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Loss of resources and gambling during the COVID-19 pandemic: a three-wave longitudinal study

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This study is based on the Conservation of Resources theory and investigates the impact of the COVID-19 pandemic and associated resource loss on gambling behaviour among Polish gamblers. The study surveyed 585 individuals engaged in land-based gambling before the pandemic. Participants completed computer-assisted web interviews, responding to questions regarding land-based and online gambling frequencies, the Problem Gambling Severity Index, and the Inventory of Loss of Resources in Pandemics. The findings revealed significant shifts in gambling behaviour due to pandemic-related restrictions. Land-based gambling declined during lockdowns and the third wave of the study, while online gambling surged as gamblers transitioned from land-based venues. Gamblers tended to return to land-based options as restrictions eased. Over consecutive waves, participants reported decreasing resource loss levels. Significantly, resource loss was influenced by gambling frequency rather than vice versa. Both types of gambling experienced parallel declines at the beginning of the pandemic, which subsided as the new situation became normalised. Players engaging more in gambling experienced more significant resource losses during the pandemic. Those with more resources at the pandemic's onset adapted more readily, whereas individuals with limited resources faced resource loss. Conclusions Even with stable gambling levels, heavy gamblers at baseline were at higher risk for issues. The dynamics between resource loss and gambling and problem gambling supported the resource loss spiral concept.

Keywords Gambling, Loss of resources, Problem gambling, COVID-19 pandemics, Longitudinal study

The COVID-19 pandemic, declared in 2020, raised concerns among mental health experts due to its global reach and impact on individuals' well-being. Early reports in 2020 highlighted the adverse effects of lockdowns on mental health[1–3]. The crisis disrupted security, daily routines, and led to varied coping strategies, including maladaptive ones[4,5]. Stress studies revealed that a loss of resources, such as job stability and security, predicts psychological distress and further resource consumption, resulting in deficits[6,7]. Hobfoll's Conservation of Resources (COR) theory defines material, social, and psychological resources[8]. The pandemic depleted numerous resources, like relationships, health, financial stability, and a sense of security[9]. In the COR theory, Stevan Hobfoll[10] posits that human activity is aimed at the seeking, acquiring, and protecting of valuable objects (resources). Stressful situations are defined as the relationship with the environment and arise in cases of fear of resource loss, actual resource loss, or lack of resource gain following investment. The source of stress can be the subjective assessment of resource loss and the objective loss of resources. Individuals with access to more resources have higher chances of gain and are simultaneously less susceptible to resource loss. To prevent resource loss, people must regularly invest in their resources, acquire new ones and compensate for previous losses. Resource limitation increases the risk of loss, and an initial loss determines the possibility of subsequent losses.

Gambling during a crisis like the pandemic can lead to resource loss, particularly with intensified gambling. Increased gambling can result in the loss of personal resources (higher psychological stress, reduced sense of control, and well-being), relational and family resources (conflicts, trust issues, severed ties), and professional and financial resources (neglecting work, reduced stability, debts)[11]. Conversely, those with limited resources are more prone to further losses, creating a loss spiral. These successive losses act as stressors, often leading to non-constructive coping strategies and exacerbating problems[10]. Early in the pandemic, Håkansson et al[12]. warned about the risks of increased gambling, primarily online, to escape pandemic-related issues. Online gambling was particularly dangerous due to its high availability. Escapist gaming during the pandemic was demonstrated by researchers[13,14]. Financial instability may have also driven gambling[15,16], a connection noted

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even before the pandemic[17].Recent studies showed mixed trends in pandemic gambling, with some reporting declines or stability compared to the pre-pandemic period[18]. Data came from cross-sectional, population-based, and longitudinal studies, as well as studies based on objective figures provided by operators[19–22]. Land-based gambling saw a notable decrease, but online gambling trends were unclear, with some reporting increases and some increases[23–25].

While gambling increase during the pandemic was not as high as Håkansson and other researchers expected[26,27], it still posed significant public health concerns. Researchers noted a link between increased gambling and problem gambling[18,23]. A cross-sectional Swedish study found that increased gambling was associated with spending more time at home, mental distress, and higher gambling severity[12]. Anxiety, stress, and increased alcohol consumption were also linked to pandemic gambling[12,28,29]. Hodgins and Stevens[29], in their review, highlighted male gender, younger age, and higher problem gambling severity as risk factors for increased gambling during the pandemic. In Finland, problem gambling during the pandemic was linked to mental health issues mediated by social motives for gambling[30].

Limited research exists on the relationship between gambling and one's perception of COVID-19's impact on life. A Canadian longitudinal study found a moderate association between the pandemic impact on health, work, free time, social isolation, and problem gambling severity. However, there was no independent predictor of gambling behaviour changes[22]. Binary logistic regression showed that higher gambling frequency during the spring lockdown of 2020 was best predicted by more types of games played, lower PGSI scores, but more declarations of intensification of mental health problems during COVID-19. The authors comment on the results by stating those who increased gambling engagement during the spring lockdown were predominantly recreational gamblers with a diverse game repertoire. Predictors of increased gambling were similar to general problem gambling risk factors, which suggests that people who grow their gambling are at risk of gambling problems[22]. A longitudinal study on gaming disorder revealed that one's perception of COVID-19's impact mediated the relationship between depression and anxiety symptoms and Internet Gaming Disorder[14]. This suggests that perception of pandemic impact may predict mental disorder development, a noteworthy point for future research.

Despite numerous studies, understanding pandemic-related changes in gambling intensity remains limited, mainly due to their cross-sectional designs[29,30]. The role of pandemic impact perception in explaining gambling changes has not been explored longitudinally. Current research suggests that pandemic-induced resource loss, including health, relationships, financial stability, and control, may intensify gambling as a non-constructive coping strategy, potentially leading to problematic gambling symptoms[6]. Gambling was seen as one such non-constructive coping strategy for managing stress[31]. Escapist coping strategies, like gambling, during the pandemic have been linked to lower quality of life[32,33].

We set several aims in our research. Due to the dominance of cross-sectional studies on gambling during the pandemic, we first wanted to analyse changes in gambling activity and gambling problems caused by the COVID-19 pandemic in a longitudinal model. We expected that land-based and online gambling patterns would reflect accessibility. Limited access to in-person venues likely led to reduced land-based gambling and increased online gambling. To explain these changes, we adopted Hobfoll's Theory of Conservation of Resources (COR) as the theoretical background. Therefore, the next aim was to explore how perceptions of resource loss during the pandemic relate to changes in gambling behaviour and gambling problem symptoms over time. While resource loss during the pandemic has been studied, most studies were cross-sectional, assessing loss at a single point. Little is known about the relationship between pandemic-related resource loss and gambling, a behaviour that can have multifaceted consequences. According to the COR theory, the association between resource loss and gambling can be bidirectional.

Materials and methods

Procedure and participants

Participants were recruited from the Nationwide Research Panel Ariadna[34], which comprised over 110,000 registered users at the time of the survey. Respondents were randomly selected from this pool of voluntary paid participants and were surveyed via computer-assisted web interviewing. Before agreeing to participate, respondents were informed that the study focused on gambling habits. They then completed a screening question in the form of a list of gambling activities, where they were asked to indicate which games they had played either online or offline at least once in their lifetime. Two additional screening questions followed: one asking when they first gambled offline and the second inquiring about the frequency of their offline gambling before the pandemic.

The timing of the survey waves was aligned with periods of heightened COVID-19 transmission or immediately following these periods. This was done to capture the impact of pandemic-related restrictions on gambling behaviour. Figure 1 provides a visual representation of the pandemic situation in Poland during the study period, illustrating the changes in COVID-19 incidence and the stringency of restrictions.

The first survey wave took place in November 2020. The inclusion criterion was participation in any land-based gambling activity at least once a month within the six months preceding March 15, 2020. The survey covered gambling participation before the initial restrictions, during the restrictions, and post-restriction up to the survey date. Initially, 661 records were provided by the panel provider. After removing data from two individuals who had never gambled, the final sample consisted of 659 records. Approximately 49.6% of the sample were women ($n=327$), with respondent ages ranging from 18 to 64 years ($M=40.3$, $SD=13.9$). The second survey occurred in May 2021, with invitations extended to individuals participating in the first wave. Two survey reminders were sent, resulting in 441 completed surveys. Notably, during this period, land-based casinos and arcades in Poland were closed from March 20, 2021, to June 5, 2021, reflecting limited access to legal land-based gambling venues[35,36]. The third survey was conducted in December 2021. During this time, Poland

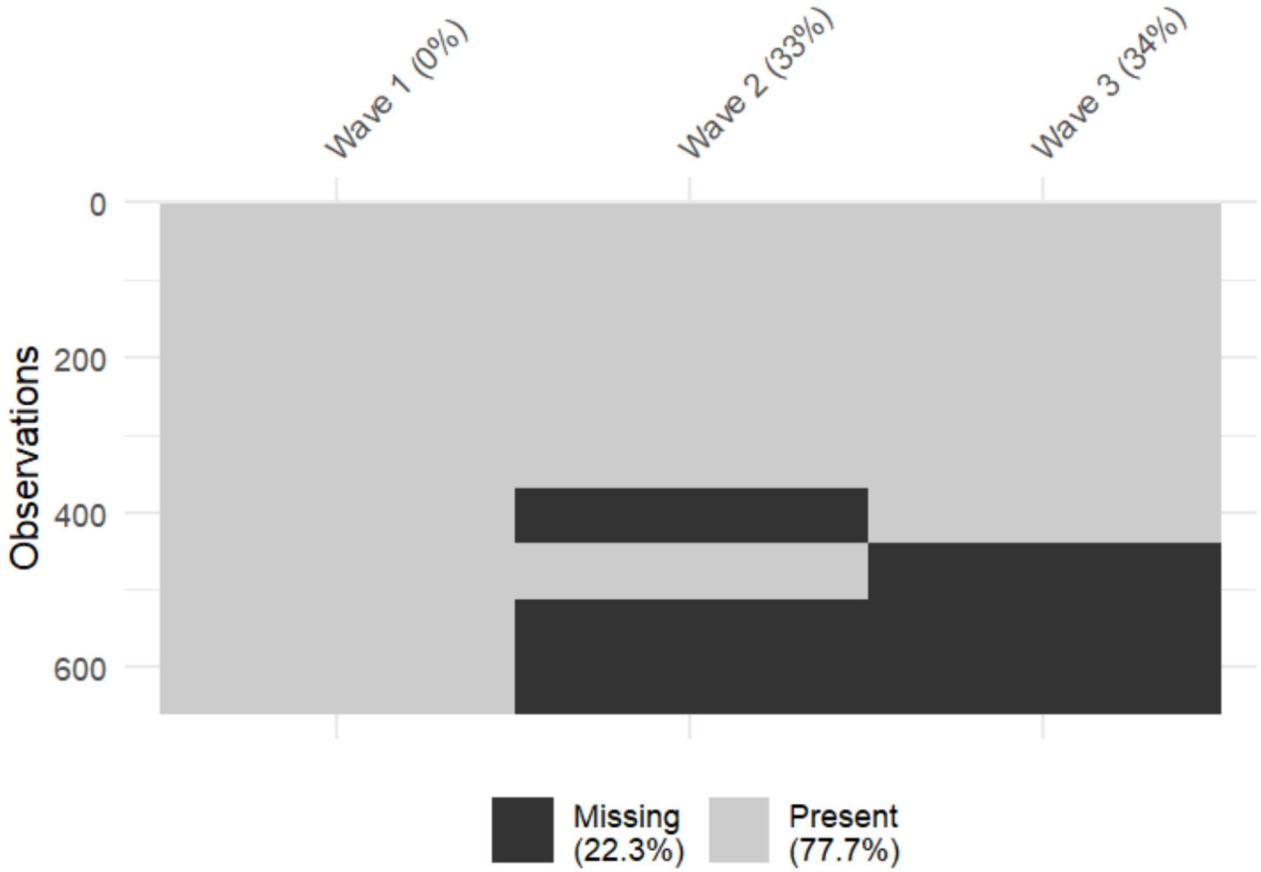

Fig. 1. Pattern of missing data in each wave of the longitudinal study.

experienced increased SARS-CoV-2 virus infections, leading to new restrictions in restaurants, hotels, movie theatres, performing arts theatres, and casinos. These restrictions began on December 1, with further measures imposed on December 14, 2021[37,38]. Invitations to participate in the survey were sent to all previous study wave participants, resulting in 436 completed surveys. The longitudinal study's missing data pattern is visualised in Fig. 2.

To assess the impact of missing data across the study's multiple waves, we analysed key variables between respondents and non-respondents in Waves 2 and 3. The results showed no significant differences for most variables, such as land-based gambling frequency, problem gambling risk, and resource loss, indicating that missingness was primarily unrelated to these variables (i.e., consistent with the missing-at-random assumption). The only significant difference was found for online gambling frequency in Wave 1 for Wave 2 missingness ($p = .03$). This result supports the assumption that missingness-at-random is a reasonable assumption for the variables in our study.

Measures

The questionnaire used in the three waves of the study consisted of three blocks of items: (1) questions regarding participant eligibility (Wave 1 only) and questions about the onset of online gambling; (2) questions about the characteristics of the respondents' online and land-based gambling activity and its changes; and (3) items measuring psychological variables, including problem gambling and loss of resources in pandemics.

The section dedicated to the characteristics of gambling activity comprised a comprehensive set of inquiries designed to investigate the online and land-based gambling behaviours of respondents. This assessment was conducted across three waves. In Wave 1, questions were about three specific periods: the six months leading up to March 15, 2020, followed by the period coinciding with the implementation of initial COVID-19 restrictions (from March 15 to May 10, 2020), and concluding with the time frame after the easing of these restrictions until the survey date in November 2020. During Wave 2, an examination of gambling activities spanned from March 27, 2021, to the survey date in May 2021. The Wave 3 period was examined from June 1, 2021, to December 2021. We utilise a symbol-based numbering scheme to denote specific time intervals for reported gambling frequency. These intervals included Wx (Wave x) – denoting the study wave, W1.my (Wave 1 measurement y) – indicating measurements within the first study wave: W1.m0 – pre-pandemic period, W1.m1 – the period

Fig. 2. Time points of the successive waves of the survey (dark gray stripes) against the background of the number of new COVID-19 cases diagnosed in Poland (red line) and the stringency of restrictions (blue line).

of the first lockdown, W1.m2 – the time frame following the first lockdown until the first survey (November 2020); W2 (Wave 2) – period from the Wave 1 until the second survey (May 2021); W3 (Wave 3) – period from the Wave 2 until the third survey (December 2021). Detailed results of statistical comparisons are presented in the Supplement.

In the current study, the following measures were employed:

Frequency of land-based and online gambling

Gambling frequency was measured on the following 6-point scale: *daily* = 6, *most days a week* = 5, *1–3 times a week* = 4, *1–3 times a month* = 3, *less than once a month* = 2, *never* = 1. The respondents rated particular types of gambling (namely: lotteries of Totalizator Sportowy; other lotteries and random draw contests; scratch cards; slot machines; poker, other card games for money; other casino games (except poker and slot machines); horse racing; sports betting (including "fantasy sports"); betting on virtual sports or e-sports; betting on financial markets (stocks, FOREX, binary options); other gambling games), providing separate ratings for land-based and online activities. The gambling frequency score was the highest frequency reported by a participant for any of the gambling activities.

Severity of problem gambling

Problem gambling severity was measured using the Polish adaptation of the Problem Gambling Severity Index (PGSI)[39,40]. The nine PGSI items were rated on a 4-point scale of *never* = 0, *sometimes* = 1, *most of the time* = 2 and *almost always* = 3. The original cut-off points for the total PGSI score were used to distinguish between four subgroups of gamblers[40]: non-problem (PGSI score = 0); low-risk (1–2), moderate-risk (3–7), and problem gambling (≥ 8). The Cronbach's α reliability values of the PGSI in the successive study waves were 0.94, 0.95, and 0.94.

Loss of resources due to the COVID-19 pandemic

The losses the participants experienced in connection with the COVID pandemic were measured using the 15-item Inventory of Loss of Resources in Pandemics (LOR-P). The respondents used a 5-point scale (from 0 = *not at all* to 4 = *to a very large extent*) to rate the degree to which they had lost what was important to them. Items measuring the subjective perception of relational, family, professional and financial losses were developed on the basis of the Hobfoll Conservation of Resources-Evaluation (COR-E) scale and its Polish adaptations[41–43]. They were selected based on the results of research (including a validation study of the COR Scale for COVID-19) which showed what losses people most commonly reported they had suffered due to the pandemic[44–50]. An analysis of the measurement model for LOR-P was carried out, which showed that the model was one-

dimensional (see Supplement). The reliability values of the LOR-P (Cronbach's α) in the successive waves of the study were 0.97, 0.96, and 0.97.

Statistical analysis

In the first stage of our analysis, we sought to investigate significant changes in critical variables throughout the study. To do this, we employed various statistical tests to assess changes in the examined variables over time. Ordinal variables (frequency of gambling and problem gambling risk) underwent analysis using the non-parametric Friedman test for dependent variables, accompanied by multiple comparison tests. Significance values were adjusted using the Bonferroni correction to account for multiple tests (based on 10 tests). To further examine changes in individual categories over time, we conducted crosstab analysis and χ^2 tests and analysed standardised residuals (e), helping to identify significant deviations in specific categories. Additionally, we used Somers' statistic (d) to measure the association between ordinal variables, providing insight into directional relationships. We conducted a repeated measures ANOVA and utilised contrast analysis for continuous variables (such as loss of resources). These statistical analyses were conducted using SPSS[51].

To investigate the relationships between land-based gambling, online gambling, resource loss, and problem gambling, we employed a Cross-Lagged Panel Model (CLPM).). This model allows us to assess how changes in one variable within an individual are associated with changes in another variable over time. Autoregressive effects capture the stability of a variable within a person, reflecting how much a person's prior state predicts their future state (e.g., how land-based gambling at Wave 1 predicts land-based gambling at Wave 2). Cross-lagged effects examine the influence of one variable on another across time points (e.g., how land-based gambling at Time 1 influences problem gambling at Time 2). A positive cross-lagged path indicates that an individual's deviation from their expected level in one domain is likely to predict a similar deviation in another domain at the next time point. We performed CLPM modelling using packages such as lavaan[52], semTools[53]and semPlot[54]within the R statistical environment[55].

Ethics

The study was carried out in compliance with the Declaration of Helsinki and approved by the Ethical Committee of the Institute of Psychology of the John Paul II Catholic University of Lublin (KEBN_36/2020). All subjects were informed about the study and provided informed consent.

The study was not preregistered. The data supporting the findings of this study are available at the Open Science Framework repository: https://osf.io/apcqt/. Supplementary data, including additional analyses and materials referenced in the article, can also be accessed through this link.

Results

Changes in the frequency of land-based and online gaming

The first aim was to analyse the changes in gambling activity caused by the COVID-19 pandemic in a longitudinal model. We expected that land-based and online gambling patterns would reflect accessibility. The initial analyses examined changes in land-based and online gambling behaviour over the study period. The analysis revealed significant differences between the study waves in both land-based gambling frequency ($Q(4) = 203.63$, $p < .001$) and online gambling frequency ($Q(4) = 142.33$, $p < .001$ based on the Friedman test for repeated measures. Post-hoc multiple comparisons (Table 1) indicated statistically significant disparities in self-reported participation levels in land-based gambling between the pre-pandemic period and all other study periods. The frequency was highest in the pre-pandemic period. Moreover, significant differences were observed in the frequency of land-based gambling between the period of the most stringent restrictions and the second wave and third wave of the study (during the restrictions, the frequency of gambling was the lowest), as well as between these two waves, with significantly lower gambling frequency in the third wave.

Concerning online gambling, significant differences in self-reported gambling frequency were identified between all measurement points in the first wave and the second wave (where the intensity of gambling was

Mode	Wave	Min	Max	Mdn	IQR	*p*-value for multiple comparisons			
						W1.m0	W1.m1	W1.m2	W2
Land-based	W1.m1	2	6	2.67	1.55				
	W1.m2	1	6	1.96	1.83	< 0.001			
	W1.m3	1	6	2.21	1.93	< 0.001	0.129		
	W2	1	6	2.52	2.01	< 0.001	< 0.001	0.003	
	W3	1	6	2.24	1.88	< 0.001	0.018	1.000	0.028
On-line	W1.m1	1	6	1.39	1.04				
	W1.m2	1	6	1.38	1.03	1.000			
	W1.m3	1	6	1.41	1.15	1.000	1.000		
	W2	1	6	2.07	2.12	< 0.001	< 0.001	< 0.001	
	W3	1	6	1.50	1.54	1.000	1.000	1.000	< 0.001

Table 1. Differences in the level of participation in land-based and online gambling at the individual measurement points of the longitudinal study ($N = 367$). Note. Mdn – median, IQR – interquartile range.

significantly higher), as well as between the second and third waves. Significantly lower gambling intensity was observed in the third wave.

An examination of variations across successive waves of the study has revealed significant trends in changes in gambling frequency at specific measurement points. Figure 3 illustrates the transitions among distinct groups of land-based and online gamblers based on their initial gambling frequency, moving to different gambling frequency categories in subsequent measurement periods. In the context of land-based gambling, it is evident that a substantial portion of individuals who had engaged in gambling less than once a month before the pandemic shifted to the non-gambling category during the initial pandemic phase (encompassing the lockdown and the months immediately following). In the subsequent waves (W2 and W3), gamblers shifted from the *never* category to lower gambling frequency categories (*1–3 times a month* and *less than once a month*). In contrast, the number of individuals discontinuing gambling remained relatively stable. The predominant trend observed indicates gamblers gravitating toward categories characterised by lower gambling frequency.

Conversely, for online gamblers, a notable and abrupt shift occurred from the *never* category to the category of gamblers who initiated online gambling for the first time during the second wave of the study (W2), followed by a return to the *never* category in the third wave (W3).

A detailed analysis showed that during the initial months of the pandemic, overall trends in land-based gambling participation remained stable. Land-based gamblers across various baseline gambling frequency categories were more likely to maintain their existing gambling frequency during the first lockdown, except for the least engaged gamblers who were more inclined to cease gambling altogether ($e = 10.3$) rather than gamble at the same frequency (less than once a month) (Table D1 in the Supplement). A similar pattern was evident in the subsequent measurement (November 2020), where individuals who had been the most frequent participants in gambling activities during the first lockdown were highly likely to sustain this pattern several months after the lockdown ($e = 23.4$) (Table D2 in the Supplement). The constancy of gambling participation levels persisted across successive time points in the study (refer to Tables D3 and D4 in the Supplement). A parallel analysis of changes in online gambling participation at individual time points during the study indicated comparable trends, detailed in Tables D5–D8 in the Supplement.

Changes in problem gambling severity

In the second step, we examined the longitudinal changes in problem gambling severity in the subsequent analysis phase. There were significant differences in problem gambling severity across the measurement time points ($Q(2) = 32.93$, $p < .001$). Analysing Wave 1 (W1.m2) and Wave 2 measurements through crosstab analyses (Table 2; $\chi^2(9) = 288.23$, $p < .001$; $d = 0.53$, $p < .001$), we observed that individuals without problem gambling symptoms in the initial survey (PGSI = 0) were notably less likely to report problem gambling in the second survey ($e = 10.5$).

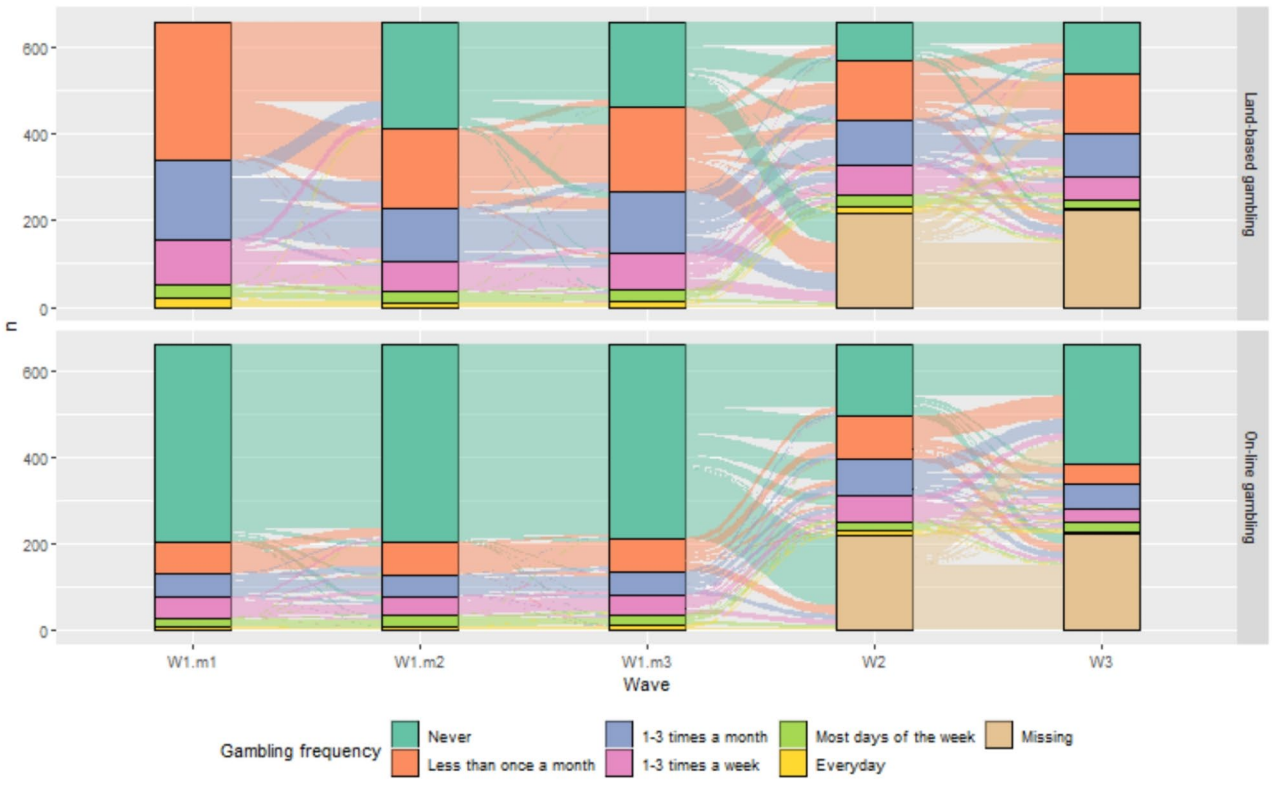

Fig. 3. Changes in the level of land-based and online gambling participation in the individual baseline gambling frequency groups.

	PGSI Wave 2												Total	
	0			1–2			3–7			8+				
PGSI Wave 1 (W1.m2)	*n*	%	e	*n*	%	e	*n*	%	e	*n*	%	e	*n*	%
0	198_{a}	74.4%	10.5	23_{b}	34.3%	-3.5	$13_{b,c}$	24.1%	-4.7	6_{c}	10.7%	-7.0	240	54.2%
1–2	44_{a}	16.5%	-2.1	27_{b}	40.3%	4.6	17_{b}	31.5%	2.3	0_{c}	0.0%	-4.0	88	19.9%
3–7	14_{a}	5.3%	-5.6	15_{b}	22.4%	2.7	17_{b}	31.5%	4.5	9_{b}	16.1%	0.9	55	12.4%
8+	10_{a}	3.8%	-7.4	2_{a}	3.0%	-2.7	7_{b}	13.0%	−0.1	41_{c}	73.2%	14.0	60	13.5%
Total	266	100.0%		67	100.0%		54	100.0%		56	100.0%		443	100.0%

Table 2. A comparison of the severity of problem gambling between Wave 2 and Wave 3 of the study. Note. *e* – standardised adjusted residuals. Each subscript letter denotes a subset of Problem Gambling Severity Index (PGSI) Wave 2 categories whose column proportions do not differ significantly from each other at the 0.05 level.

	PGSI Wave 3												Total	
	0			1–2			3–7			8+				
PGSI Wave 2	*n*	%	e	*n*	%	e	*n*	%	e	*n*	%	e	*n*	%
0	198_{a}	78.6%	10.4	$11_{b, c}$	25.0%	-5.2	11_{c}	29.7%	-4.1	3_{b}	8.6%	-6.6	223	60.6%
1–2	29_{a}	11.5%	-2.3	18_{b}	40.9%	5.3	4_{a}	10.8%	− 0.7	2_{a}	5.7%	-1.5	53	14.4%
3–7	17_{a}	6.7%	-4.7	$11_{b, c}$	25.0%	2.8	13_{c}	35.1%	4.5	$4_{a, b}$	11.4%	− 0.2	45	12.2%
8+	8_{a}	3.2%	-8.1	$4_{a, b}$	9.1%	− 0.8	9_{b}	24.3%	2.2	26_{c}	74.3%	11.5	47	12.8%
Total	252	100.0%		44	100.0%		37	100.0%		35	100.0%		368	100.0%

Table 3. A comparison of the severity of problem gambling between Wave 2 and Wave 3 of the study. Note. *e* – standardised adjusted residuals. Each subscript letter denotes a subset of PGSI Wave 3 categories whose column proportions do not differ significantly from each other at the 0.05 level.

Conversely, those initially classified as problem gamblers (PGSI = 8+) were significantly more likely to meet the problem gambling criteria in the second survey ($e = 14$). Moreover, they were significantly less likely to no longer meet the criteria for problem gambling in the second survey six months later ($e = -7.4$).

Similar patterns of PGSI score changes were evident in Wave 2 and Wave 3 of the study (Table 3; $\chi^2(9) = 223.35$, $p < .001$; $d = 0.52$, $p < .001$). Participants who did not meet the problem gambling criteria in the second wave were more likely to maintain this status six months later in the third wave ($e = 10.4$) and less likely to develop problem gambling symptoms ($e = -6.6$). Problem gamblers exhibited consistent gambling severity between the second and third surveys ($e = 11.5$).

These findings indicated a prevailing trend where problem gambling severity remained relatively stable across measurement time points during the pandemic. The emergence and progression of the COVID-19 pandemic did not lead to sudden shifts in problem gambling severity or the abrupt development of problem gambling symptoms.

Changes in the level of self-reported resource loss

Because the next aim was to explore how perceptions of resource loss during the pandemic relate to changes in gambling behaviour and gambling. First, we investigated the gamblers' self-reported resource losses at different measurement time points. The analysis revealed a statistically significant difference in resource loss among at least two groups ($F(1.58, 678.93) = 141.201$, $p < .001$, $\eta^2 = 0.15$).

Contrast analysis results indicated significant differences in self-reported resource loss between the first and second measurements ($F(1, 366) = 105.52$, $p < .001$, $\eta^2 = 0.22$) and between the second and third measurements ($F(1, 366) = 41.84$, $p < .001$, $\eta^2 = 0.10$). Initially, respondents reported the greatest losses in the first survey ($M_{W1.m2} = 44.6$, $SD_{W1.m2} = 16.5$). However, in subsequent surveys, the self-reported loss of resources gradually decreased, with the most substantial reduction observed in the second survey ($M_{W2} = 34.6$, $SD_{W2} = 14.7$; $M_{W3} = 29.6$, $SD_{W3} = 13.1$).

Associations between resource loss and level of participation in gambling activities over time

In the final phase of this study, we explored the longitudinal relationship between gambling participation and self-reported resource loss. The Supplement (Table C1) contains detailed parameters of CLPM encompassing three measurement points for the variables of interest (see Fig. 4).

The model revealed that gambling frequency during the first measurement had the most substantial impact on gambling frequency, as reported in subsequent study waves (W2 and W3). This effect held for both land-based and online gambling. Interestingly, the frequency of online gambling reported in the first wave influenced the frequency of land-based gambling in the second and third waves. In contrast, the frequency of land-based gambling in the initial wave predicted the frequency of online gambling in the second wave. Cross-lagged effects of gambling frequency between waves W2 and W3, while statistically significant, were comparatively smaller for both land-based and online gambling.

Furthermore, we identified a statistically significant effect of land-based gambling frequency on self-reported resource loss in subsequent waves, extending to resource loss in both Wave 2 and Wave 3. The level of resource loss reported in the first measurement predicted self-reported resource loss in the second measurement, and resource loss reported in the second measurement determined the level of loss reported in the third measurement.

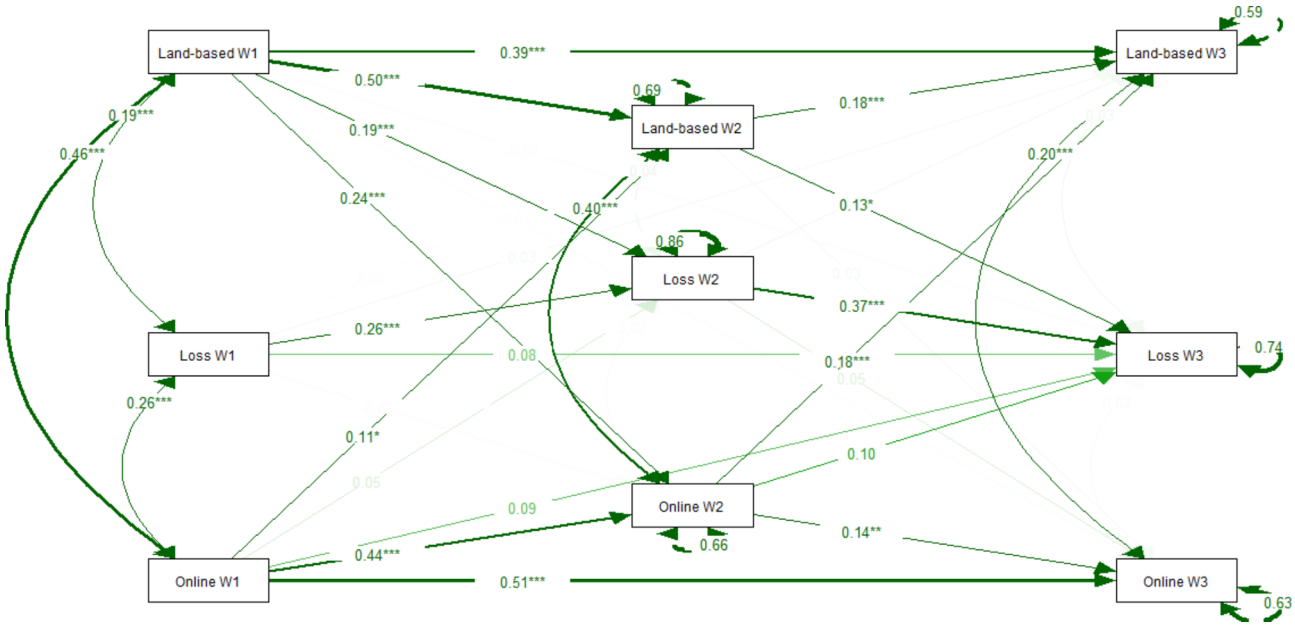

Fig. 4. Cross-lagged panel model of land-based and online gambling and loss of resources due to the pandemic ($N = 659$).* $p < .05$, ** $p < .01$, *** $p < .001$.

Notably, there was no significant relationship between resource loss in the first and third measurements. Additionally, we found no evidence to suggest that the experience of resource loss significantly impacted the frequency of land-based or online gambling. This implies that gambling frequency influenced resource loss rather than the reverse.

Associations between resource loss and problem gambling activities over time

In the subsequent analysis, a second CLPM elucidated the associations between problem gambling and resource loss at successive measurement time points. The observed relationships are presented in Fig. 5 and detailed in Table C2 in the Supplement. The severity of problem gambling measured in the first survey exerted the most significant influence on problem gambling severity in subsequent measurements. The level of self-reported resource loss in the initial measurement predicted resource loss in the second measurement, and resource loss reported in the second measurement influenced the level of loss reported in the third measurement. Notably, the relationship between the first and third measurements exhibited the weakest connection. Furthermore, problem gambling severity impacted the sense of resource loss in the following measurement, and the severity of problem gambling in Wave 1 also influenced the perception of resource loss in Wave 3. This implies that problem gambling, rather than the reverse, influenced resource loss.

Discussion

Our longitudinal study tracked changes in land-based and online gambling participation, spanning from 6 months before the COVID-19 pandemic to over a year after its onset. It was the first aim of our research. Our primary finding revealed a significant drop in land-based gambling frequency during the initial pandemic phase compared to pre-pandemic levels. This can be attributed to the shock of state-imposed restrictions and the abrupt shift in daily life due to the new realities of the pandemic. In Poland, the first lockdown commenced on March 15, 2020, marking the nation's first encounter with such a crisis, instigating widespread anxiety about various aspects of life. Outdoor activities, including land-based gambling, were abruptly halted.

Conversely, during our second survey in May 2021, we observed a notable upswing in land-based gambling frequency. Despite limited access to land-based venues (casinos and slot machine arcades remained closed), many participants engaged in land-based gambling more frequently than in other pandemic periods. After nearly a year of adapting to the pandemic, people may have started to perceive the situation as the new normal. This surge in gambling could also have been influenced by increasing vaccination availability in Poland and the growing belief that normalcy was returning[56]. Additionally, the timing of the May survey and reduced perceived COVID-19 risks due to the time of year also likely influenced the results. Some gamblers might have turned to illegal gambling options due to the continued closure of legal venues.

Our third survey in December 2021 recorded a decline in gambling frequency among our study group. This may have resulted from renewed COVID-19 threats associated with new variants like Delta and Omicron in November[56]. The initial sense of security reported in May was diminishing, paralleling the re-imposition of

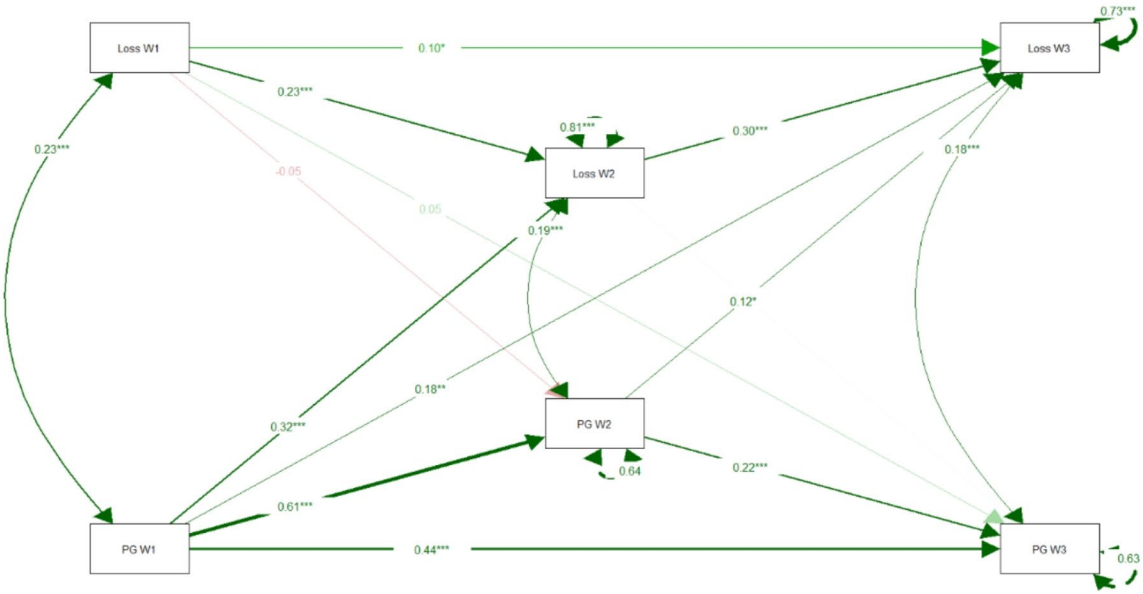

Fig. 5. Cross-lagged panel model of problem gambling and loss of resources due to the pandemic ($N = 659$).

restrictions in Poland. The fluctuation in gambling participation aptly illustrates the evolving social climate throughout the pandemic in Poland, a topic hitherto unexplored in existing studies.

In the context of online gambling, the second survey (May 2021) revealed significant shifts in participation frequency, notably a dramatic rise in daily or near-daily gamblers. Limited offline gambling opportunities led many accustomed to land-based play to explore online alternatives (it should be noted that at the baseline, all the respondents gambled on land-based activities and were thus "accustomed to" this form of gambling). This transition is evident in Fig. 3, where respondents moved from *never* to various online frequency categories, ranging from *less than once a month* to *daily*. After a year of pandemic-induced stress, some gamblers may have returned to gambling as a non-constructive coping strategy, choosing a more accessible form.

In the third survey (December 2021), online gambling followed a pattern similar to land-based gambling, with a marked decrease in frequent participation. Our initial hypothesis anticipated that restrictions on land-based gambling would drive increased online gambling. However, both types of gambling experienced parallel declines, suggesting that crises initially disrupt established habits and activities, leading to a shock reaction, which subsides as the new situation becomes normalised. This observation is unique, as most prior COVID-19 pandemic studies were conducted within its first year, primarily among specific populations, in cross-sectional and focused on the initial pandemic impact[57–60]. Gamblers may exhibit a stronger tendency toward 'shock' and 'freezing' reactions, as proposed by the COR theory, particularly those with limited resources who may not proactively protect their existing resources in the face of potential loss[61].

The second aim was to explore how perceptions of resource loss during the pandemic relate to changes in gambling behaviour and problem gambling risk. Our study offers a longitudinal perspective on the relationship between gambling and resource loss during the COVID-19 pandemic. Our findings suggest that increased gambling preceded resource loss during the pandemic. Recent research has highlighted that not only excessive or problematic gambling but also non-problematic gambling and, more generally, easy access to gambling can have detrimental effects[62,63]. Our results support the idea that experiences of loss are associated with gambling in general.

The COVID-19 pandemic and its associated restrictions resulted in widespread resource loss, contributing to heightened psychological distress and an increased risk of mental health issues, aligning with the COR theory[64,65]. A two-wave longitudinal study by Yu and colleagues[66] found a positive association between resource loss across various life domains mentioned earlier and the risk of depression. Furthermore, resource loss mediated the link between survey time and depression risk.

However, not everyone experienced resource loss similarly during the pandemic. For instance, a Polish study identified four clusters of individuals based on resource loss and gain during the pandemic[49]. The largest cluster comprised individuals who experienced minimal changes in resource levels, while the smallest cluster included those who faced significant losses but also substantial resource gains. The remaining cluster saw significantly more significant resource losses than gains. Nonetheless, this study did not consider psychological factors that might elucidate these differences.

In our investigation, we hypothesised, based on COR theory, that gamblers might have had poorer baseline mental well-being than non-gamblers, potentially explaining why the former experienced more substantial resource losses. This aligns with a Polish study by Chwaszcz et al[67]., which demonstrated that individuals seeking psychological support, a potential resource multiplier, experienced smaller resource losses. Additionally, seeking help is an active coping strategy, which, according to existing research, correlates with resource gains[61].

Furthermore, our data indicated that gamblers reported decreasing levels of resource loss in each successive study wave, with statistically significant differences between measurements. The most important difference was observed between Wave 1 (November 2020) and Wave 2 (May 2021). This trend may be attributed to the gradual normalisation of everyday life during the pandemic, transitioning from an initial shock with numerous restrictions and losses due to stringent anti-COVID-19 measures to gradual adaptation and reduced resource loss. This observation is consistent with the findings of Yu et al[66]., which showed a decrease in self-reported loss of financial, social, and family resources and loss of control over the future over 12 months during the pandemic.

It is plausible that individuals functioning better at the pandemic's onset (baseline) adapted more rapidly due to their greater available resources. Conversely, individuals with limited resources at baseline, such as gamblers in our study, were more likely to experience a spiral of losses rather than replenish their resources. This underscores a key finding of our research. Our model further elucidates the relationship between problem gambling severity and resource loss. We found that problem gambling severity at baseline predicted subsequent severity in later surveys and translated into resource loss in subsequent surveys. This aligns with Hobfoll's concept of the resource loss spiral[10].

Limitations and conclusions

The study has some limitations. Firstly, the fundamental limitation of the study is the lack of population representativeness in our sample. Sample weighting was impossible because demographic statistics specifically related to individuals participating in any land-based gambling are not available in Poland. So, our findings pertain specifically to the study participants rather than being generalisable to a broader population. Also, a relatively small sample size restricts the strength of our conclusions. Therefore, we did not analyse changes in individual types of gambling activities, including illegal activities. Secondly, some of our data are retrospective, which also weakens the conclusions due to distortions in autobiographical memory.

However, strengths include the longitudinal design and capturing changes at three time points, which provides insight into gambling dynamics during the pandemic. The study contrasts with cross-sectional research that relied on retrospective data. It also explored resource loss experiences during the pandemic, a less common approach in gambling research. Nevertheless, we acknowledge the uneven timeframes between survey waves and the varying pre-assessment periods (i.e., a 6-month pre-pandemic compared to a 2-month lockdown and

6-month post-lockdown). This issue could affect the comparability of gambling-related behaviors and resource levels across different time intervals. The study's waves were spaced unevenly, with time intervals of 6 months and 7,5 months between waves. Although the CLPM is robust enough to handle minor variations in time intervals, this uneven spacing could still have implications for some estimates. Future research should consider a weighting approach to address this issue, enhancing the accuracy of analyses concerning resource changes and gambling behaviours over time.

The findings emphasise the role of problem gambling in resource loss. Heavily involved gamblers at baseline faced a higher risk of developing issues, even with stable gambling levels. The study underscores that increasing gambling involvement over time should not be seen as the sole predictor of problems. Most of the gamblers we surveyed maintained relatively constant levels of involvement in gambling over the year-and-a-half study period. However, gamblers who consistently engaged in more gambling from the beginning experienced greater resource losses during the pandemic. These insights are valuable for providing support and preventing gambling-related problems. Our results are consistent with Hobfoll's COR theory, particularly its second principle, which highlights that resource loss carries more weight than resource gain in stressful situations[68].

Data availability

The data supporting the findings of this study are available at the Open Science Framework repository: https://osf.io/apcqt/.

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Author contributions

B.L.K. and R.P.B. conceived and designed the study. B.L.K. and R.P.B. analyzed and interpreted the data. R.P.B. performed the statistical analysis. B.L.K. obtained funding for the study. B.L.K. supervised the study. Both authors reviewed and approved the final manuscript.

Declarations

Competing interests

The authors declare no competing interests.

Data source

Our World in Data[69]. The number of daily new confirmed COVID-19 cases per million people (7-day rolling average) based on the WHO COVID-19 Dashboard (World Health Organization, 2020); the stringency index is a composite measure based on nine response indicators, including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest) based on Hale et al[70].

Additional information

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Additional information

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