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Understanding funding-related bias in gambling research: insights from unhealthy commodities industries and medical/pharmaceutical research – a scoping review

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ABSTRACT

Despite the risk of funding-related bias (RoFRB) introduced by industry funding in gambling research, empirical investigations remain limited. To inform understanding of RoFRB in gambling research, this scoping review synthesized 52 peer-reviewed studies (2019–2024) spanning gambling, other unhealthy commodity sectors, and medical research – fields with similar commercial dynamics to gambling and more extensive examination of RoFRB. Findings indicate that industry influence manifests through identifiable patterns and mechanisms, at both micro (individual study) and macro (evidence base and research ecosystem) levels, with varying detectability. While industry funding is associated with influence, the extent of funder involvement in the research process appears to shape the relationship between funding source and RoFRB. Compared to other sectors, gambling studies show inconsistent uses of the term ‘industry funding,’ narrower explorations of industry influence, and more limited methodological approaches to assessing RoFRB. We propose a two-dimensional framework mapping influence by level and detectability, along with a typology of funders to improve definitional consistency. To improve the identification and mitigation of funder influence in gambling research, stronger disclosure standards, adoption of open science practices, and development of a dedicated RoFRB assessment tool are recommended.

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Introduction

Ideally, research into gambling-related harm should be funded through independent and trusted public agencies such as the United Kingdom Research and Innovation (UKRI) research councils or the Canadian Institutes for Health Research (CIHR; Adams, 2024; Wardle et al., 2020). However, until recently, limited public funding may have led researchers to seek alternative sources, often linked to gambling revenue (Cassidy et al., 2013). This potential reliance has raised concerns and sparked ongoing debate about the role and influence of industry funding in gambling studies (e.g. Adams, 2007; Baxter, 2020; Bowden Jones et al., 2022; Cassidy et al., 2013; Clark, 2015; Collins et al., 2020; Cowlshaw & Thomas, 2018; Delfabbro et al., 2020; Kim et al., 2016; Ladouceur et al., 2019; Nikkinen, 2019; Shaffer et al., 2019; Wardle et al., 2020; Wohl & Wood, 2015).

Despite extensive debate, few studies have empirically examined how funding influences gambling research. Two reviews published in 2019 compared gambling industry-funded and non-industry-funded studies and did not find evidence of systematic industry influence (Ladouceur et al., 2019; Shaffer et al., 2019). These studies, however, relied on funding disclosures and conflict of interest statements to classify studies, which may be limited by the completeness and accuracy of disclosure. Nevertheless, concerns about industry influence on research are not unique to gambling and have been empirically examined in relation to other unhealthy commodities – potentially harmful products, such as tobacco, alcohol, gambling, cannabis, and ultra-processed food and drink – for which public health approaches have proven effective in reducing harm (Royal Society For Public Health, 2022). These products are supplied by unhealthy commodity industries (UCIs), defined as ‘industries or groups of corporations where a significant share of their product portfolio comprises unhealthy commodities with high profit margins aimed at, and easily accessible to, large numbers of consumers’ (Knai et al., 2021). Comparable concerns have also been raised in the medical and pharmaceutical sectors, which feature extensive commercial involvement in research, often exceeding public investment (Rasmussen et al., 2018; Siena et al., 2023). Taken together, these fields provide a valuable body of empirical work on the influence of industry funding on research, offering insights for the gambling field.

This paper presents a scoping review of empirical literature examining the impact of industry funding on research in UCIs and the medical/pharmaceutical domains. The review has four objectives: (1) to identify how industry funding in these domains may influence or bias research and determine what lessons can be applied to gambling studies; (2) to examine how such influence has been measured, assessed, or evaluated; (3) to identify factors contributing to the RoFRB; and (4) to map existing measures, tools, or instruments used to assess this risk.

Methods

A scoping review methodology was adopted as it provides a systematic process for searching, selecting, and synthesizing evidence for complex and exploratory research questions while accommodating both quantitative and qualitative study designs

Box 1: SPIDER Framework for the review	
S (Sample):	Peer-reviewed studies that addressed industry funding of research.
PI (Phenomenon of Interest):	The impact of industry funding on the reporting of research findings, outcomes, and agendas, or any other aspect of research. This included identifying specific ways industry funding can introduce bias and how these biases manifest in various aspects of research.
D (Design):	Published literature of any research designs, such as observational, correlational, analytical or experimental research designs.
E (Evaluation):	Studies that (1) evaluated the influence of industry funding on any aspect of research, or (2) identified factors contributing to the risk of industry funding-related bias in research, or (3) discussed, validated, or applied checklists, tools, instruments, or related items to assess the risk of funder-related bias in industry-funded research studies, or (4) addressed any combination of 1, 2 and 3.
R (Research type):	Empirical qualitative, quantitative, or mixed-methods studies as well as reviews.

Figure 1. SPIDER framework used for the review.

(Arksey & O'Malley, 2005; Colquhoun et al., 2014). The PRISMA guidelines for scoping reviews was followed (PRISMA-ScR; Tricco et al., 2018). As this study reviewed existing literature without involving human participants, ethics approval was not required.

Information sources and search strategy

Four databases were searched for studies published between January 2019 and August 2024: Web of Science, Medline, PsycINFO, and PubMed. January 2019 was chosen as the start date as the first reviews examining funding-related bias in gambling research were published in 2019.¹ Searches were conducted on August 29–30, 2024. Search terms combined keywords and subject headings related to funding and bias, using appropriate Boolean and proximity operators. Terms included: 'industr* fund*', 'commercial* fund*', 'bias*', 'funding effect,' and 'conflict* of interest*.' The search strategy was developed by an information specialist and peer-reviewed by an external librarian using the PRESS checklist.² See Supplementary Materials A for full search syntaxes.

Eligibility criteria

The SPIDER framework (see Figure 1) guided the review and inclusion criteria, given its suitability for non-clinical, non-interventional, and exploratory research, accommodating diverse study designs (Amir-Behghadami, 2021; Cooke et al., 2012). Studies were included if they were peer-reviewed, empirical primary research or review articles focused on UCIs. Given the extensive work on funding-related bias in the medical and pharmaceutical fields, studies in these fields were also included if they were reviews, meta-epidemiological, or methodological research. Opinion-based papers (e.g. editorials, commentaries) and non-English articles were excluded.

Screening protocol and selection process

Search results were managed using Covidence, which automatically removed duplicates. Two reviewers independently screened titles and abstracts, followed by full-text screening, using the eligibility criteria. Disagreements were resolved through discussion or adjudicated by a third reviewer. See inclusion/exclusion decision flow chart in Supplementary Materials B.

Data charting and synthesis of results

Four authors jointly identified variables for extraction. Thereafter, one author created the data charting template in Covidence and worked with another author to iteratively update the template as new themes emerged. Another author provided technical oversight.

Article metadata (e.g. authors, year), study characteristics (e.g. methods, industry focus), and relevant key findings were extracted. Given the heterogeneity of study designs and evidence levels from case studies to meta-research, direct comparisons were not feasible and no formal quality assessment was conducted.

Extracted data were imported into Excel for analysis. A basic quantitative summary of study characteristics (publication year, geographic focus, methodology, sector of focus, funding sources, lead author affiliations and author(s) COI declarations) was generated. A flexible analytic approach combining thematic and content analysis and incorporating both inductive and deductive methods was applied (Hsieh & Shannon, 2005). Relevant text from included studies was systematically coded, with codes developed and refined iteratively. Codes were grouped into categories and themes, forming the basis for a structured narrative synthesis of recurrent patterns identified across the included studies.

Results

The systematic search and screening identified 52 eligible articles (see Figure 2 for PRISMA diagram). Most of the included studies focused on food and nutrition ($n = 19$), followed by tobacco ($n = 9$), alcohol ($n = 5$), gambling ($n = 4$), and cannabis ($n = 2$); two studies addressed multiple sectors. The remaining 11 studies were reviews or meta-epidemiological studies from the medical and pharmaceutical sectors. See Supplementary Materials C, D, and E for characteristics of included studies, summary findings, and a list of excluded full-text articles with reasons.

What is ‘industry funding?’

A key finding was the varied operationalization of ‘industry funding.’ Outlined below is how ‘industry,’ ‘funding,’ or the combined term were defined across sectors.

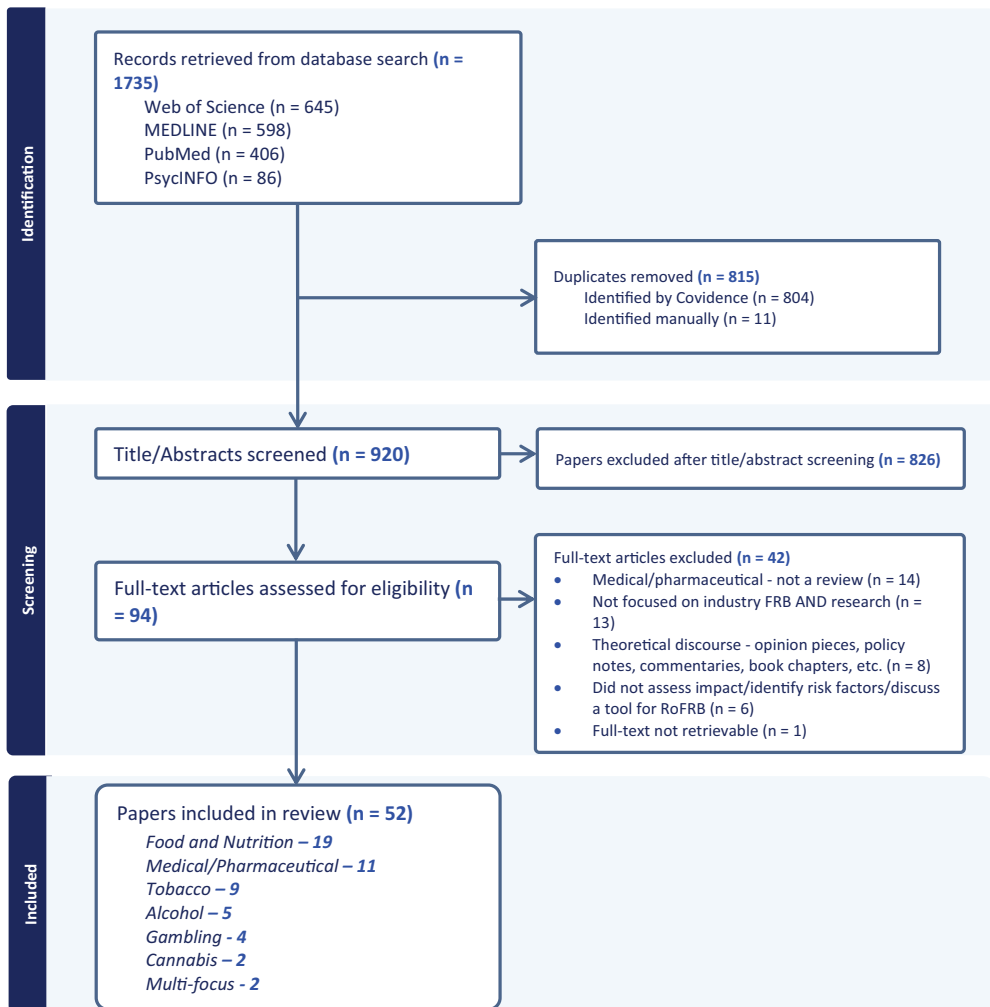


Figure 2. PRISMA flow diagram.

Unhealthy commodities industries

Alcohol. Studies typically defined alcohol industry funding broadly, including funding from for-profit alcohol companies and industry-funded third parties (Golder & McCambridge, 2021; McCambridge & Mitchell, 2022; Mitchell & McCambridge, 2022; Mitchell et al., 2020; Vos et al., 2020). However, definitions varied by study aim. For example, Mitchell et al. (2020)'s report on the Moderate Alcohol and Cardiovascular Health (MACH) trial restricted 'industry' to transnational producers, excluding smaller actors, whereas the other studies included funding from alcohol companies, trade associations, and social aspect organizations (SAOs), which are grant-making bodies voluntarily funded by for-profit companies and engaged in social impact work.

Food and nutrition. Cullerton et al. (2019) defined the ‘food industry’ as ‘*commercial food and beverage companies, including growers, producers, manufacturers, distributors, retailers, and their associations, regardless of size, but excluding the alcohol industry.*’ This definition was widely adopted and often expanded, implicitly or explicitly, to include third-party organizations voluntarily funded by the food industry (Greenhalgh, 2021; Mialon et al., 2021; Sacks et al., 2020; Steele et al., 2020, 2022; Steele, Ruskin, Sarcevic, et al., 2019). Funding was typically defined broadly, covering both direct financing (e.g. grants) and indirect ties (e.g. historical financial links), as classified by Lauber et al. (2021). In the food and nutrition sector, the definition of ‘industry’ is broad; it is therefore important to clarify that it is the subset of the food industry involved in producing ultra-processed food commodities that is considered UCI.

Tobacco. All included tobacco-focused studies defined industry funding as support from tobacco companies or affiliated entities, including nonprofits and research organizations funded voluntarily by the companies (Braznell et al., 2024; Hendlin et al., 2019; Legg et al., 2021, 2024; McDonald et al., 2023; Pasetes et al., 2020; van der Eijk & Tan, 2023; van der Eijk et al., 2019; Vassey et al., 2023). Some studies also considered pharmaceutical companies as ‘industry’ due to increasing tobacco companies’ investments in that sector (Pasetes et al., 2020; van den Berg et al., 2024; Vassey et al., 2023). Funding, often called ‘sponsorship,’ included grants, supplies, employment, consultancy, honoraria, and non-financial contributions, such as product provision (Hendlin et al., 2019; Pasetes et al., 2020; Vassey et al., 2023).

Cannabis

Cannabis recently shifted from prohibition to commercial availability in a few jurisdictions, so the for-profit cannabis industry’s involvement in public health research is relatively nascent (Buchman et al., 2025). Consequently, only two cannabis-focused studies met the inclusion criteria (Carr et al., 2022; Grundy et al., 2023). Only one explicitly defined industry funding, applying the International Committee of Medical Journal Editors (ICMJE) typology for funding and conflicts of interest (COIs), to capture both financial and non-financial conflicts related to cannabis companies, funding types, and author affiliations. Grundy et al. (2023) operationalized the ICJME definitions into a structured coding system in which COIs captured secondary interests at the author level (e.g. consulting, ownership, advisory roles), while funding referred to support for the current work, including employment or salary support, grant funding, and non-financial support.

Gambling. Most studies implicitly adopted Shaffer et al. (2019)’s operational definition of industry funding as support from gambling operators, while excluding state-owned enterprises, regulators, and industry-sponsored third parties (Collins et al., 2020; Ladouceur et al., 2019; Shaffer et al., 2019; van Schalkwyk et al., 2021). However, Dun-Campbell et al. (2023) considered conferences industry-funded if supported by gambling companies, third-party recipients of industry funds, or state-owned gambling corporations. Notably, ‘funding’ or ‘sponsorship’ was not explicitly defined.

Medical/Pharmaceutical industries

Few studies in the medical and pharmaceutical sectors explicitly defined ‘industry funding,’ likely due to well-established COI disclosure frameworks in the sector (e.g. ICJME guidelines, the FDA COI regulations). These studies typically used ‘sponsorship’ to refer to financial or material support, including authorship, statistical assistance, equipment, or grants (Fuentes et al., 2020; Stegeman et al., 2023). Even partial sponsorship from for-profit companies was usually sufficient to classify a study as industry-funded (Nejstgaard et al., 2023; Veroniki et al., 2023; Zhang et al., 2022).

Summary

Across all sectors, research funded by state-owned enterprises and regulators (public entities involved in production, distribution, or regulatory oversight) was generally not classified as industry funding, including in gambling. However, there was variability in entities considered ‘industry.’ Compared with other sectors, gambling studies tended to apply narrower and less explicitly defined definitions. In contrast, sectors such as tobacco and pharmaceuticals more consistently applied broader and more detailed classifications, including diverse financial and non-financial relationships. Due to this variability, findings in this review are reported based on each study’s own definition of industry funding.

How was industry influence assessed?

Of the 52 included studies, 44 explicitly described the methods used to identify industry influences in research, which we grouped into three broad categories: (1) assessment of study or article characteristics, (2) examination of effect sizes, results, or conclusions, and (3) critical analysis of industry actions in research. We also noted the data sources used to identify the influences. Gambling studies tended to rely more on assessment of study or article characteristics using article-based data sources which may be limited by the completeness and accuracy of authors’ disclosures.

Assessment of study or article characteristics

Four studies assessed characteristics such as study design, methodological rigor, and bibliometric indicators (e.g. citation counts) (Grundy et al., 2023; Hu et al., 2022; Ladouceur et al., 2019; Veroniki et al., 2023). These were used to evaluate whether industry-funded studies systematically differed from non-funded ones on research design, outcomes, and characteristics.

Examination of effect sizes, results, or conclusions

Nineteen studies examined effect sizes, reported results, or study conclusions to identify patterns of funder influence like favorable results or publication bias (Carr et al., 2022; Chartres et al., 2019, 2020; Fuentes et al., 2020; Graham et al., 2022; Hendlin et al., 2019; Hu et al., 2022; Mishali et al., 2019; Nejstgaard et al., 2023; Pasetes et al., 2020; Pedroza-Tobias et al., 2021; Rao, 2022; Sacks et al., 2020; Saltaji et al., 2021; Shaffer et al., 2019; Vassey et al., 2023; Veroniki et al., 2023; Vos et al., 2020; Zhang et al., 2022). Examination was done at the study level (by comparing results with conclusions, identifying inconsistencies or industry-friendly framing) and the evidence synthesis level, using pooled analyses or meta-regression.

Critical analysis of industry actions in research

Seventeen studies investigated the actions of commercial actors in shaping research practices or outputs (Braznell et al., 2024; Dun-Campbell et al., 2023; Greenhalgh, 2021; Legg et al., 2021; Mialon et al., 2020; Mialon et al., 2021; Mitchell et al., 2020; Rey-López & Gonzalez, 2019; Steele et al., 2020, 2022; Steele, Ruskin, McKee, et al., 2019; Steele, Ruskin, Sarcevic, et al., 2019; Tanrikulu et al., 2020; van der Eijk & Tan, 2023; van der Eijk et al., 2019; van Schalkwyk et al., 2021; Wood et al., 2020). These analyses were primarily used to identify broader patterns and mechanisms of influences, such as shaping research agendas and using front organizations.

Data sources

The studies used a range of data sources to evaluate industry influences, drawing either from within target articles or secondary sources. Article-based sources included funding disclosures, author affiliations, COI statements, and methodology/results sections. However, their utility was limited by selective reporting, differing journal policies, and the omission (intentional or not) of relevant results or COIs (Braznell et al., 2024; Clancy, 2022; McDonald et al., 2023; Rasmussen et al., 2015; Rey-López & Gonzalez, 2019; Shaffer et al., 2019; Vassey et al., 2023; Veroniki et al., 2023).

Some studies used secondary sources, including author disclosures in other publications, internal industry documents, research agreements, and online searches (Braznell et al., 2024; Carr et al., 2022; Dun-Campbell et al., 2023; Greenhalgh, 2021; Lauber et al., 2021; Legg et al., 2024, 2021; McCambridge & Mitchell, 2022; Mialon et al., 2020, 2021; Mitchell et al., 2020; Pasetes et al., 2020; Rao, 2022; Sacks et al., 2020; Steele, Ruskin, McKee, et al., 2019; Steele et al., 2020, 2022; Tanrikulu et al., 2020; van der Eijk & Tan, 2023; van Schalkwyk et al., 2021; Vassey et al., 2023; Veroniki et al., 2023; Wood et al., 2020). These sources were particularly useful for assessing indirect, undisclosed, or systemic forms of influence, but were more resource-intensive and sometimes required special access (e.g. Freedom of Information requests).

Assessment approaches used in gambling studies

In gambling studies, assessment approaches were more limited in scope and diversity compared with other sectors. Ladouceur et al. (2019) and Shaffer et al. (2019) primarily assessed study or article characteristics, with Shaffer et al. additionally evaluating whether hypotheses were confirmed or rejected. Both relied exclusively on article-based data sources. In contrast, Dun-Campbell et al. (2023) and van Schalkwyk et al. (2021) used more critical, contextual analyses to identify pro-industry narratives and strategic agenda-setting.

How does industry funding influence research?

Of the 52 included studies, 43 specifically examined how industry exerts influence across study design, results, conclusions, conference agendas, and broader scientific discourse. Only eight studies did not report evidence of influence: three on gambling (Collins et al., 2020; Ladouceur et al., 2019; Shaffer et al., 2019), two on alcohol (Mitchell & McCambridge, 2022; Vos et al., 2020), and one each on tobacco (Pasetes et al., 2020), food and nutrition (Mishali et al., 2019), and cannabis (Carr et al., 2022). All studies

focused on the medical/pharmaceutical sector found evidence of influence. Only the two studies that undertook critical analysis of industry actions in gambling research identified such influence (Dun-Campbell et al., 2023; van Schalkwyk et al., 2021), therefore findings presented in this section draw from the empirical evidence from other UCIs. See Supplementary Materials F for distribution by sector.

The influences reported in the included studies could be grouped into two categories: (1) patterns of influence - how funding-related bias manifests in research outputs; and (2) mechanisms of influence - the pathways through which influence occurs.

Patterns of influence

Favorable effect sizes or results. Industry-funded studies are more likely to report findings aligned with the interests of the funder, including overestimated effect sizes or results (Braznell et al., 2024; Chartres et al., 2019, 2020; Fuentes et al., 2020; Hendlin et al., 2019; Hu et al., 2022; Legg et al., 2024; Mitchell et al., 2020; Nejstgaard et al., 2020, 2023; Pedroza-Tobias et al., 2021; Rahimzadeh et al., 2022; Rao, 2022; Rey-López & Gonzalez, 2019; Sacks et al., 2020; Saltaji et al., 2021; Tanrikulu et al., 2020; Veroniki et al., 2023). For instance, Hu et al. (2022) found that industry-funded probiotic trials tended to report larger treatment effects than independently funded studies. Although this was the most reported pattern of influence, a prevalence of industry-favorable findings does not indicate poor-quality research (Rao, 2022).

Favorable spin on narrative

Another pattern observed was the use of ‘spin’ or ‘results framing’ in industry-funded studies. Even when results were neutral or unfavorable, findings were often presented in such a manner as to minimize harms or negative outcomes, deflect blame from industry products, or emphasize personal responsibility over broader regulatory or population-level interventions (Braznell et al., 2024; Dun-Campbell et al., 2023; Hendlin et al., 2019; Legg et al., 2024; Pedroza-Tobias et al., 2021; Rao, 2022; Rey-López & Gonzalez, 2019; Steele et al., 2020; Steele, Ruskin, Sarcevic, et al., 2019; van Schalkwyk et al., 2021; Vassey et al., 2023). For example, Rao (2022) analyzed nutrition research abstracts and found that industry-funded articles often present positive results more optimistically while downplaying negative outcomes, which may lead readers to view negative results less seriously.

Publication bias and selective reporting

Industry funders may suppress, delay, or discourage the publication of unfavorable results while promoting studies with favorable outcomes, thereby contributing to publication bias (Braznell et al., 2024; Hu et al., 2022; Legg et al., 2024, 2021; Mialon et al., 2020, 2021; Pedroza-Tobias et al., 2021; Rahimzadeh et al., 2022; Steele et al., 2020, 2022; Tanrikulu et al., 2020; Zhang et al., 2022). For example, a study found that excluding drug trials with financial COIs from meta-analyses sometimes changed conclusions about effectiveness and adverse effects (Zhang et al., 2022). While more observable at the broader evidence level, selective reporting of favorable results may also occur at the individual study level.

Influence on overall scientific discourse and research agenda

Industry funding often steers the broader direction of research toward topics that align with commercial interests (Braznell et al., 2024; Dun-Campbell et al., 2023; Florides & Christodoulides, 2023; Greenhalgh, 2021; Hendlin et al., 2019; Legg et al., 2024; Mialon et al., 2021; Mitchell et al., 2020; Steele et al., 2020; Steele, Ruskin, McKee, et al., 2019; Steele, Ruskin, Sarcevic, et al., 2019; Tanrikulu et al., 2020; van der Eijk & Tan, 2023; Vassey et al., 2023; Wood et al., 2020). Industry funders also tend to strategically fund theoretical publications such as commentaries and letters to generate doubt or challenge unfavorable evidence (Hendlin et al., 2019). Often, industry research agendas focus on four dominant frames: (1) the medicalisation or specialisation of solutions, such as pharmacological treatments for harm; (2) the complexity of harm pathways, emphasising multifactorial causes to discourage universal harm-reduction approaches; (3) an emphasis on individual responsibility, framing harms as a personal rather than structural issue; and (4) deflection from population-level interventions by focusing on harms among specific demographic groups, such as young men (Dun-Campbell et al., 2023).

Mechanisms of industry influence

Mechanisms identified across included studies were found to cluster into three categories: (1) direct involvement, (2) relational pathways, and (3) institutional and normative pressures.

Direct involvement

Direct involvement refers to explicit actions taken by funders to shape the research process. Studies link such involvement with exaggerated effect sizes (Fuentes et al., 2020; Hu et al., 2022; Saltaji et al., 2021). One meta-review of meta-epidemiological studies shows a 12% increase in favorable effect estimates in drug trials with active funder involvement, although commercial funding source itself did not significantly affect effect-size estimates (Nejstgaard et al., 2023). These mechanisms include:

Shaping the research questions: Funders influence which questions are asked and which topics are excluded, often narrowing research to align with commercial interests (Florides & Christodoulides, 2023; Grundy et al., 2023; Legg et al., 2024; Mialon et al., 2021).

Reviewing and approving study design and methodology: Funders may influence methodological decisions to ensure favorable results by directly providing input on protocols, ethics, and conflict-of-interest procedures to align with their interests, which may result in intentional selection of study designs, methodology, and outcomes that favor industry interests (Braznell et al., 2024; Legg et al., 2024; Mialon et al., 2021; Mitchell et al., 2020; Rahimzadeh et al., 2022).

Stopping or modifying research: Funding agreements may grant funders the power to halt or modify studies at any stage potentially leading to the suppression of unfavorable findings (Steele, Ruskin, McKee, et al., 2019).

Authorial control and influence: The involvement of industry-employed coauthors is consistently associated with more favorable findings or narrative (Graham et al., 2022; Mialon et al., 2021).

Delaying or reviewing publication: Pre-publication review clauses, sometimes under the pretext of protecting proprietary information, may result in the selective release, delay, or omission of unfavorable findings (Steele, Ruskin, McKee, et al., 2019).

Controlling dissemination: Funders may steer how findings are communicated, promoting favorable results while downplaying unfavorable findings using media and third parties (Braznell et al., 2024; Legg et al., 2024).

Relational pathways

Unlike direct involvement, which is formal and overt, relational pathways are indirect, sometimes informal mechanisms through which funders influence research via personal, institutional, or social connections. These interactions are often opaque but nonetheless impactful. These mechanisms include:

Informal guidance and lobbying: Industry funders may influence research subtly through personal relationships, professional events, and informal consultations. For instance, Greenhalgh (2021) and van der Eijk and Tan (2023) found that the food industry in China and the tobacco industry in Singapore used social events, personal ties, and professional networks to guide obesity and tobacco research in ways that aligned with their interests.

Use of front organizations: Industry funding is often routed through front organizations (entities that appear independent but are covertly created, funded, or directed by for-profit companies, usually without disclosing these ties) to obscure the funder's role and reduce scrutiny, enabling support for favorable research while appearing uninvolved (Braznell et al., 2024; Golder & McCambridge, 2021; Greenhalgh, 2021; Lauber et al., 2021; Legg et al., 2024; Mialon et al., 2021; Mitchell & McCambridge, 2022; Mitchell et al., 2020; Steele et al., 2022; Steele, Ruskin, Sarcevic, et al., 2019). In some cases, funding originates from sectors that appear unrelated. For example, pharmaceuticals-funded e-cigarette studies were more likely to promote tobacco-industry-like harm reduction narratives (Hendlin et al., 2019).

Embedding in research ecosystems: Industry funders may exert subtle, long-term influence via institutional partnerships, co-sponsorships, or advisory roles. For example, Greenhalgh (2021) described how a scientific organization tied to a transnational food company, operated from within a national public health agency, leveraging shared staff and informal authority to shape obesity research.

Institutional and normative pressures

Unlike direct or indirect industry actions, this category refers to structural forces and internalized norms that shape researcher behavior, often without active intervention from funders. These mechanisms typically operate through institutional expectations (e.g. pressure to attract and retain funding), social conditioning (i.e. shared norms around funder-preferred research), or subconscious alignment with these perceived norms, making them difficult to detect or measure. These mechanisms include:

Institutional and psychological pressures: Ties to industry can make researchers feel compelled, consciously or unconsciously, to align with industry interests. This pressure may lead to avoidance of controversial topics, softened interpretations, or framing of results. Even in the absence of direct interference, contractual clauses such as pre-

publication review or study termination rights can also exert a ‘chilling effect,’ discouraging the publication of findings unfavorable to funders (Steele, Ruskin, McKee, et al., 2019).

Normative influence and self-censorship: Prolonged exposure to industry funding can normalize assumptions about what constitutes appropriate or fundable research. Researchers, particularly early-career or industry-grant-dependent scholars, may internalize these expectations and unconsciously adapt their research questions, methods, or interpretations to align with industry-friendly expectations, even without explicit pressure from the funder (Golder & McCambridge, 2021; Legg et al., 2024; Mitchell & McCambridge, 2022).

Conceptual framing of funder influences: Level of influence and Ease of detection

Industry influence on research is complex, operating across multiple levels, from direct effects on individual studies to broader impacts on scientific discourse and research priorities, and varying in how readily it can be identified. To provide structure to this complexity, we developed a two-dimensional framework (see Figure 3) based on the patterns and mechanisms outlined above. It captures:

- (1) **Level of influence:** Micro-level (individual studies) vs. macro-level (broader research systems and agendas).
- (2) **Ease of detection:** A continuum ranging from easily observable to subtle or deeply embedded influences.

Micro-level influences manifest within individual studies – through aspects like design, methodology, analysis, interpretation, or the degree of funder involvement. In contrast, macro-level influences operate at broader institutional, sectoral, or research ecosystem level. These macro-level dynamics are often not visible within single studies and are typically identified through broader analyses, such as bibliometric reviews, funding trend studies, or meta-research across study corpora.

Ease of detection varies both within and across levels of influence. Some macro-level phenomena, such as publication bias, may be identified through systematic comparisons of industry- and non-industry-funded research. Others, like informal guidance or lobbying, are more difficult to detect without access to internal documents or institutional ethnographic insight. Similarly, while certain micro-level patterns (e.g. authorial influence or narrative spin) are visible in published outputs, more subtle mechanisms, such as study-level self-censorship, are harder to observe.

The placement of the dots (influences) in Figure 3 is illustrative, based on a qualitative judgment informed by the evidence in the included literature.

What factors contribute to risk of funding-related bias (RoFRB)?

Drawing on evidence from included studies, we identified six relatively observable indicators that may signal RoFRB at the micro level. These indicators are listed in order of their relative importance: (1) presence of patterns of influence, (2) funder

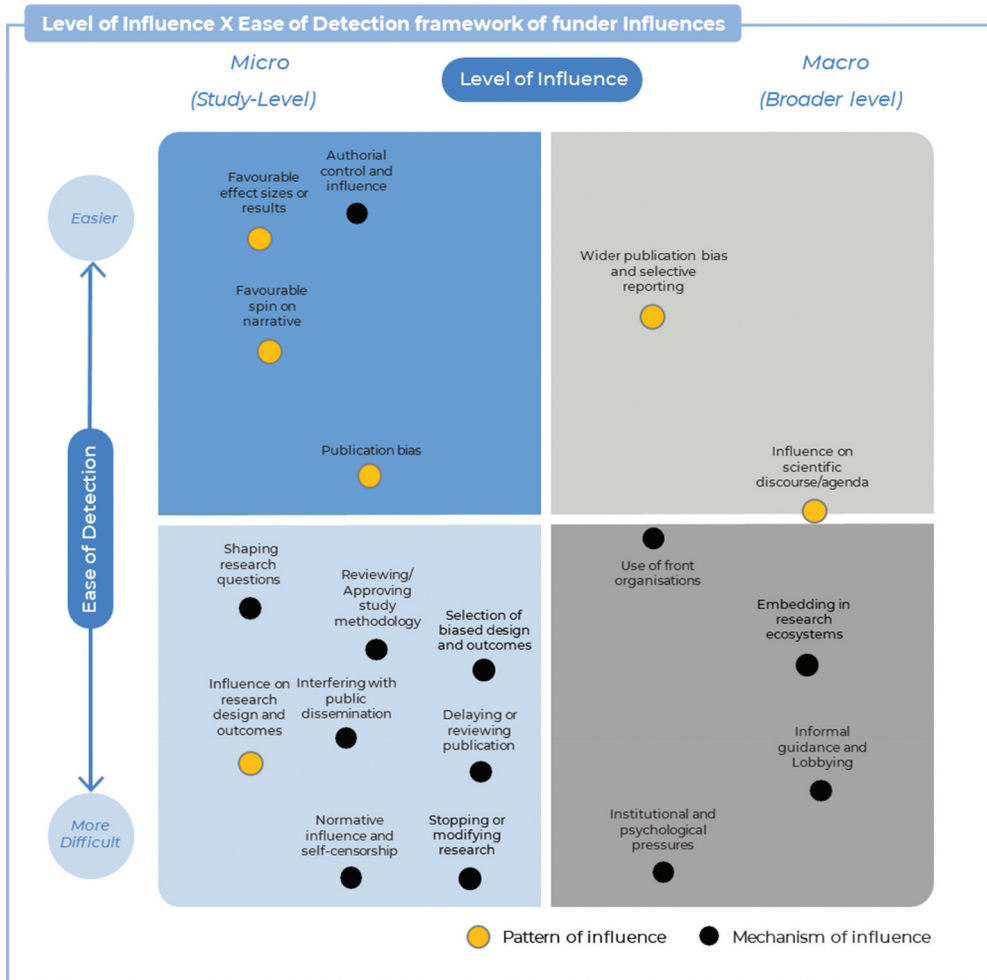


Figure 3. Level of influence by ease of detection framework of funder influences.

involvement, (3) level of openness and transparency, (4) industry ties, (5) funding source, and (6) supplementary factors.

- (1) *Presence of patterns of influence:* RoFRB was often inferred from favorability to funders in findings, conclusions, or framing. A health guidance document recommended that if results of a study favored funders, reviewers should consult methodologists and consider downgrading study quality (Stegeman et al., 2023).
- (2) *Funder involvement:* The extent and nature of funder involvement in a research process was a significant RoFRB indicator. Researcher autonomy over design, data, and publication was seen as essential to scientific integrity (Cullerton et al., 2019). Studies were rated high-risk when industry funder involvement was coupled with restricted funding conditions, though concerns remained if there was active funder involvement even in the absence of explicit restrictions (Stegeman et al., 2023).

- (3) *Level of openness and transparency*: Practices like pre-registration, open data and code, and full disclosure of funding arrangements and relevant ties, including those of close associates, are thought to mitigate RoFRB by enabling scrutiny (Cullerton et al., 2019; Pasetes et al., 2020; Plottel et al., 2020; Rahimzadeh et al., 2022; Veroniki et al., 2023).
- (4) *Industry ties*: Other industry relationships – financial, in-kind, or advisory – can contribute to RoFRB. These include:
 - Grants for other studies, consultancy agreements, honoraria, and ownership interests in industry products (Grundy et al., 2023; Steele et al., 2020; Vassey et al., 2023);
 - Consulting or advisory roles that involve lobbying for industry interests (Greenhalgh, 2021; Mitchell & McCambridge, 2022; Steele et al., 2020);
 - Gifts, travel, or non-financial support (e.g. products, data, or writing support) from industry sponsors (Grundy et al., 2023; Steele et al., 2020; van der Eijk & Tan, 2023; Wood et al., 2020); and
 - Ghost-writing or undisclosed authorship for industry-sponsored publications (Braznell et al., 2024; Graham et al., 2022).

The degree of risk depends on both the financial value and the strategic relevance of these ties (Graham et al., 2022).

- (5) *Funding source*: Beyond direct industry funding, RoFRB may be heightened when research is funded through front organizations or when the funding source is ambiguous or undisclosed (Greenhalgh, 2021; Legg et al., 2024).
- (6) *Methodological or editorial laxity*: Publication in journals with industry affiliations or weaker editorial standards, bypassed or nontransparent peer review, and poor adherence to reporting or quality appraisal guidelines may indicate RoFRB (Legg et al., 2024; Mialon et al., 2021; Veroniki et al., 2023).

What measures, checklists, tools, or instruments have been used to assess RoFRB?

Only a smaller subset of included papers ($n = 12$) applied specific tools, checklists, or defined criteria to classify studies into risk categories (e.g. high, low, or unclear) based on funder-related factors. Of these, seven relied on existing tools as proxies for RoFRB, while five developed or applied custom checklists or criteria specifically aimed at assessing RoFRB – two of which combined both approaches. None of the included gambling studies used tools, criteria or checklists specifically designed to assess RoFRB.

Established tools as proxies

Seven studies used established tools such as the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I), ROBINS for Exposure (ROBINS-E), and the Appraisal tool for Cross-Sectional Studies (AXIS) tool as indirect measures of RoFRB (Carr et al., 2022; Chartres et al., 2019, 2020; Florides & Christodoulides, 2023; McDonald et al., 2023;

Nejstgaard et al., 2020; van Schalkwyk et al., 2021). These tools helped identify broader patterns (e.g. methodological weaknesses) across industry-funded versus non-industry-funded studies but were limited in directly assessing funder-specific influences (e.g. funder involvement).

RoFRB-Specific tools

Five studies applied tailored checklists or criteria specifically designed to assess RoFRB (Fuentes et al., 2020; Hu et al., 2022; Pasetes et al., 2020; Saltaji et al., 2021; Stegeman et al., 2023). All were studies focused on the medical or pharmaceutical sectors, except for Pasetes et al. (2020), which examined the tobacco industry. Table 1 summarizes each study's tool approach, the RoFRB factors considered, and the risk categories and definitions.

Discussion

This review synthesized data from 52 empirical studies (2019–2024) across UCIs and medical/pharmaceutical sectors on how industry funding is defined, how it influences research, and how both influence and RoFRB are assessed.

Definitions of 'industry funding' varied, generally including both financial and non-financial support from for-profit corporations, affiliates, and SAOs, but excluding state-owned entities and regulators. The review found that the source of funding alone does not reliably indicate industry influence or RoFRB, as industry influence is multi-level and complex, involving consistent patterns (e.g. favorable findings) and mechanisms (e.g. front groups). Furthermore, industry influence operates at both micro (individual study) and macro (research ecosystem) levels, with varying visibility. Influence can be assessed using data from article-based sources (e.g. COI statements) or external sources (e.g. transparency databases), with the latter being more likely to reveal undisclosed ties but more resource-intensive.

A two-dimensional framework mapping influence by level and detectability is proposed. Six potential indicators of RoFRB - (1) presence of patterns of influence, (2) funder involvement, (3) level of openness and transparency, (4) industry ties, (5) funding source, and (6) methodological or editorial laxity - were identified. Existing checklists/tools in medical/pharmaceutical research typically address only two of these factors - funder involvement and funding source - highlighting the need for a more comprehensive tool.

Implications for gambling research

Influences explored and methodological approaches

Gambling research lags behind other UCIs and the medical/pharmaceutical sectors in both the scope of influences examined and the methods used to empirically assess funder influence and RoFRB. Empirical gambling studies on funder influence have largely focused on methodological characteristics and relied on article-based data, with limited examination of underlying mechanisms of industry

Table 1. RoFRB-Specific assessment tools: approaches, considered factors, and risk classification.

Study	Approach	RoFRB Factors Considered	Risk Categories and Definitions
Medical/Pharmaceutical			
Fuentes et al. (2020)	Custom criteria based on funding source and sponsor involvement to classify sponsorship influence	Funder involvement Funding source	Appropriate: Sponsor had no role in conduct, analysis, or authorship OR non-profit/public funding source. Inappropriate: Sponsor's employees involved in research. Unclear: Insufficient disclosure or funding not reported.
Hu et al. (2022)	Custom criteria based on Consolidated Standards of Reporting Trials (CONSORT) statement (Turner et al., 2012) + Als-Nielsen et al. (2003) to classify risk	Funder involvement	Low: Minimal or no sponsor involvement – no sponsorship or sponsor was not involved in study conduct, data management, analysis, or co-authorship (must be explicitly stated if industry sponsored). High: Sponsor involved in key aspects of the research; sponsor involvement was ambiguous, or disclosure was unclear.
Saltaji et al. (2021)	Cochrane Handbook for Systematic Reviews of Interventions (Higgins, 2008) + Als-Nielsen et al. (2003) to classify risk	Funder involvement Funding source	Low: Sponsor acknowledged but had no role in study design, analysis, reporting OR funding from non-industry sources OR sponsor only provided materials. High: Industry-employed authors or sponsor had active role in study. Unclear: Disclosures on funding or sponsor involvement missing/incomplete.
Stegeman et al. (2023)	Two decision tools (one for individual studies and the other for evidence syntheses) developed by guideline development experts to assess industry sponsorship bias	Presence of patterns of influence (favourable results, publication bias) Funder involvement Funding source	No concrete indications of influence: Sponsor not involved OR funding was unrestricted, and results were not favourable to sponsor OR non-industry/unknown funder with no concerns. Potentially indications of influence: Industry-funded, grant restrictions unknown, and results were favourable to sponsor OR other concerns present. Be aware of other influences: Industry-funded with unrestricted grant; sponsor involvement unclear. Beware of influence – high risk of bias: Sponsor actively involved AND funding was restricted.
UCIs - Tobacco			
Pasetes et al. (2020)	Custom criteria based solely on funding source to classify risk	Funding source	Low: Government-funded. High: Funded by pharmaceutical or tobacco industry. Unclear: No funding or COI info disclosed.

influence. Notably, studies using only such data (Ladouceur et al., 2019; Shaffer et al., 2019) reported no industry influence, whereas those employing contextual or critical approaches (Dun-Campbell et al., 2023; van Schalkwyk et al., 2021) uncovered pro-industry narratives and agenda-setting. Explicit assessments of RoFRB, even those using established tools or checklists as proxies, are rare in gambling studies, and no RoFRB-specific assessment tool currently exists in this field. These gaps highlight the need for the adoption of more varied methodologies that explore a wider range of patterns and mechanisms of funder (both commercial and noncommercial) influence, using diverse data sources and interpretive frameworks, as well as the development of a dedicated tool to assess RoFRB in gambling research.

RoFRB tool development and transparency needs

Developing a dedicated tool to assess RoFRB in gambling research is both timely and necessary. Ideally, such a tool would capture the full spectrum of funder influence, from micro-level patterns (e.g. favorable findings, narrative spin) to broader systemic mechanisms (e.g. institutional or normative pressures). However, given the relatively limited evidence base on funder influence in gambling research at the time of this review, the tool should be developed iteratively. Initial versions could prioritize more readily observable indicators, drawing on lessons from other UCIs and the medical/pharmaceutical sectors, and guided by the level of influence – ease of detection framework. As the evidence base grows, particularly through critical analysis of gambling corporations' actions, the tool should evolve to capture both subtler and sector-specific forms of influence. Importantly, the tool should be applied across all gambling-related studies, irrespective of funding source, to help detect patterns that may otherwise go unnoticed.

Meaningful progress will also depend on greater transparency, which entails having clear, standardized definitions of funding sources and consistent, detailed disclosure requirements, including adoption of open sciences practices. Notably, Louderback et al. (2023) found that industry-funded gambling studies more frequently report open science practices, including open access, open materials, and power analyses. Embracing open science practices may help mitigate RoFRB by enabling scrutiny. Strengthening transparency requirements across journals and institutions, irrespective of funding source, will be essential for making RoFRB assessments in gambling research more credible, comparable, and adaptable over time.

Definition

The first step in assessing RoFRB is identifying the funding source. Other UCIs, such as tobacco and alcohol, typically apply broader and more standardized definitions of 'industry' to include companies that profit directly from the product, as well as organizations funded or governed by such companies (Institute of Alcohol Studies, 2020; Movendi International, 2019; Tactics, Tobacco, 2023; World Health Organization, 2003). In tobacco research, this may extend to

adjacent sectors, such as pharmaceuticals, due to historical tobacco industry efforts to undermine public health (Brandt, 2012; Godlee et al., 2014). Similarly, established frameworks for COI disclosure exists in the medical and pharmaceutical sectors guiding ‘industry funding’ definition (Institute of Medicine of the National Academies, 2009; International Committee of Medical Journal Editors [ICJME], n.d.; Krimsky & Rothenberg, 1998). Funding is interpreted broadly to include grants, consultancy, travel, and other financial ties.

In gambling research, definitions of ‘industry funding’ are inconsistent, which creates challenges for transparency, COI identification, and RoFRB assessment. Some consider research funded by state-owned gambling operators to be ‘industry funding’ while others do not. Table 2 describes suggested terms and definitions that could be used when declaring research funding in gambling studies.

Independent organisation with no gambling affiliation

Public or charitable funders (e.g. CIHR in Canada, UKRI in UK)

Limitations

This review drew on diverse literatures across gambling, health, and other fields, allowing for cross-sector comparisons. A key strength of this review is that conclusions regarding funder influence are based solely on empirical evidence reported in included studies, rather than speculation, highlighting the robustness of our findings. However, implications pertaining to funding-related bias in gambling research are drawn mostly from adjacent fields and are limited by the lack of empirical evidence from gambling-specific research, necessitating further research. Furthermore, although government and nonprofit funders are often seen as neutral, they can influence research, as evident in political agenda-setting (Babor et al., 2025; Collins et al., 2020; Gomes & Stavropoulou, 2019; Wojick & Michales, 2015). These influences remain under-researched and were not explored in this review. Potential correlates of funding-related biases, such as the preference for ‘positive’ or ‘novel’ results in academic publishing, positionality³ or the tendency for researchers skeptical of public health to gravitate toward industry funding, were not examined and warrant investigation in future research (Ioannidis, 2005; Krimsky, 2013).

Other limitations pertain to the study methodology. The review included only English-language literature and may not reflect the perspectives of non-English publications. Additionally, as a scoping review, study quality was not appraised and effect sizes were not quantified, limiting the depth of evidence assessment. Due to the heterogeneity of the included studies, a qualitative analysis approach was adopted, which may introduce interpretive bias or subjectivity in categorizing findings.

Conclusion

This review highlights the complex and multi-level ways in which industry funding can influence research, beyond what is visible in individual studies and their funding disclosures. While other sectors have begun to systematically assess these risks, gambling research remains markedly behind in both definitions and

Table 2. Suggested funder categories and definitions.

Funder Category	Definition
Commercial gambling companies	For-profit, private companies or corporations that profit directly from the provision, promotion, and expansion of gambling products and services. This includes gambling operators (such as casinos and online betting platforms), software and platform providers, advertising, marketing, and affiliate agencies that promote gambling products, lobbyists and trade associations that represent the interests of gambling companies, as well as data analytics firms that support customer targeting, risk assessment, or revenue optimisation. It also encompasses investors and shareholders with a financial stake in these companies. It does not include regulators, governmental bodies that receive revenue from gambling proceeds, or state-owned gambling operators. Examples of organisations that fit this definition include FanDuel, Playtech, etc.
Industry-sponsored organisations	Industry-sponsored organisations are third-party organisations that receive voluntary funding directly from commercial gambling companies. These organisations often have gambling industry board representation, trustees, and a high frequency of contact with gambling-related bodies (Bowden Jones et al., 2022). Examples of industry-sponsored organisations in the gambling sector include the International Center for Responsible Gambling and GambleAware. In alcohol studies, a subset of industry-sponsored organisations have been referred to as Social Aspects/Public Relations Organizations (SAPROs) (Babor, 2009; Miller et al., 2011).
State-owned gambling operators	State-owned gambling operators are government-owned entities established to operate gambling activities within a specific jurisdiction (country, state, province, or territory) to ensure that gambling is made available to the public in a controlled and socially responsible manner. Examples include Norsk Tipping (Norway), Veikkaus Oy (Finland) or the Ontario Lottery and Gaming Corporation and British Columbia Lottery Corporation (Canada).
Charitable gambling organisations	Non-profit entities that conduct gambling activities (e.g. raffles, bingo) to raise funds for charitable causes. These organisations operate within the framework of gambling regulation but do not profit from gambling in the same way as commercial gambling companies. They are typically required to allocate a portion of their proceeds to charitable purposes and are regulated under specific laws governing charitable gambling in their jurisdiction.
Regulatory/governmental bodies	Organisations that play a role in the regulation of gambling but are not commercial gambling companies, industry-sponsored organisations, or state-owned gambling operators (as defined above). They include, but are not limited to, regulators and other governmental bodies overseeing or administering gambling-related regulation, policies, funding, etc. Examples include the United Kingdom Gambling Commission, the Alcohol and Gaming Commission of Ontario, etc.
Independent organisations operating in the gambling space	Organisations that receive funds from the proceeds of gambling (e.g. harm reduction levies, fines, or other involuntary contributions), but over which the industry exerts no control. Examples include the Academic Forum for the Study of Gambling or research institutes or organizations receiving funding through the recently enacted UK statutory gambling levy.
Independent organisation with no gambling affiliation	Public or charitable funders (e.g. CIHR in Canada, UKRI in UK)

methodological approaches. To ensure greater rigor and transparency, the field must adopt a clearer and more operationally useful definition of ‘industry funding,’ diversify methodological strategies for assessing RoFRB, embrace open science practices, and prioritize the development of a dedicated tool to assess RoFRB. Strengthening transparency standards and improving consistency in disclosures will be essential for identifying and mitigating industry influence in gambling research moving forward.

Notes

1. A brief search for non-theoretical, gambling-focused articles predating 2019 was conducted. No articles eligible for inclusion in this review were returned. This is corroborated by Collins et al. (2020), who conducted a similar search for empirical articles on gambling industry funding biases.
2. The Peer Review of Electronic Search Strategies (PRESS) checklist is available on OSF: https://osf.io/n5t4k?view_only=06f856d3519747a0a665b36969afc981. It is important to note that the PRESS checklist lists 27 July 2024 as the search end date, reflecting when the search strategy was developed for peer review, while the final search syntaxes indicate August 2024, when the searches were actually conducted following receipt of the PRESS feedback.
3. Positionality, as used here, broadly refers to a researcher's social, political, and personal standpoint, which may influence what they study, how they conduct research, and how they interpret findings. This standpoint is shaped by factors such as identity, values, and personal or family experiences, including, for example, lived experience of gambling harm.
4. Regulatory settlements applied for socially responsible purposes. Available at: <https://www.gamblingcommission.gov.uk/licensees-and-businesses/page/regulatory-settlements-applied-for-socially-responsible-purposes>

Disclosure statement

The authors declare no conflicts of interest in relation to commercial gambling companies.

Adetoun Dapo-Famodu, Matthew M. Young, Kyle A. Tuico, and Sasha Stark (SST) are employed by Greo Evidence Insights (Greo). Greo has received funds in the last five years from the Ontario Ministry of Health and Long-Term Care (Canada), non-profits, charities, and post-secondary institutions (Canada). Greo has also received funds from social responsibility arms of Canadian crown corporations (i.e., state owned gambling operators) that conduct and manage provincial/territorial gambling, regulatory settlement funds (Great Britain), third-sector charities (Great Britain), and international regulators. Prior to 2022, SST was employed at the Responsible Gambling Council, where, in the past five years, she worked on projects funded by Carleton University, Greo, MGM Resorts International, GambleAware, and Playtech.

Simon Dymond (SD), Elliot A. Ludvig (EAL), Amanda Roberts (AR), Jim Rogers (JR), Steve Sharman (SSH), and Richard Tunney (RT) hold or have held honorary leadership roles with the Academic Forum for the Study of Gambling, which is funded through regulatory settlements approved by the Great Britain Gambling Commission and administered by Greo.

In the last five years, SD has received funding from Health and Care Research Wales, the Welsh Government Office for Science – Ser Cymru, the Research Wales Infrastructure Fund, GambleAware, the GC (regulatory settlements), Greo, the RAF Benevolent Fund, the Armed Forces Covenant Fund Trust, the Office for Veterans' Affairs Health Innovation Fund, the British Academy/Leverhulme Trust, the Bristol Hub for Gambling Harms Research, and the International Center for Responsible Gaming. EAL has received external funding from the Economic and Social Research Council (ESRC, UK) and AGRI and consulted on a project funded by GambleAware. AR has received funding from the Society for the Study of Addiction (SSA), Greo, National Institute of Health Research (NIHR), Lincolnshire County Council, Ashfield District Council, Health and Care Research Wales, Public Health Lincoln and Santander. JR has received funding from the NIHR, Lincolnshire County Council, Nottinghamshire County Council and Ashfield District Council. SSH has received funding from UK Research and Innovation (UKRI) via a Future Leaders Fellowship, the King's Prize Fellowship, and the SSA Academic Fellowship. SSH has received additional research funding from the NIHR, and Greo. RT has received external funding from the ESRC, and named as CO-I on grants from the International Center for Responsible Gaming, the AFSG, and Greo. RT serves on the editorial boards of

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This project is funded from regulatory settlements for socially responsible purposes.⁴ Regulatory settlement funds are involuntary payments from gambling operators. They are “a payment in lieu of the financial penalty the United Kingdom Gambling Commission (GC) might otherwise impose for breach of a licence condition”. Importantly, “there is to be no publicity or benefit for the operator in connection with the regulatory settlement”, and the gambling operator has no control over and is not even permitted to communicate with, the organisation provided the funds (in this case Greo Evidence Insights), except to carry out necessary financial transactions. Decisions regarding the awarding of regulatory settlement funds are made by the Social Responsibility Funds Group of the GC. Once awarded, there is no influence exerted on projects by the GC other than monitoring to ensure milestones described in successful proposals are met.

Notes on contributors

Adetoun Dapo-Famodu (AD) has over 15 years of experience in transdisciplinary, applied public health research and evaluation, primarily with multilateral organisations focused on human capital and social development policy and practice in resource-constrained settings. Her work is typically situated at the intersection of evidence and practice, supporting informed policy and decision making. She holds Master’s degrees in Public Health Epidemiology, and Data, Economics, and Development Policy. AD is currently a Lead Research Analyst at Greo Evidence Insights, where she leads and supports research projects in gambling and related areas, specialising in systematised evidence appraisal and synthesis.

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Data availability statement

The data supporting the findings of this scoping review are available in the supplementary materials of this article. This includes the search syntaxes, the inclusion/exclusion decision flow chart, the list of included studies with key article metadata (such as titles, authors, publication year, and journal name) and summary of findings, and the list of studies excluded at full-text screening with reasons for exclusion. Due to copyright and licensing restrictions, access to full texts of the included studies is not provided, but full references are listed for further access.

Open scholarship



This article has earned the Center for Open Science badge for Open Materials. The materials are openly accessible at https://osf.io/b6hu2/overview?view_only=b8123ac9bb04487096bba2e028f2d5ba

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