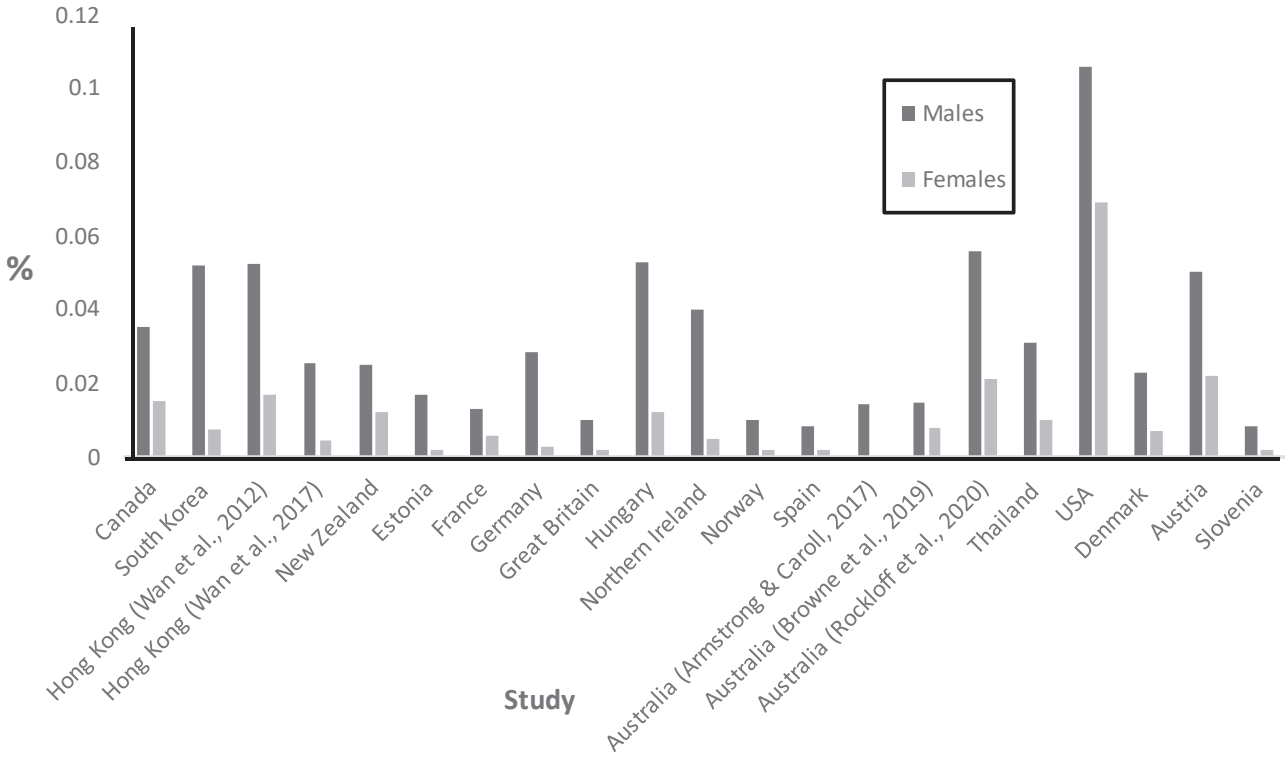

Fig. 3. Prevalence of problem gambling gender and study

Note. Studies are identified by country in this graph and corresponding authors can be found in Table 1. Countries where multiple studies were included are identified by author in this graph. Studies are ordered according to region and country.

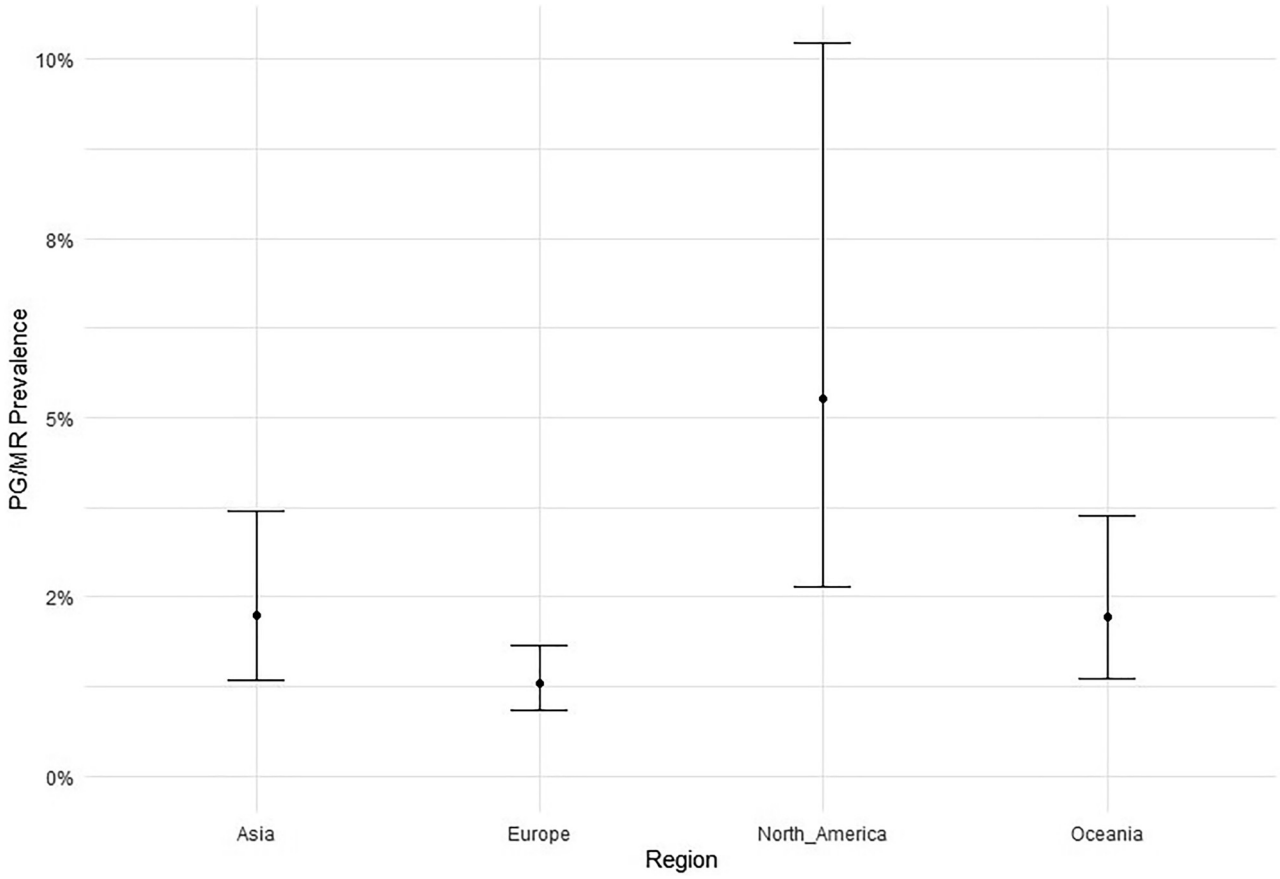

Fig. 4. Prevalence of problem gambling by region
Note. Studies are identified by region in this plot and included countries can be found in Table 1.

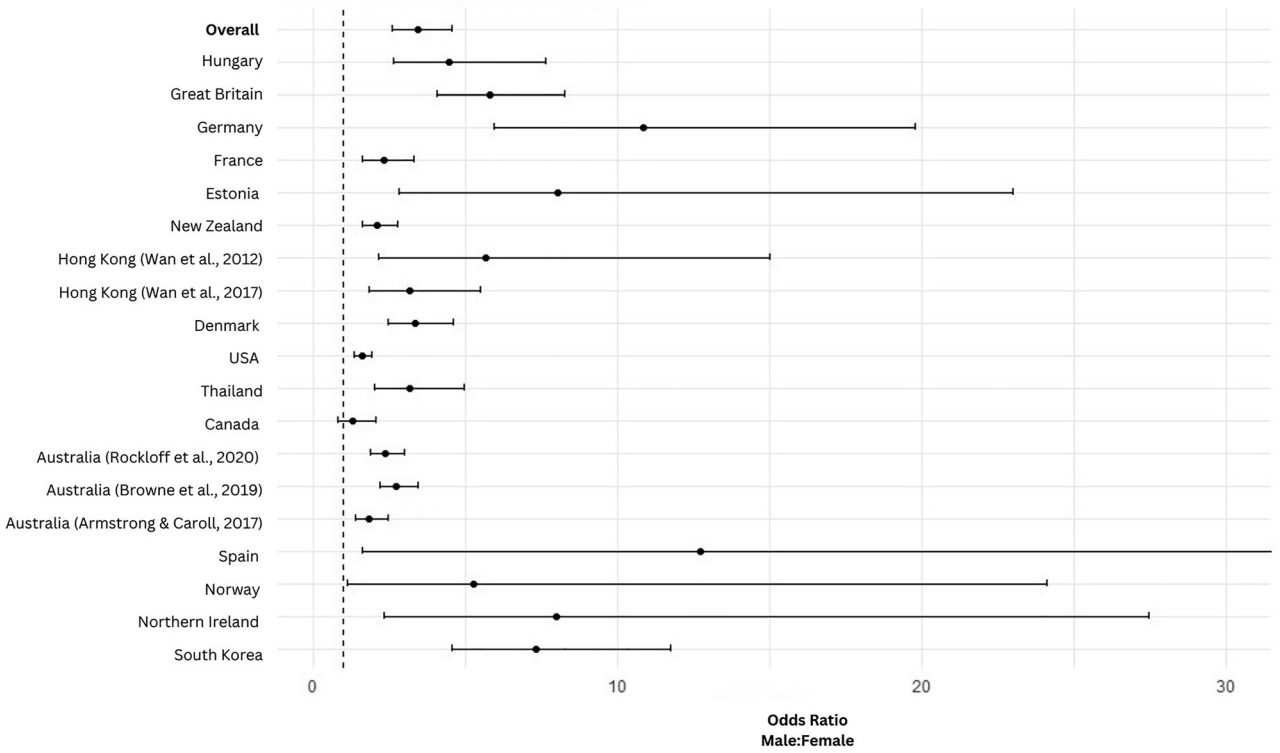

Fig. 5. Odds ratio of gender and study derived from meta-analysis
Note. Studies are identified by country in this plot and corresponding authors can be found in Table 1. Countries where multiple studies were included are identified by author.

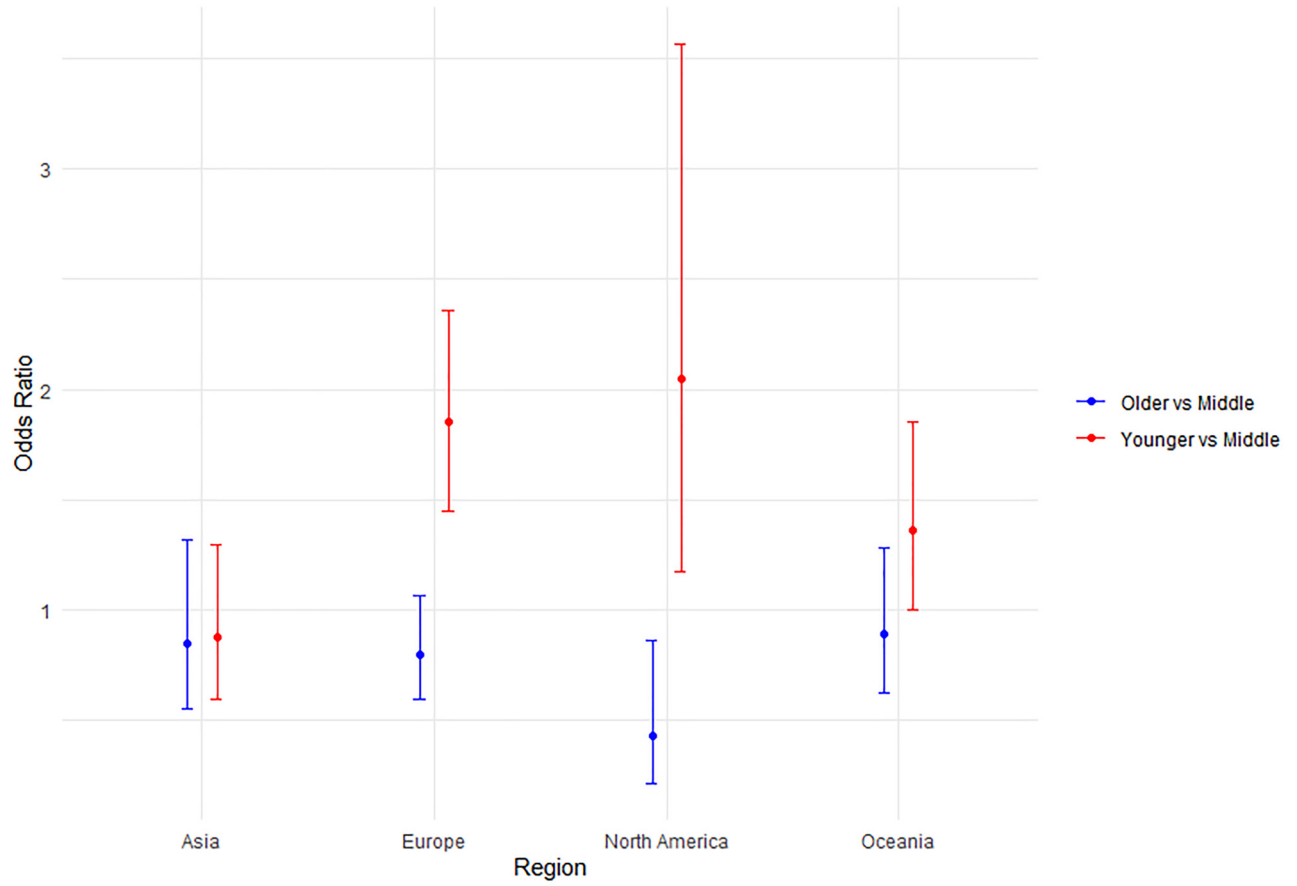

Fig. 6. Odds ratios comparing different age groups (Older vs Middle, Younger vs Middle) across various regions (Asia, Europe, North America, Oceania)
Note. Studies are identified by region in this plot and included countries can be found in Table 1.

Table 3. Summary of problem gambling prevalence by age and gender groups derived from meta-analysis

Region	Problem gambling prevalence (%)				
	YA	MA	OA	Male	Female
Asia	2.46	2.74	2.40	3.97	0.88
Europe	4.04	2.44	1.90	2.38	0.43
North America	3.84	2.07	1.28	7.06	4.79
Oceania	5.77	2.95	3.81	3.47	1.48

Note. Studies are identified by region in this table and included countries can be found in Table 1.

Table 4. Odds ratio OA/MA and YA/MA by region

Region	Odds Ratio 95% CI	
	OA/MA	YA/MA
Asia	0.85 [0.55, 1.32]	0.88 [0.60, 1.30]
	$p = 0.4729$, $z = -0.72$	$p = 0.5185$, $z = -0.65$
Europe	0.80 [0.60, 1.07]	1.85 [1.45, 2.36]
	$p = 0.1273$, $z = -1.52$	$p < 0.0001$, $z = 4.98$
North America	0.43 [0.22, 0.86]	2.05 [1.18, 3.56]
	$p = 0.0175$, $z = -2.38$	$p = 0.0114$, $z = 2.53$
Oceania	0.89 [0.63, 1.28]	1.36 [1.178, 3.56]
	$p = 0.5443$, $z = -0.61$	$p = 0.0518$, $z = 1.95$

Note. Abbreviations used are as follows: Younger Adults (YA), Middle-aged Adults (MA), and Older Adults (OA).

DISCUSSION

Our meta-analysis found that approximately 1.9% of the adult population reported PG across global jurisdictions. Young adults are 1.51 times more likely to report PG than middle aged, and older adults are 0.80 times less at-risk than the middle-aged group, although these age effects differed markedly between regions, as shown in Table 4. The gender effects were larger, with males having a 3.44 times greater risk than females. The finding that young males are at greater risk is consistent with prior research (Bakken, Gotestam, Grawe, Wenzel, & Oren, 2009; Department for Social Development Northern Ireland, 2016; Ekholm et al., 2014; Ministry of Health, 2009; Wardle et al., 2009). Thus, this attempt at a comprehensive global meta-analysis supports a broad interpretation that these effects are relatively consistent across diverse cultures and jurisdictions. However, the very high degree of heterogeneity observed between studies underscores the degree to which these demographic effects are moderated by local cultural and regulatory factors, as well as differences in methodology, measure, and sampling approach.

The elevated prevalence of problem gambling among younger men may be understood within the framework of

cultural norms and expectations regarding masculinity, which often place value on risk-taking, impulsivity, and sensation-seeking behaviours (Dowling et al., 2017). In many cultural contexts, gambling activities may hold a particular allure for younger males as they serve as a means to assert masculinity, engage in competitive behaviour, or seek novel experiences and thrills (Delfabbro, King, & Griffiths, 2016). Moreover, socio-cultural scripts dictating gender roles and the perceived acceptability of gambling practices across various age groups could potentially compound these demographic patterns (Gainsbury, Russell, & Hing, 2018).

The substantial geographical variations observed in our meta-analytic findings, particularly the differing age effects in Asia and the reduced gender gap in North America, point to the influential role of cultural, ethnic, and environmental factors in shaping gambling behaviour and PG risk (Customer Market Insights, 2023; Maharaj, Alli, & Mokwena, 2013; Raylu & Oei, 2004; Smith, 2005; Wan et al., 2017). In Asian countries like South Korea, Hong Kong, and Thailand, the higher prevalence among middle-aged adults compared to younger groups may be attributable to strict legal prohibitions that limit early gambling exposure, as well as cultural stigmas that could lead to underreporting among youth (Maharaj et al., 2013; Raylu & Oei, 2004; Wan et al., 2017). These countries tend to adopt conservative stances towards gambling, characterised by stringent legal prohibitions aimed at curtailing access to gambling activities (Smith, 2020). These regulatory measures are largely driven by societal concerns regarding the potential social and moral implications associated with gambling. One notable distinction lies in the scope of legalised gambling forms. Asian countries typically offer limited legalised forms of gambling, such as state-operated lotteries or licensed casinos restricted to designated tourist areas (Kolandai-Matchett & Wenden Abbott, 2022; Philippine Amusement and Gaming Corporation, 2014). Cultural attitudes towards gambling also play a pivotal role in shaping regulatory policies. In Asia, gambling is often viewed with social stigma and moral apprehension, prompting policymakers to enact stringent regulations aimed at safeguarding vulnerable populations, particularly younger individuals (Hing, Russell, Tolchard, & Nower, 2016).

In contrast, gambling in Australia boasts a more liberal regulatory framework, fostering a well-established yet tightly regulated gambling industry that encompasses a wide array of gambling options accessible through licensed venues and online platforms. This diversity is evidenced by the presence of casinos, sports betting facilities, electronic gaming machines, lotteries, and horse racing, all of which are legalised and subject to regulation at both state and federal levels. Moreover, regulations governing online gambling diverge significantly between regions. While many Asian countries enforce strict restrictions or outright bans on online gambling, countries like Australia and North America permit certain forms of online betting, such as sports wagering and betting on racing events, under a regulated framework (Gainsbury, Russell, & Hing, 2015). However, the provision of online casino games and poker services to Australian residents is prohibited, unlike in North America where these forms of gambling are widely available.

The widespread availability, accessibility, and social acceptance of gambling in many North American contexts could explain the elevated problem gambling rates among females in this region compared to other parts of the world (Smith, 2005). The recent increase of online gambling and sports betting options, especially in North America, may have disproportionately impacted younger demographics and reduced historically robust gender gaps (Customer Market Insights, 2023). Online gambling platforms provide convenient and discreet avenues for individuals, including younger demographics, to engage in gambling activities from the comfort of their own homes or mobile devices. This increased accessibility to gambling options may disproportionately impact younger demographics, and females who may not have previously participated in venue-based gambling activities could now be drawn to online gambling environments due to their convenience and anonymity.

Taken together, these findings underscore the complex interplay of biological, psychological, and socio-cultural forces that shape gambling engagement and related harms. A more nuanced examination of geographical variations in future research, spanning multiple levels of analysis from neurobiological to environmental factors, could yield valuable insights to inform prevention and treatment efforts tailored to specific cultural contexts.

It is important to acknowledge that the age range used to define "younger adults" (18–35 years) may be broader than some conventional definitions which cap young adulthood around 25 years of age. However, given the heterogeneity in age group boundaries across the included studies, some approximation was required. Furthermore, there was unavoidable overlap in the age ranges, with individuals aged 30-35 being captured in both the younger and middle-aged categories, and those aged 45-55 being included in both the middle-aged and older categories. To address this, a conservative approach was taken where individuals in these overlapping ranges were only counted once in their respective lower age bracket, preventing any double-counting.

In our systematic review and meta-analysis, we prioritised data from government reports and publications issued by statutory bodies and government departments. This methodological choice was informed by the recognition that these sources offer comprehensive and systematically collected data, which is crucial for understanding problem gambling prevalence across various jurisdictions. Given the nature of these sources, concerns regarding traditional publication biases commonly associated with academic journals—where studies with positive findings are more likely to be published—are significantly mitigated.

Government reports and statutory publications are subject to mandates for public disclosure, aiming to inform policy and public understanding regardless of the nature or direction of the findings. This requirement for transparency reduces the likelihood that studies are selectively published

based on their results, thus addressing one of the primary concerns related to publication bias in our analysis.

The studies included in this review spanned over two decades, during which the gambling environment has undergone substantial changes, most notably the proliferation of online gambling options. While this temporal variability contributes to the heterogeneity observed across studies, it also afforded a unique opportunity to assess whether demographic risk factors persisted despite evolving gambling contexts and accessibility. Our findings of consistent age and gender effects, albeit with regional differences in magnitude, suggest these demographic patterns may be somewhat invariant to environmental shifts and plausibly influenced by more stable biological or developmental factors.

While the age range of participants in the studies reviewed spanned from 14 years to over 75 years, reflecting the broad demographic included in general population surveys, it is important to clarify that our analysis was restricted to data from individuals of legal gambling age onwards. This approach was consistent with our exclusion criteria, focusing our analysis on participants aged 18 years and older (or the legal gambling age in the respective jurisdictions), to provide insights into problem gambling prevalence within the legal-age gambling population. This methodological detail ensures our findings are directly relevant to populations legally permitted to gamble, aligning with established research standards and ethical considerations in gambling research.

There was also variability in the measure used to identify gambling problems (PGSI, DSM-4, DSM-5, SOGS, NODS, ICD-10, and Lie/Bet), although many of these instruments assessed similar domains informed by the Diagnostic and Statistical Manual of Mental Disorders (DSM) (Becona, 2004; Buth, Wurst, Thon, Lahusen, & Kalke, 2017; Kun et al., 2012; Sassen et al., 2011; Schrans & Schellinck, 2008). However, the Lie/Bet uses a succinct format, focusing on just two key questions, and therefore may lack the depth and specificity required for accurately identifying and understanding the full spectrum of PG. Despite these similarities, the way that measures were used to define PG varied greatly, for example in the number of criteria used (two to 20), the options for responses ('yes' or 'no', and Likert scales) and the way in which results were interpreted (PG defined by different scores when using the same measure) (Seabury & Wardle, 2014). These methodological differences highlight how varied screening measures in gambling research can result in different PG rates (Seabury & Wardle, 2014). Nevertheless, these methodological differences should not overly impact the relative risk with respect to demographics within studies.

While a moderator analysis of the PG measurement tools would provide valuable insights into how these instruments might impact prevalence rates, the feasibility of such an analysis within the scope of our study was limited. The primary constraints were the high degree of variability in the measurement tools used across studies and the limited number of data points available for each instrument type. This heterogeneity in measurement approaches, combined with a dataset not sufficiently large to support a detailed moderator analysis, made it impractical to include the variability of PG measurement tools as a factor in our analyses.

LIMITATIONS

The findings of this meta-analysis should be considered in light of several limitations. Firstly, there was notable variation in the publication and accessibility of national gambling research across different jurisdictions. While some studies were peer-reviewed and internationally accessible, others were local and less readily available. This disparity in the publication landscape led to the inclusion of only publicly available data in the review, potentially omitting significant findings from various regions. Additionally, the exclusion of non-English language studies, despite the global focus of the review, may have limited the representation of the full spectrum of problem gambling research across diverse cultural and linguistic contexts.

Additionally, several important prevalence studies that did not meet the age band criteria were excluded. Notably, Rachel Volberg has conducted numerous significant studies on PG prevalence that were not included in our meta-analysis due to these methodological differences, in particular considering adolescent problem PG. Volberg's extensive body of work, including her research on gambling in North America and her comprehensive reviews across various jurisdictions, has been instrumental in understanding the demographics of PG (Volberg, 1992; Volberg & Bernhard, 2006; Volberg et al., 2008, 2010; Williams, Volberg, & Stevens, 2012). This should be considered when interpreting the results from the present study.

Another limitation was the considerable variation in the research methodology and quality of the included studies. Differences in participant numbers, measurement tools used, and definitions of problem gambling contributed to the high degree of heterogeneity observed in the prevalence estimates across studies (I^2 up to 98.39%). This methodological variability challenges the comparability and generalisability of the findings, as the inconsistencies in how problem gambling was assessed and defined may have influenced the reported rates.

The variability in the instruments and criteria used to assess PG across the included studies also presented a limitation. While these measures generally assess similar domains informed by diagnostic criteria, the specific items, response scales, and scoring thresholds employed differed. One notable limitation of this study is the inconsistency in reporting the methods used for diagnostic interviews across the included studies. Table 1 references the criteria for DSM diagnoses but does not specify whether these criteria were applied through self-report checklists or formal diagnostic interviews. This variability in reporting resulted in an incomplete understanding of the diagnostic methods used, potentially impacting the comparability of the findings. To enhance transparency and robustness in future research,

we recommend the standardisation of reporting diagnostic methods, explicitly stating whether DSM criteria are assessed via self-report or diagnostic interviews.

This measurement heterogeneity likely contributed to the observed high degree of variability in the prevalence estimates, as different approaches to identifying problem gambling may yield divergent results. It should be noted that the initial title and abstract screening as well as the full-text screening were conducted by a single reviewer. Future reviews should involve multiple independent reviewers to assess inter-rater reliability in the screening process, to provide a more comprehensive and diverse representation of the global problem gambling landscape.

Despite these limitations, the findings of this meta-analysis offer valuable insights into the complex interplay of biological, psychological, and sociocultural factors that shape gambling engagement and related harms. The observed geographical variations in age and gender effects, particularly the differing patterns in Asia and North America, underscore the influential role of cultural, ethnic, and environmental factors in shaping gambling behavior and problem gambling risk. These regional differences highlight the importance of adopting a nuanced, context-specific approach to understanding and addressing problem gambling.

Future research should strive to address these limitations by expanding the scope of the review to include non-English language studies, enhancing the methodological rigor and consistency across studies, and incorporating a team-based approach to the review process. A more comprehensive and harmonized assessment of problem gambling prevalence and risk factors across diverse global contexts could yield invaluable insights to inform tailored prevention and treatment strategies that account for the unique sociocultural and regulatory landscapes.

CONCLUSION

Gambling behaviour is multifaceted and cannot be attributed to a single factor. It is shaped by an interplay of biological, psychological, and social influences (Griffiths & Delfabbro, 2001). This study found that commonly reported higher PG risk for younger and male individuals is statistically significant in a global meta-analysis, with a meaningfully larger RR for these groups. However, there is also regional variation, most notably differing age effects in Asia, and an apparently diminished gendered effect in North America. Furthermore, there is a very high degree of heterogeneity between individual studies, which is understandable given the diversity in regulation, culture, and methods. The global patterns of PG with respect to age and sex support the idea that it is influenced by biological factors and their associated traits, but that these are also significantly moderated by cultural and regulatory factors. Future research could focus on more sophisticated data fusion of relevant datasets, allowing analysis of interactive effects between specific age, gender and other demographic factors. Although it is challenging to ensure consistent parameterisation across studies, meta-analytic models might conceivably integrate other study-level factors, such as overall gambling participation, available products, and regulatory measures. Integrating global, cross-jurisdictional and cross-cultural information data from across the globe has the potential to better inform the biopsychosocial framework, and guide more effective prevention and intervention strategies.

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