Report Summary

Inferring causality in gambling research using matching methods and sample selection models

What this report is about

There is evidence that some forms of gambling are more strongly linked to addictive behaviour. But these findings are not consistent across different studies. For example, a study using data from the British Gambling Prevalence Survey 2007 found that only one gambling activity (fixed odds betting terminal use), was linked to problem gambling. But this finding was not replicated in other datasets.

Gambling prevalence studies often use cross-sectional data. However, this data is seriously limited because responses to questions about gambling behaviour can be influenced by selection bias. Selection bias occurs when those who take part in the study (e.g. by engaging in a specific type of gambling) are not representative of the target population (i.e., the entire group that the study wants to better understand), or factors that bias selection also affect the outcome of interest (e.g. gambling harms). It is hard to tell whether characteristics (e.g., age, gender, education, and socioeconomic background) influences how people engage with gambling products or whether selection bias influences how people engage with the products.

Matching methods can be used to try to create similar conditions to a randomized controlled trial. Matching methods work by trying to match participants on a series of control variables. Some examples of matching methods include propensity score matching and coarsened exact matching.

Another method used in other social science disciplines is sample selection models. Sample selection uses separate equations to assess for engagement and the quantity of interest (e.g., disordered gambling). Sample selection model assumes that there are variables in the model that explain sample selection that do not explain the quantity part of the analysis.

Why is this report important?

There is evidence that some forms of gambling are more strongly linked to addictive behaviour. But these findings are not consistent across different studies. Most gambling prevalence studies use cross-sectional data, which can be influenced by selection bias. This report is important because it reviews the use of matching methods, (e.g., propensity score matching, coarsened exact matching, and sample selection models) in gambling prevalence studies. This report also includes an analysis of 9 British gambling prevalence surveys. The authors used these approaches to identify which gambling activities are associated with the most severe individual gambling harms. They found that engagement in some activities (i.e., online gambling, slots) is linked to greater problem gambling. Also, the results suggest it is important to control for selection biases in gambling research.

In this study, the authors reviewed three approaches: propensity score matching, coarsened exact matching, and sample selection modelling. They used these approaches to identify which gambling activities are associated with the most severe individual gambling harms. This helps policy makers identify whether certain gambling products should be watched closer or have greater regulation.

What was done?

In this study, the authors reviewed three approaches: propensity score matching, coarsened exact matching, and sample selection modelling. The authors first conducted a literature review to see how these methods have been used in gambling research.

The authors then used these approaches to examine the relationship between specific gambling products and gambling harm. They wanted to know which gambling activities are associated with the most severe individual gambling harms.

Then, the authors examined the extent to which specific gambling products are linked to problem gambling. They did this by using data from 9 surveys that measured gambling prevalence. Included surveys were: The British Gambling Prevalence Surveys (2007, 2010), Health Surveys for England (2012, 2015, 2016, 2018) and the Scottish Health Surveys (2012, 2015, 2016). These surveys were collected by the National Centre for Social Research. These surveys used a probability sampling approach. All three surveys used the same gambling engagement and problem gambling questions, including the Problem Gambling Severity Index to measure disordered gambling.

Because the surveys include multiple questions about similar activities, the authors of this report collapsed similar activities into 8 broader categories of activities: casino/table, online betting, offline betting, pools, scratchcards, lotteries, bingo, and slot machines/FOBTs.

The authors also included the following variables in their analysis: age, sex, income, education level, Index of Multiple Deprivation, current smoking status, current drinking status, self-reported health, and whether participants had a longstanding illness.

Next, the authors removed incomplete responses. Then they conducted multiple analyses, including a propensity score matching procedure and a coarsened exact matching procedure. The authors also applied two-part modelling to the data. Next, the authors conducted a meta-analysis. They did this to combine the findings from the separate analyses.

What you need to know

Literature Review

The authors identified 40 relevant papers. Of these papers, 33 used a propensity score model (PSM) to match a control group and a condition group. These groups were matched on either risk factors or observed baseline variables that might predict gambling behaviour. For example, some studies used propensity score models to create a matched sample of people who do not have gambling problems with those that do, based on risk factors.

Of the remaining papers, six used sample selection modelling (SSM). Sample selection modeling was used to correct for sample selection bias in measuring gambling prevalence. Another paper used a two-part model to examine the effect of IQ on participation in horse race betting. Of the 40 papers, none used coarsened exact matching or directed acyclic graphs.

Most of the papers analyzed existing data sets. The authors identified various themes among these studies, including (1) impact of legislation (e.g., regulation); (2) gambling products and modality (e.g., online vs land-based gambling); (3) how individual differences (e.g. personality, religiosity) determine gambling engagement; (4) controlling for clinical noise and (5) how gambling attitudes and norms affect behaviour. A few studies collected original data. Most of this data was collected with clinical populations of people with problem gambling.

Some of the papers also identified different risk factors linked to gambling. Risk factors included IQ, standard of living, and attitudes towards gambling. These papers often used these risk factors to create matched groups or address selection bias.

Almost half of the included papers did not include a measure of problem gambling. Ten papers used the Problem Gambling Index as a measure of problem gambling. Another 5 papers used the South Oaks Gambling Screen (SOGS). Three papers used the NORC Diagnostic Screen for Gambling Disorders (NODS).

Overall, the authors of this review noted that there is opportunity for more studies to use SSM. There is also opportunity for more studies to use other methods like

coarsened exact matching or directed acyclic graphs in studying gambling data.

Propensity Score Matching (PSM) results

Engagement in almost every gambling activity was linked with greater problem gambling. But some activities had much stronger relationships to problem gambling. These activities included: online gambling, slot machines (including FOBTS). Other activities had slightly higher relationships with problem gambling, including offline betting and casino/table games. Lotteries and scratchcards were linked with smaller increases in problem gambling.

Coarsened Exact Matching (CEM) results

Due to the matching procedure, the CEM method involved discarding a lot of participant responses. The results from the Coarsened Exact Matching were similar to the findings from the Propensity Score Matching procedure. The main difference was that the link between football pools, bingo engagement, and problem gambling was low in the CEM analysis. But the relationships between online gambling, slots, and problem gambling remained strong.

Two Part Modelling results

The authors did not find a relationship between lottery and scratchcard engagement and problem gambling. This differs from findings using the PSM and CSM methods. The authors think this may be because most participants who gambled played the lottery and scratchcards. But otherwise, the results were similar to the PSM and CEM results.

Meta-analysis

Most gambling activities were linked with a higher risk of addictive behaviour. But there was a clear range of risk. Some gambling activities (e.g., online gambling and slots) had higher risk than others (e.g., lotteries).

The authors note that the results suggest it is important to control for selection biases in gambling research. For example, when participants' responses were not matched by age or gender, there was a strong relationship between problem gambling and football pools and bingo engagement. But when participants' responses were matched by age and gender, there was a much smaller relationship.

Who is it intended for?

This report is intended for researchers who study gambling prevalence and gambling harms.

What does the report recommend?

This report recommends that researchers use methods such as propensity score matching, coarsened exact matching and sample selection matching to control for selection biases in gambling research.

About the researchers

Richard James, **Hyungseo Kim** and **Lucy Hitcham** are affiliated with the School of Psychology in the Faculty of Science at the University of Nottingham in Nottingham, UK. **Richard Tunney** is affiliated with the Department of Psychology at Aston University in Birmingham, UK. For more information about this study, please contact Richard James at Richard.James4@nottingham.ac.uk

Citation

James, R., Kim, H., Hitcham, L., & Tunney, R. (2023). *Casual Inference Methods in Gambling.* Prepared for Greo Evidence Insights. https://doi.org/10.33684/2024.004

Study disclosures

This study was funded by a Secondary Data Analysis Grant provided through Greo.

Greo

Greo has partnered with the Knowledge Mobilization Unit at York University to produce Research Snapshots. Greo is an independent knowledge translation and exchange organization with almost two decades of international experience in generating, synthesizing, and mobilizing research into action across the health and wellbeing sectors. Greo helps organizations improve their strategies, policies, and practices by harnessing the power of evidence and stakeholder insight.

Learn more about Greo by visiting greo.ca or emailing info@greo.ca.