

Online interventions for problem gamblers with and without co-occurring mental health symptoms: Randomized controlled trial

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Abstract

Background: Problem gambling and depression or anxiety frequently co-occur. Further, the treatment needs of people with co-occurring gambling and mental health symptoms may be different from those of problem gamblers who do not have a co-occurring mental health concern. The current randomized controlled trial examined whether there is a benefit to providing access to mental health Internet interventions (G+MH intervention) in addition to an Internet intervention for problem gambling (G-only intervention) in participants with gambling problems who do or do not have co-occurring mental health symptoms.

Methods: Potential participants were recruited within Canada and screened using an online survey to identify those meeting criteria for problem gambling. As part of the baseline screening process, current depression and anxiety were assessed. Eligible participants agreeing (N = 283; 68% from Manitoba) to take part in the study were randomized to one of two versions of an online intervention for gamblers – an intervention that just targeted gambling issues (G-only) versus a website that contained interventions for depression and anxiety in addition to an intervention for gamblers (G+MH). It was predicted that problem gamblers who did not have co-occurring mental health symptoms would display no significant difference between intervention conditions at three- and six-month follow-ups. However, for those with co-occurring mental health symptoms, it was predicted that participants receiving access to the G+MH website would display significantly reduced gambling outcomes at both follow-ups as compared to those provided with G-only website.

Results: The 283 participants had significant gambling concerns, as indicated by a mean PGSI score of 15.6 (SD = 6.1). Further, a substantial proportion (75.6%) had signs of psychological distress that indicated current difficulties with depression or anxiety. While usage of the online gambling intervention was reasonable (41% completed half of the intervention modules), only a minority of the participants accessed the mental health intervention (26% accessed any module and 7% completed two modules).

Despite efforts to retain participants in the trial (repeated email contacts to request completion of the follow-up surveys; payment for completion of the surveys), there was a poor follow-up rate (38.2% at 3-months and 35.7% at 6-months). While this level of follow-up is not unusual in Internet intervention trials, it does limit the strength of conclusions that can be made from the research. We have put additional procedures in place to improve follow-up rates for our later trials in this line of research.

There was a significant reduction in gambling (frequency of gambling and severity of gambling problems among participants who completed the trial). However, there did not appear to be any advantage with providing a mental health online intervention alongside the gambling

intervention for participants with co-occurring mental health concerns. Specifically, the inclusion of the mental health intervention did not improve the degree of improvement in gambling.

Discussion: The online gambling intervention was positively received and appeared to help participants in addressing their gambling concerns (note: this research trial was not designed to be able to make causal statements that the gambling intervention caused the improvements in gambling outcomes). The addition of a mental health online intervention did not appear to be an advantage to participants in this intervention. Thus, based on the results of this trial, we recommend that the online gambling intervention continue to be made available to those in need, but that the additional resources needed to also provide the mental health online intervention may not be merited.

Trial registration: ClinicalTrials.gov NCT02800096; Registration date: June 14, 2016

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Abbreviations

RCT: Randomized Controlled Trial

G-only: Internet intervention targeting problem gambling

G+MH: G-only intervention plus access to MoodGYM, an Internet intervention for depression and anxiety

PGSI: Problem gambling severity index

NODS: The National Opinion Research Centre DSM screen for gambling problems

PHQ-9: Patient Health Questionnaire

GAD-7: Generalized Anxiety Disorder 7 item scale

K10: Kessler Psychological Distress Scale

AUDIT-C: Alcohol Use Disorders Identification Test – Consumption measure

Research Protocol

Note: The Background and Methods section of this proposal are reproduced from the published research protocol for this study , however the tense has been changed to past (Cunningham et al., 2016). The reference for the publish research protocol is:

Cunningham, J.A., Hodgins, D.C., Bennett, K., Bennett, A., Talevski, M., Mackenzie, C.S., & Hendershot, C.S. (2016). Online interventions for problem gamblers with and without co-occurring mental health symptoms: Protocol for a randomized controlled trial. *BMC Public Health*. 16, 624. [open access publication]

Background

It is estimated that up to half of pathological gamblers have co-occurring mental health symptoms (e.g., depression or anxiety disorder) (Bischof et al., 2013; Desai & Potenza, 2008; Kessler et al., 2008; Lorains, Cowlshaw, & Thomas, 2011; Martin, Usdan, Cremeens, & Vail-Smith, 2014 ; Petry, Stinson, & Grant, 2005). While there is little work in this area, co-occurring mental health symptoms are thought to impact the treatment needs of problem gamblers (Dowling, Merkouris, & Lorains, 2016; Geisner et al., 2014; Hodgins & el-Guebaly, 2010; Stea & Hodgins, 2011; Toneatto & Ladouceur, 2003; Wynn, Hudyma, Hauptman, Houston, & Faragher, 2014). The interrelationship between problem gambling and co-occurring mental health symptoms may not have the same cause for all those experiencing these co-occurring conditions. For some, gambling may be an attempt to alleviate the symptoms of depression and anxiety (Blaszczynski & Nower, 2002). Others may experience symptoms of anxiety and depression as a result of increasing difficulties with gambling (financial or otherwise) (Kim, Grant, Eckert, Faris, & Hartman, 2006). For others, while occurring simultaneously, problem gambling and co-occurring mental health symptoms may not be causally related (or both might be the result of some third factor) (Quilty, Watson, Robinson, Toneatto, & Bagby, 2011).

While the functional relationship of gambling to co-occurring mental health symptoms is an important research question, the goal of the present trial is a pragmatic one and, as such, does not need to wait upon a better understanding of these interrelationships. We seek to determine whether providing simultaneous access to online help for gambling problems and mental health symptoms is of benefit for those experiencing both concerns (and, to a lesser extent, that providing simultaneous access is not disadvantageous for those with just a gambling problem and no co-occurring depression or anxiety symptoms). A secondary goal will be to determine if there are moderators (e.g., extent of use) for the hypothesized benefit of providing access to a gambling and mental health intervention website to those problem gamblers with co-occurring mental health symptoms.

The need for alternatives to face-to-face care: The large majority of problem gamblers will never access traditional treatment (Cunningham, 2005; Slutske, 2006; Suurvali, Hodgins, Toneatto, & Cunningham, 2008). Barriers include stigma, availability, and a desire for self-reliance (Suurvali, Hodgins, Toneatto, & Cunningham, 2012). The Internet is widely available and has been recognized as an important platform through which to decrease treatment-seeking stigma, and to provide evidence-based care in an accessible and cost-efficient fashion (Portnoy, Scott-Sheldon, Johnson, & Carey, 2008). Despite being unwilling, or unable to attend traditional treatment, many problem gamblers have voiced an interest in accessing help through other means, such as the Internet (Cunningham, Hodgins, & Toneatto, 2008).

Self-help for gambling: There is a growing evidence base for self-help interventions targeting gambling – primarily through bibliotherapy with or without limited contact with a therapist (Hodgins & Holub, 2007; Raylu, Oei, & Loo, 2008). To increase the accessibility of such interventions, some efforts have also been made to provide Internet-based self-help materials for problem gamblers (Hodgins, Fick, Murray, & Cunningham, 2013; Luquiens et al., 2016). However, these online interventions have little or no published evidence base and relevant issues, such as the best way to provide such services to people with co-occurring mental health

symptoms have, as yet, not been addressed.

Major research questions

The proposed trial compared two Internet intervention websites – an intervention that just targets gambling issues (G-only) versus one that contains interventions for anxiety and depression in addition to an intervention for gamblers (G+MH). The primary hypotheses are:

Hypothesis 1: For problem gamblers with co-occurring mental health symptoms, it was predicted that participants provided access to the G+MH website will display significantly reduced gambling outcomes at three- and six-month follow-ups as compared to those provided access to the G-only website.

Hypothesis 2: Problem gamblers without co-occurring mental health symptoms will display no significant difference between the G-only and G+MH websites at three- and six-month follow-ups.

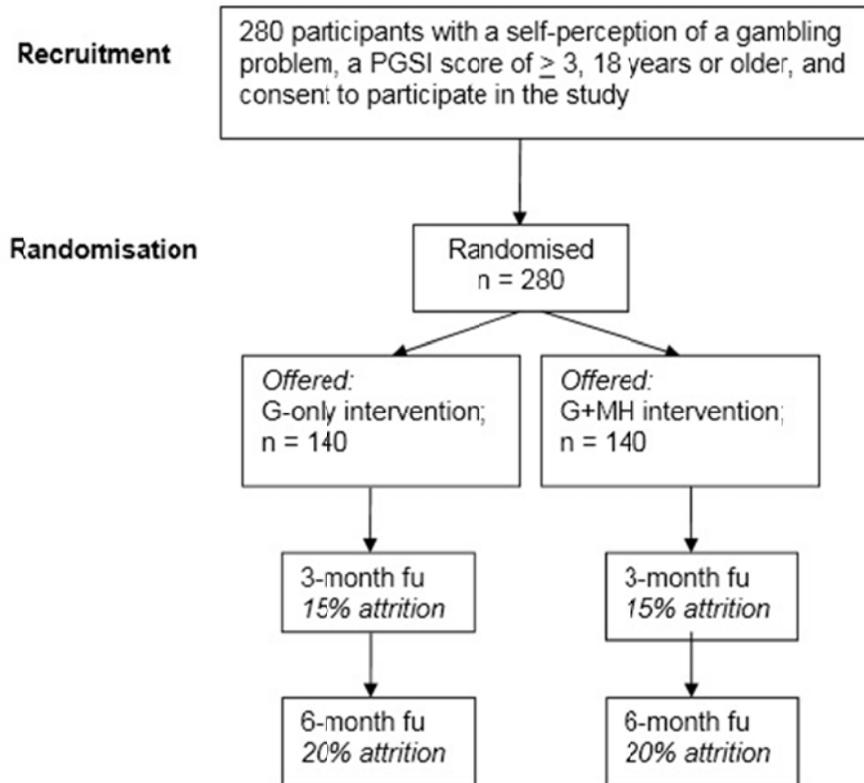
Hypothesis 3: Respondents who have more involvement with the G-only intervention between baseline and three-month follow-up will demonstrate more improvement in gambling outcomes at six-month follow-up, compared to respondents who have less involvement with the G-only intervention.

Methods/Design

Study Design

The study was a two-arm, double blinded, parallel group RCT. See Figure 1 below for a Consort Diagram summarizing this trial design.

Figure 1. Overview of the proposed intervention trial



Recruitment

Respondents were recruited using online advertisements (e.g., Google Adwords). The advertisement asked if the person was concerned about their gambling and if they were interested in participating in a study that contained online help for gambling (with compensation provided). Interested participants followed a link to a brief online survey to assess eligibility (details provided below). Those eligible and who provided informed consent were sent an email with a unique link to the remaining baseline assessment. Participants who completed the baseline measures were then randomized into one of the two Internet interventions described below (G-only versus G+MH). Only participants who completed the baseline survey via their unique link were randomized and included in the trial. After completing the baseline survey, participants created a password which they then used to access the respective intervention websites through the study website portal. Research staff involved in the trial were not informed of respondents' group allocation during interventions or at follow-up. All participants were followed-up at three- and six-month post-randomization using an online survey (an email invitation including a unique link was sent to each participant). In order to promote retention, participants completing each of the follow-ups were sent a \$20 gift certificate from Amazon.ca (i.e., honorarium of \$40 total). Ethics approval was obtained from the Research Ethics Boards of the Centre for Addiction and Mental Health (Canada) and the Australian National University (Australia).

Inclusion Criteria: Primary inclusion criteria followed those used in the ongoing trial by Hodgins et al. (Hodgins et al., 2013) and comprised of being 18 years of age or older, perception of a gambling problem and scoring 3 or greater on the Problem Gambling Severity Index (PGSI) (Ferris & Wynne, 2001). Prior treatment access was measured but was not be used as an inclusion/exclusion criterion. This is because the intent of this trial was to evaluate the impact of the interventions in the extended range of potential community participants. Random assignment to condition with stratification ensured that socio-demographic characteristics, such as treatment access, would be evenly distributed across conditions. Similarly, hazardous alcohol use and illicit drug consumption was measured but was not be used as exclusion criteria. Finally, the trial recruited participants with and without co-occurring mental health symptoms. We anticipated, based on prevalence data, that approximately 50% of the sample would be experiencing co-occurring mental health symptoms. This was established using the Kessler 10, with a score of 22 or more indicating current psychological distress (Brooks, Beard, & Steel, 2006; Kessler et al., 2002).

Randomization

Randomization was conducted via an automated computer algorithm, set up by a researcher not involved in the day-to-day conduct of the trial according to ICH Guideline E9 ("ICH Harmonised Tripartite Guideline. Statistical principles for clinical trials. International Conference on Harmonisation E9 Expert Working Group," 1999). Randomization was stratified by age (18-35 years/over 36 years), sex (male/female), and prior use of treatment for problem gambling (have previously accessed treatment/have not accessed treatment).

Interventions

G-only: The gambling only Internet intervention consisted of a new online version of the self-change tools developed by Hodgins et al. (Hodgins & Makarchuk, 2002). These tools have shown a significant impact on gambling in three trials of the paper-based version of these materials (Diskin & Hodgins, 2009; Hodgins, Currie, Currie, & Fick, 2009; Hodgins, Currie, & el-Guebaly, 2001), and have previously been translated successfully into an online format (Hodgins et al., 2013). A major focus was to provide individuals with clear and concise behavioural and cognitive strategies for meeting the goal of reducing or quitting gambling. The various workbook sections are readily adaptable into online interactive formats.

G+MH: For participants in the G + MH condition, logging into the web portal allowed them to access the G-only Internet intervention as well as an online intervention for depression and anxiety. The mental health intervention chosen was MoodGYM, an extensively evaluated intervention found to be effective in a variety of different settings (Christensen, Griffiths, & Jorm, 2004; Griffiths, Christensen, Jorm, Evans, & Groves, 2004; Powell et al., 2013).

Baseline Assessment

The online assessment included a demographic profile (age, gender, education, marital status, income, employment status) and a gambling, mental health and treatment history assessment. Problem gambling severity was measured using the past year PGSI and the past three month version of the NORC DSM-IV Screen for Gambling Problems (NODS) which indicates DSM-IV severity (Toce-Gerstein & Volberg, 2004; Wulfert et al., 2005). Hodgins (Hodgins, 2004)

administered the NODS to problem gamblers as part of a 1-year follow-up after a brief treatment to assess its utility as a treatment outcome measure. Internal reliability was fair to good and the factor structure and item-total correlations supported the existence of a single higher order construct that correlated moderately with gambling behaviour and outcome. Prior treatment access was measured using the items developed for previous trials conducted by Hodgins et al. (Hodgins et al., 2009; Hodgins et al., 2001). In addition, participants were asked to identify a treatment goal (quit or reduced gambling) and how successful they thought they would be (0 “not at all” to 10 “extremely”) in the next 3 months and in the next 6 months.

Severity of depressive symptoms was measured using the PHQ-9 (Kroenke, Spitzer, & Williams, 2001). Severity of anxiety symptoms was measured using the GAD-7 (Spitzer, Kroenke, Williams, & Lowe, 2006). The Kessler 10 (K10) questionnaire was included to provide a continuous measure of general psychological distress that is responsive to change over time. The K10 has been well validated and its brevity and simple response format are attractive features. It also produces a summary measure indicating probability of currently experiencing an anxiety or depressive disorder (Brooks et al., 2006; Kessler et al., 2002).

Hazardous alcohol consumption was measured using the Alcohol Use Disorder Identification Test Consumption measure (AUDIT-C) (Dawson, Grant, Stinson, & Zhou, 2005). Illicit drug use was assessed in a manner commonly used on general population surveys – by asking if the participant had used (from a list) any of the primary illicit drug categories ever, and in the last 12 months (Ialomiteanu & Adlaf, 2010). A more detailed assessment of illicit drug use was not warranted in this situation as the incidence of use was expected to be too low for detailed analysis.

Quality of life was assessed by the EUROHIS-QoL 8, an eight-item version of a widely used measure. This short form has been used in a number of countries, is robust psychometrically, and overall performance is strongly correlated with scores from the original EUROHIS-QoL (Schmidt, Muhlan, & Power, 2006).

Follow-up Assessments

Three and six months after randomization, an email invitation was sent to participants containing a link to the follow-up assessment. Up to two reminder emails were sent to promote retention in the trial. The follow-up consisted of an assessment of gambling behaviour, problem gambling severity (NODS), self-rated improvement, psychiatric distress, alcohol and illicit drug use, quality of life, and use of other treatment resources. Primary outcome measures consisted of problem gambling severity (as measured by the NORC DSM-IV screen for Gambling Problems (NODS – past 3-month version)) (Hodgins, 2004), and mean days per month gambling in the past 3 months.

Use of Interventions: We accessed a complete record of the amount and type of use participants made of the G-only and G + MH interventions. This information was used to test the moderation hypothesis that degree of involvement with the online gambling intervention would be related to success at overcoming gambling problems. We operationalized degree of involvement with G-only and G + MH interventions by recording the number of times the participant accessed the site.

Power Analysis

We proposed to collect a sample of 280 participants and we estimated that we would successfully follow about 224 participants at six months (20% attrition) (Hodgins et al., 2009). This number would also provide sufficient power to conduct the proposed statistical tests comparing hypotheses, based upon gambling frequency and NODS data from Hodgins et al. (Hodgins et al., 2009; Hodgins et al., 2001), assuming a correlation of .5 between baseline and follow-up values, power = .80 and an $\alpha = .05$. This sample size would be sufficient to detect a difference of about 2 gambling days per month between conditions at each follow-up interval. Smaller differences may not have been clinically important. Similarly, this sample size would be sufficiently powered to detect a 1 point difference on the NODS at 6 months. These calculations were based upon a repeated measures ANOVA model. The proposed analyses employed mixed effects repeated measures models and, as such, would have greater statistical power because all observed data were included.

Data Analysis

Analyses for Hypotheses 1 and 2, comparing outcomes between groups, employed mixed effects repeated measures models that use all available data for each participant. Separate analyses were conducted for each primary outcome variable. This same analytic approach, with the addition of interaction terms, was used for secondary analyses examining moderators (e.g., extent of use). Missing data was handled using a maximum likelihood approach to estimate covariances, variances and means, and all models were generated using IBM SPSS, version 24.0.

Results

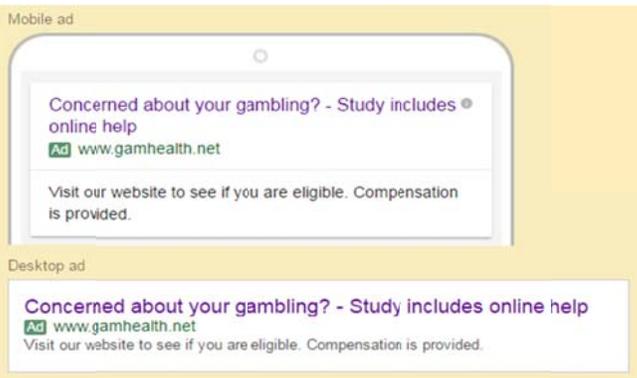
Recruitment strategy and sample size

Participants were recruited into the study between June 2016 and January 2017 using a comprehensive advertising strategy which incorporated in-print, online and radio ads. As recruitment was primarily targeted at individuals in Manitoba, Canada, various standard in-print and online recruitment ads (e.g., 1/8 page, page banners, 350 x 200 pixels) were placed in a variety of local newspapers, websites and transit systems such as: Coffee News, the Winnipeg Sun, ebrandon.ca, winniepmovies.com, and the Winnipeg Transit System. It is important to note that most online ads were accessible across multiple digital devices such as computers, tablets and mobile phones. In addition, several radio ads were also aired on local news, music and sports radio stations across Manitoba such as 680 CJOB, KISS 102.5, 99.9 BOB FM, and TSN 1290. Lastly, an intensive social media campaign was also launched which included targeting ads to individuals in Manitoba who used specific keywords in Google searches (i.e., Google Adwords), expressed special interests within Facebook and Twitter, and through the promotion of the study's Facebook and Twitter page which included direct links to the study's website. While the majority of advertising campaigns were designed to specifically target individuals in Manitoba, Canada, social media advertisements were expanded to all of Canada within the first few months of recruitment in order to achieve the desired sample size. A sample of some the recruitment ads used within the study can be found in Figure 2.

Overall, a total of 386 participants met eligibility criteria and were screened into the study. Of those, 284 verified their email address and completed the baseline questionnaire thus enrolling into the study. Due to a programming error, one participant was not randomized at baseline and did not receive an intervention, therefore reducing the final sample to 283 participants. In total, 193 participants were recruited from Manitoba into the final sample, representing 68% of the sample.

Figure 2. Sample of recruitment advertisements

A. 

B. 

C. 

D. 

E. 

- A. Online banner ad on winniepgmovies.com
- B. Online mobile and desktop ads on google.ca web searches
- C. Print ad in local Manitoba newspapers
- D. Online desktop Facebook ad

E. Print ad in Winnipeg Transit

Sample description and problem gambling severity

Demographic and clinical characteristics

The demographic characteristics of the study sample are presented in Table 1. Overall, slightly less than half of the participants were male (45.6%), more than half completed at least some post-secondary education (58.1%) and were employed full or part-time (72.1%). In addition, the mean (SD) age was 40.7 (12.8), with participants ranging in age from 18 to 65 years old. The sample as a whole presented with high problem gambling severity at baseline as indicated by a mean score of 15.6 on the PGSI (SD = 6.1) and 91.2% of participants met criteria for problem gambling. In addition, the majority of the sample (75.6%) scored 22 or above on the Kessler-10, indicating the co-occurrence of mental health symptoms. Nonetheless, only one third of the sample had ever attended formal help (34.3%). Some of the most commonly endorsed forms of gambling that caused participants problems included VLT (55.8%), slot machines (50.9%), instant or scratch tickets (26.5%), and table games in casino (25.4%). More detailed and other clinical and gambling characteristics are presented in Tables 2 through 3.

Table 1. Demographic characteristics of full sample.

Variable	N = 283
Age, mean years (SD)	40.7 (12.8)
Males, % (n)	45.6 (129)
Education completion, % (n)*	
High school or less	41.8 (117)
Some post-secondary or greater	58.2 (163)
Marital status, % (n)	
Married/Common law	51.7 (147)
Single	30.0 (85)
Divorced/Separated	15.5 (44)
Widowed	2.5 (7)
Employment status, % (n)	
Full/Part-time employed	72.1 (204)
Student/Retired/Homemaker	11.0 (31)
Not employed/disabled	17.0 (48)
Personal income, % (n)*	
<\$30,000	26.1 (72)
\$30,000 - \$49,999	17.4 (48)
\$50,000 - \$79,999	26.1 (72)
\$80,000 or more	30.4 (84)

Note: * Some variables contained missing data:
Education completion (n=3); Personal income (n=7).

Table 2. Baseline gambling and clinical characteristics of full sample.

Variable	N = 283
NODS, mean (SD)	6.5 (2.5)
days gambled in last 30	13.0 (7.8)
PGSI, mean (SD)	15.6 (6.1)
Past 30 days <i>total</i> amount spent, median (min; max)	\$1,000 (\$0; \$45,000)
Past 3 months <i>largest</i> amount spent, median (min; max)	\$500 (\$5; \$65,000)
K10, mean (SD)	29.5 (10.0)
Ever attended formal treatment, % (n)	34.3 (97)
PHQ-9, mean (SD)	12.1 (7.2)
GAD-7, mean (SD)	9.48 (6.26)

Note: NODS; NORC DSM-IV Screen for past 3 month Gambling Problems
 PGSI; Problem Gambling Severity Index
 K10; Kessler Psychological Distress Scale
 PHQ-9; Patient Health Questionnaire
 GAD-7; Generalized Anxiety Disorder 7-item scale

Table 3. Most common types of gambling endorsed by participants as causing them problems.

Type of Gambling	N = 283 % (n)
VLT	55.8 (158)
Slot machines	50.9 (144)
Instant or scratch tickets	26.5 (75)
Table games in casino	25.4 (72)
Lottery tickets	17.0 (48)

Bivariate comparisons across G-only and G + MH interventions at baseline

Bivariate comparisons were conducted to detect statistical differences between participants randomized into the G-only and G + MH interventions on both demographic and relevant clinical characteristics at baseline (Table 4). Overall, the two groups were found to score significantly different on the PGSI, with individuals in the G + MH intervention exhibiting a higher degree of problem gambling severity at baseline than those randomized to the G-only intervention ($p = 0.043$). As a result, baseline PGSI is included as a covariate in all final study models.

Table 4. Differences between G-only and G + MH interventions on baseline demographic and clinical characteristics.

Variable	Intervention		<i>p</i>
	Gambling Intervention Only (n= 142)	Gambling + MH (n=141)	
Age, mean years (SD)	40.5 (13.0)	40.9 (12.7)	0.822
Males, % (n)	45.8 (65)	45.4 (64)	0.948
Some post-secondary or greater, % (n)	63.1 (89)	53.2 (74)	0.094
Married/Common law, % (n)	50.0 (71)	53.9 (76)	0.511
Full/Part-time employed, % (n)	70.4 (100)	73.8 (104)	0.532
Personal Income >\$30,000, % (n)	72.7 (101)	75.2 (103)	0.633
Co-occurring mental health symptoms, % (n)*	71.8 (102)	79.4 (112)	0.136
PGSI, mean (SD)	14.9 (6.3)	16.4 (5.8)	0.043
NODS, mean (SD)	6.4 (2.6)	6.6 (2.4)	0.435
days gambled in last 30, mean (SD)	13.3 (7.6)	12.8 (8.0)	0.615
Ever attended formal treatment, % (n)	33.8 (48)	34.8 (49)	0.866
PHQ-9, mean (SD)	11.7 (7.1)	12.5 (7.3)	0.343
GAD-7, mean (SD)	8.9 (6.1)	10.1 (6.4)	0.112

Note: Group differences were computed using chi-squares and t-tests.

* Computed as proportion of participants scoring 22 or greater on Kessler 10

PGSI; Problem Gambling Severity Index

NODS; NORC DSM-IV Screen for past 3 month Gambling Problems

PHQ-9; Patient Health Questionnaire

GAD-7; Generalized Anxiety Disorder 7-item scale

Follow-up rates and bivariate comparisons across participants followed-up and those lost to follow-up at baseline

Despite efforts to minimize attrition rates (i.e., multiple reminder emails, honorariums), low follow-up rates of 38.2% (n=108) and 35.7% (n=101) were observed at both 3- and 6- months, respectively. Bivariate comparisons were conducted to determine whether there was a different follow-up rate between intervention condition, as well as differences between participants who were followed-up for at least one time point versus those completely lost to follow-up, on both baseline demographic and clinical characteristics (Table 5). Overall, the follow-up rates between the two interventions at both 3- and 6-months were not significantly different (3-month follow-up, $p = 0.096$; 6-month follow-up, $p = 0.410$). Nonetheless, participants who exhibited greater problem gambling severity and frequency at baseline, that is reported greater scores on the PGSI, NODS, and more days gambled in the past 30, were more likely to have been lost to follow-up at both 3- and 6-months (PGSI, $p = 0.04$; NODS, $p = 0.01$; days gambled in past 30, $p < 0.0001$), than those who reported less severe gambling problems at baseline. No other significant differences ($p > 0.05$) were found on baseline demographic or clinical characteristics between participants who completed at least one follow-up survey, versus those who were lost to follow-up at both 3-and 6-months.

Table 5. Differences between participants with at least one follow-up completed versus those lost to follow-up on baseline demographic and clinical characteristics.

Variables at Baseline	Follow-Up		<i>p</i>
	Baseline Only (n= 148)	Any Follow-up Completed (n=135)	
Age, mean years (SD)	41.2 (12.8)	40.2 (12.9)	0.551
Males, % (n)	48.0 (71)	43.0 (58)	0.398
Some post-secondary or greater, % (n)	58.6 (85)	57.8 (78)	0.886
Married/Common law, % (n)	54.1 (80)	49.6 (67)	0.457
Full/Part-time employed, % (n)	71.6 (106)	72.6 (98)	0.856
Personal Income >\$30,000, % (n)	70.5 (103)	77.7 (101)	0.177
Co-occurring mental health symptoms, % (n)	76.4 (113)	74.8 (101)	0.764
PGSI, mean (SD)	16.3 (6.0)	14.9 (6.0)	0.044
NODS, mean (SD)	6.8 (2.3)	6.1 (2.6)	0.017
days gambled in last 30, mean (SD)	14.6 (7.8)	11.3 (7.5)	<0.0001
Ever attended formal treatment, % (n)	33.8 (50)	34.8 (47)	0.855
PHQ-9, mean (SD)	12.8 (7.1)	11.4 (7.3)	0.121
GAD-7, mean (SD)	10.0 (6.3)	8.9 (6.1)	0.127

Note: Group differences were computed using chi-squares and t-tests.

* Computed as proportion of participants scoring 22 or greater on Kessler 10

** Some variables contained missing data: Education completion (n=3); Personal income (n=7).

PGSI; Problem Gambling Severity Index

NODS; NORC DSM-IV Screen for past 3 month Gambling Problems

PHQ-9; Patient Health Questionnaire

GAD-7; Generalized Anxiety Disorder 7-item scale

Bivariate comparisons across the G-only and G + MH interventions at baseline for participants with at least one follow-up

Bivariate comparisons were conducted among participants who were reached for at least one follow-up, to detect any differences between those randomized into the G-only and G + MH intervention on baseline demographic and clinical characteristics. Overall, no significant ($p > 0.05$) differences were observed between the experimental groups (Table 6).

Table 6. Differences between G-only and G + MH interventions on baseline demographic and clinical characteristics for participants with at least one follow-up.

Variable	Intervention		<i>p</i>
	Gambling Intervention Only (n=74)	Gambling + MH (n=61)	
Age, mean years (SD)	38.9 (12.7)	41.8 (13.1)	0.197
Males, % (n)	44.6 (33)	41.0 (25)	0.673
Some post-secondary or greater, % (n)	62.2 (46)	52.5 (32)	0.256
Married/Common law, % (n)	47.3 (35)	52.5 (32)	0.551
Full/Part-time employed, % (n)	70.3 (52)	75.4 (46)	0.505
Personal Income >\$30,000, % (n)	76.4 (55)	79.3 (46)	0.691
Co-occurring mental health symptoms, % (n)*	71.6 (53)	78.7 (48)	0.346
PGSI, mean (SD)	14.7 (6.2)	15.2 (5.8)	0.623
NODS, mean (SD)	6.3 (2.7)	5.9 (2.6)	0.430
days gambled in last 30, mean (SD)	11.5 (7.4)	11.0 (7.6)	0.701
Ever attended formal treatment, % (n)	35.1(26)	34.4 (21)	0.931
PHQ-9, mean (SD)	11.3 (7.3)	11.6 (7.2)	0.816
GAD-7, mean (SD)	8.7 (6.1)	9.1 (6.3)	0.720

Note: Group differences were computed using chi-squares and t-tests.

* Computed as proportion of participants scoring 22 or greater on Kessler 10

PGSI; Problem Gambling Severity Index

NODS; NORC DSM-IV Screen for past 3 month Gambling Problems

PHQ-9; Patient Health Questionnaire

GAD-7; Generalized Anxiety Disorder 7-item scale

Associations between interventions and gambling outcomes throughout the study

Hypothesis 1: Effect of access to G + MH intervention on gambling outcomes for gamblers with co-occurring mental health symptoms

Hypothesis: For problem gamblers with co-occurring mental health symptoms, it was predicted that participants provided access to the G +MH intervention will display significantly reduced gambling outcomes at three and six-month follow-ups as compared to those provided access to the G-only intervention.

Mixed effects models were used to investigate the effect of the the G + MH intervention versus the G-only intervention on gambling changes over time among gamblers experiencing co-occurring mental health symptoms (Tables 7 - 8). In total, two models were fitted to the data, each examining the fixed effect of time, intervention, and the time by intervention interaction on two different outcome measures of gambling: NODS scores and the number of days gambled in the past 30. Overall, both models revealed no significant differences across interventions in gambling at baseline, however all gamblers with co-occurring mental health symptoms experienced significant reductions in their gambling severity (NODS; $p = <0.0001$) and frequency (days gambled in the past 30; $p = <0.0001$) over time. The first model, examining changes in NODS scores over time did not support our hypothesis as reductions in gambling severity over time did not differ by intervention among gamblers with co-occurring mental health symptoms ($p = 0.187$). The second model similarly did not support our hypothesis, but instead revealed significant differences in gamblers' frequency of gambling over time across interventions ($p = 0.052$). Three subsequent post-hoc comparisons were conducted using Bonferroni corrections to determine between which two time points in the study (i.e., BL, 3M, or 6M) participants in the G-only and G + MH significantly differed in their level of reduction of gambling frequency. Overall, only one comparison was significant, and it was found that among gamblers with co-occurring mental health symptoms, those randomized into the G-only intervention experienced a greater reduction in gambling frequency from 3-months to 6-months, than those who were randomized into the G + MH intervention ($t(220)=2.41, p=0.017$). Graphs illustrating the changes in gambling severity and gambling frequency over time for gamblers with co-occurring mental health symptoms across both the G-only and the G + MH interventions are presented in Figures 3 and 4, respectively.

Table 7. Mixed-effect model results of time, intervention, and time by intervention on gambling severity (NODS) for gamblers with co-occurring mental health symptoms (N=214)

Effect	Estimate	<i>t</i>	<i>p</i>
Intercept	2.78	6.45	<0.0001
PGSI (at Baseline)	0.23	10.25	<0.0001
Time (Reference: Baseline)			
3-months	-2.10	-6.28	<0.0001
6-months	-2.44	-7.05	<0.0001
Intervention (Reference: G + MH)			
G - only	0.23	0.81	0.418
		<i>F</i>	<i>p</i>
Time by Intervention interaction		1.69	0.187

Note: PGSI; Problem Gambling Severity Index

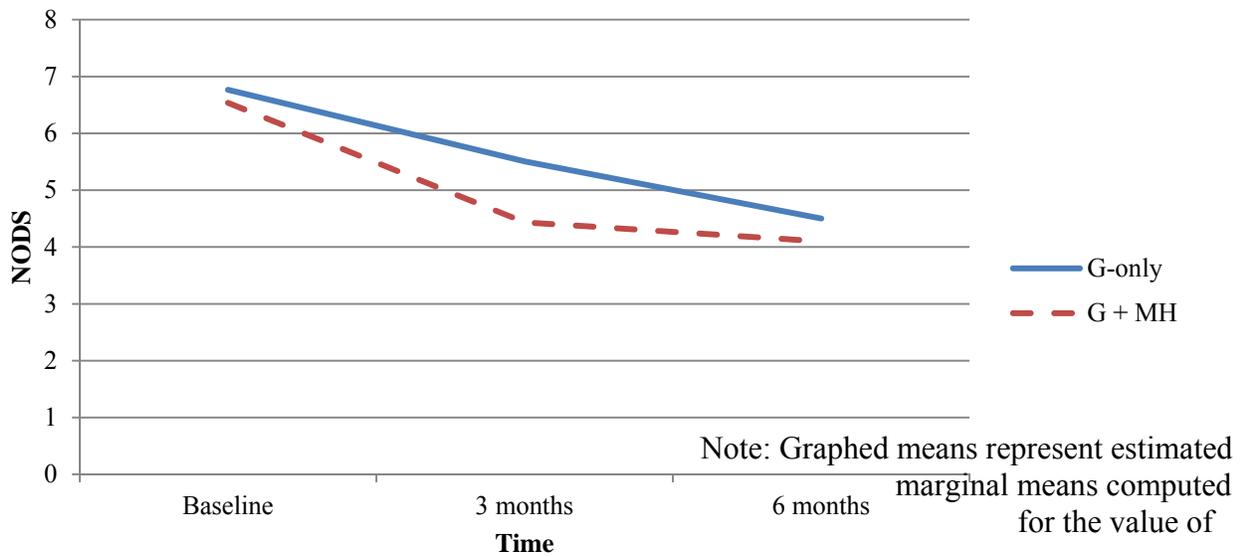
Table 8. Mixed-effect model results of time, intervention, and time by intervention on gambling frequency (number of days gambled in last 30) for gamblers with co-occurring mental health symptoms (N=214)

Effect	Estimate	<i>t</i>	<i>p</i>
Intercept	6.07	10.31	<0.0001
PGSI (at Baseline)	1.03	3.39	0.001
Time (Reference: Baseline)			
3-months	0.47	-5.93	<0.0001
6-months	0.46	-5.88	<0.0001
Intervention (Reference: G + MH)			
G - only	1.11	0.96	0.34
		<i>F</i>	<i>p</i>
Time by Intervention interaction		2.99	0.052

Note: PGSI; Problem Gambling Severity Index

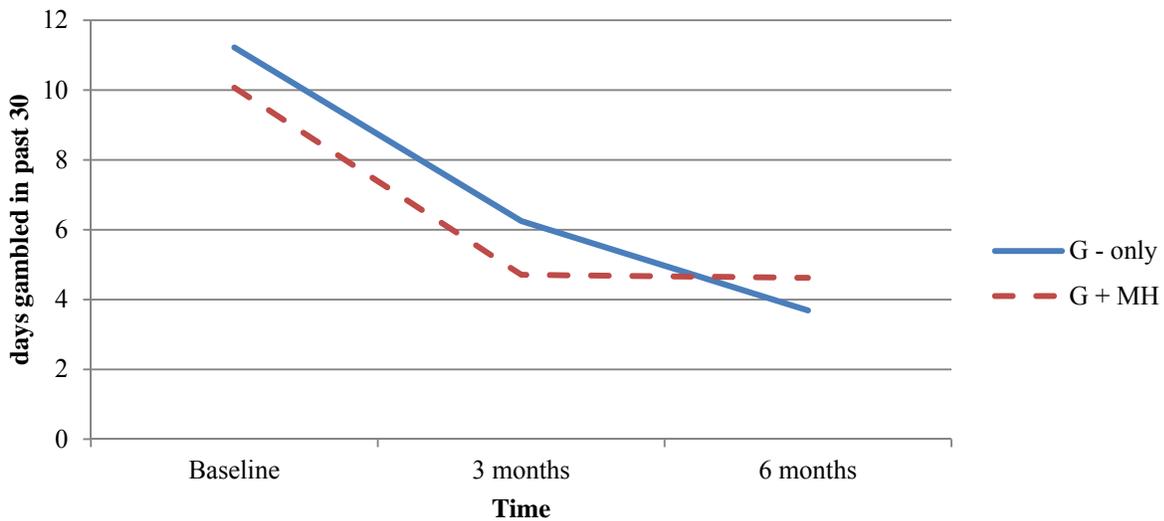
Note: Graphed means represent estimated marginal means computed for the value of baseline PGSI (Problem Gambling Severity Index) = 16.7

Figure 3. Gambling severity across time for gamblers with co-occurring mental health symptoms in the G-only and G + MH intervention



baseline PGSI (Problem Gambling Severity Index) = 16.7

Figure 4. Gambling frequency across time for gamblers with co-occurring mental health symptoms in the G-only and G + MH intervention



Note: Graphed means represent estimated marginal means computed for the value of baseline PGSI (Problem Gambling Severity Index) = 16.7

Hypothesis 2: Effect of access to G + MH intervention on gambling outcomes for gamblers without co-occurring mental health symptoms

Hypothesis: Problem gamblers without co-occurring mental health symptoms will display no significant difference between the G-only and G+MH interventions at three- and six-month follow-ups.

Similarly to how hypothesis 1 was tested, two mixed effect models were fitted to the data to examine the relationship between, time, the two interventions (i.e., G-only and G + MH), the time by intervention interaction on changes in gambling severity and frequency over time for gamblers without co-occurring mental health symptoms (Tables 9 – 10). Overall, both models revealed that gamblers without co-occurring mental health symptoms significantly reduced their gambling severity (NODS; $p = <0.0001$) and frequency (days gambled in the past 30; $p = <0.001$) over time, and no differences in gambling severity or frequency were found between intervention groups at baseline ($p > 0.05$). Consistent with our hypothesis, both models also revealed that the level of reduction in gambling severity and frequency over time among gamblers without co-occurring mental health symptoms did not significantly differ by intervention (NODS, $p = 0.413$; days gambled in the past 30, $p = 0.263$). Graphs illustrating the changes in gambling severity and gambling frequency over time for gamblers without co-occurring mental health symptoms across both the G-only and the G + MH interventions are presented in Figures 5 and 6, respectively.

Table 9. Mixed-effect model results of time, intervention, and time by intervention on gambling severity (NODS) for gamblers without co-occurring mental health symptoms (N=69)

Effect	Estimate	<i>t</i>	<i>p</i>
Intercept	2.37	4.02	< 0.0001
PGSI (at Baseline)	0.21	5.32	< 0.0001
Time (Reference: Baseline)			
3-months	-0.97	-1.33	0.187
6-months	-2.60	-4.07	< 0.0001
Intervention (Reference: G + MH)			
G - only	-0.08	-0.17	0.862
		<i>F</i>	<i>p</i>
Time by Intervention interaction		0.90	0.413

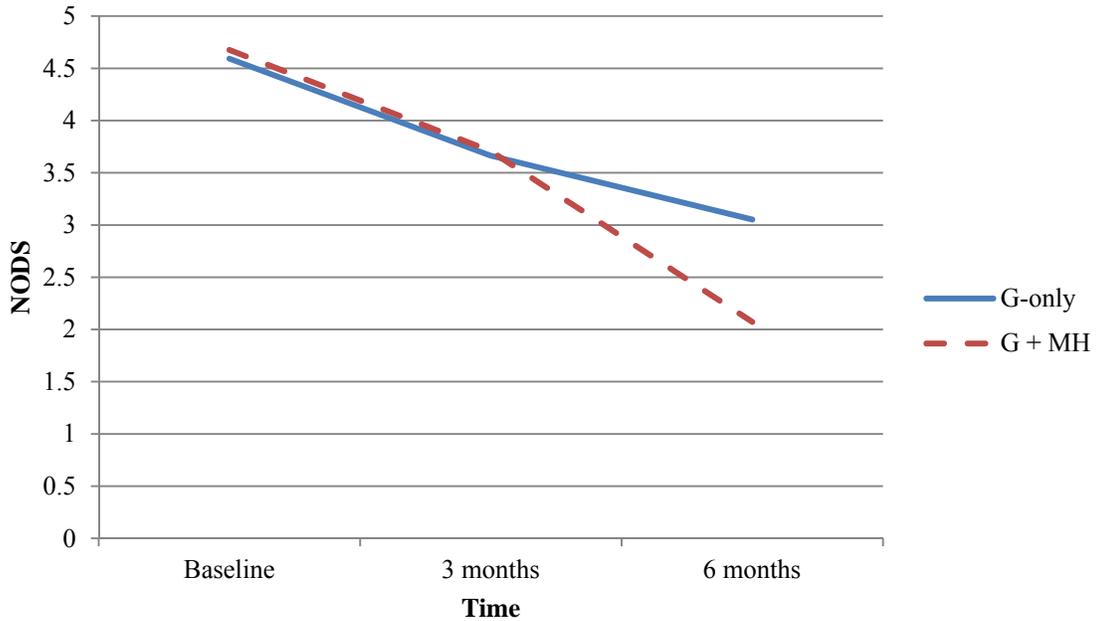
Note: PGSI; Problem Gambling Severity Index

Table 10. Mixed-effect model results of time, intervention, and time by intervention on gambling severity (number of days gambled in last 30) for gamblers without co-occurring mental health symptoms (N=69)

Effect	Estimate	<i>t</i>	<i>p</i>
Intercept	6.43	6.86	< 0.0001
PGSI (at Baseline)	1.03	1.55	0.126
Time (Reference: Baseline)			
3-months	0.72	-1.31	0.196
6-months	0.52	-3.04	0.003
Intervention (Reference: G + MH)			
G - only	1.10	0.46	0.644
		<i>F</i>	<i>p</i>
Time by Intervention interaction		1.36	0.263

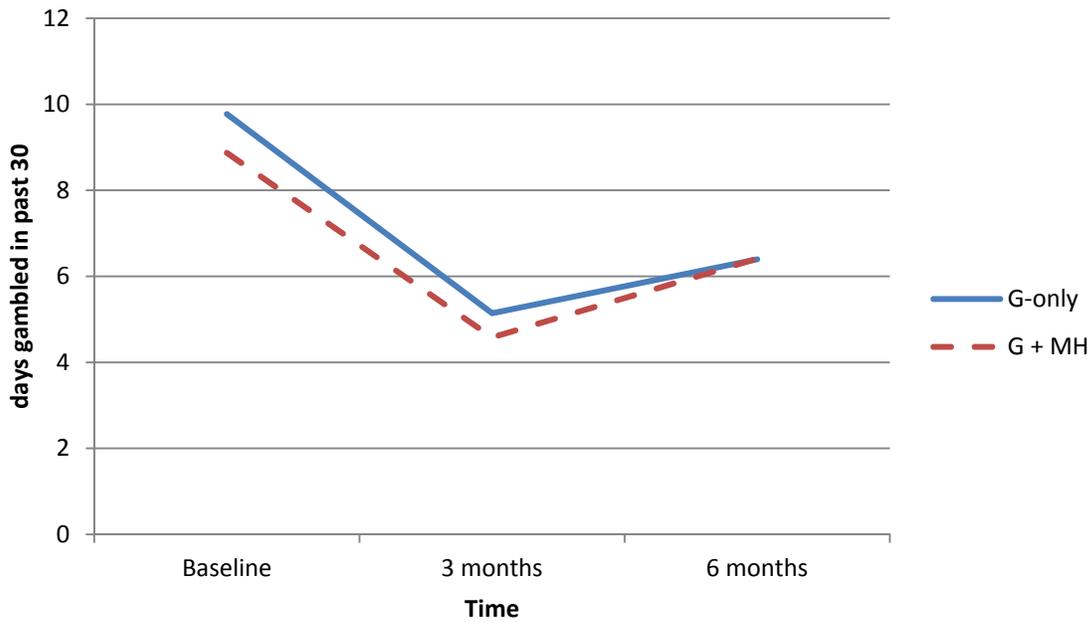
Note: PGSI; Problem Gambling Severity Index

Figure 5. Gambling severity across time for gamblers without co-occurring mental health symptoms in the G-only and G + MH intervention



Note: Graphed means represent estimated marginal means computed for the value of baseline PGSI (Problem Gambling Severity Index) = 11.1

Figure 6. Gambling frequency across time for gamblers without co-occurring mental health symptoms in the G-only and G + MH intervention



Note: Graphed means represent estimated marginal means computed for the value of baseline PGSI (Problem Gambling Severity Index) = 11.1

Hypothesis 3: Effect of level of involvement with the G-only intervention on gambling outcomes

Hypothesis: Respondents who have more involvement with the G-only intervention between baseline and the three month follow-up will demonstrate more improvement in gambling outcomes at six-month follow-up, compared to respondents who have less involvement with the G-only intervention.

The association between intervention usage for participants randomized into the G-only intervention and gambling outcomes was also explored using mixed effect models. Two models were fitted to the data, each investigating the fixed effect of time, number of logins between baseline and 3-months, and the time by login interaction on changes in gambling severity (i.e., NODS) and frequency (i.e., days gambled in past 30) over time (Tables 11 – 12). In general, both models revealed that for gamblers randomized into the G-only intervention, the number of times participants logged into the intervention between baseline and 3-months was not significantly predictive of reductions in gambling severity (NODS, $p = 0.126$) or the frequency of gambling (days gambled in the past 30, $p = 0.782$) over time.

Table 11. Mixed-effect model results of time, total logins, and time by total logins on gambling severity (NODS) for gamblers in the G-only intervention (N=142)

Effect	Estimate	<i>t</i>	<i>p</i>
Intercept	2.60	5.85	< 0.0001
PGSI (at Baseline)	0.24	9.15	< 0.0001
Total Logins	-0.02	-0.21	0.830
Time (Reference: Baseline)			
3-months	-1.55	-3.71	< 0.0001
6-months	-1.67	-3.73	< 0.0001
		<i>F</i>	<i>p</i>
Time by Total Logins interaction		2.10	0.126

Note: PGSI; Problem Gambling Severity Index

Table 12. Mixed-effect model results of time, total logins, and time by total logins on gambling severity (number of days gambled in last 30) for gamblers in the G-only group (N=142)

Effect	Estimate	<i>t</i>	<i>p</i>
Intercept	7.46	11.20	< 0.0001
PGSI (at Baseline)	1.03	2.68	0.008
Total Logins	0.97	-0.83	0.406
Time (Reference: Baseline)			
3-months	0.54	-4.06	< 0.0001
6-months	0.44	-5.12	< 0.0001
		<i>F</i>	<i>p</i>
Time by Total Logins interaction		0.25	0.78

Note: PGSI; Problem Gambling Severity Index

Severity of Depression and Anxiety Symptoms over time

In addition to examining changes in gambling over time, we also sought to understand whether the provision of simultaneous access to online help for gambling problems and mental health symptoms had an impact on depression and anxiety symptoms over time for both gamblers with and without co-occurring mental health symptoms, respectively. The association between depressive symptoms and anxiety symptoms, respectively with, time, intervention (i.e., G-only and G + MH) and the time by intervention interaction was tested using mixed effect models with a random intercept. Four models were fitted to the data to examine these associations separately for depressive and anxiety symptoms among gamblers with and without co-occurring mental health symptoms. Overall, we found that gamblers without co-occurring mental health symptoms did not experience changes in their depressive nor anxiety symptoms over time, regardless of which intervention they were randomized into (Tables 13, 14). While gamblers with co-occurring mental health symptoms experienced a significant decrease in both their depressive and anxiety symptoms over time, these decreases were not dependent on the intervention they were randomized into (Tables 15, 16).

Table 13. Mixed-effect model results of time, intervention, and time by intervention on depressive symptoms (PHQ-9) for gamblers without co-occurring mental health symptoms (N=69)

Effect	Estimate	<i>t</i>	<i>p</i>
Intercept	3.79	5.20	< 0.0001
Time (Reference: Baseline)			
3-months	-1.35	-0.96	0.341
6-months	-0.79	-0.64	0.523
Intervention (Reference: G + MH)			
G - only	1.11	1.16	0.250
		<i>F</i>	<i>p</i>
Time by Intervention interaction		1.49	0.232

Note: Depressive symptoms assessed using Personal Health Questionnaire (PHQ-9)

Table 14. Mixed-effect model results of time, intervention, and time by intervention on anxiety symptoms (GAD-7) for gamblers without co-occurring mental health symptoms (N=69)

Effect	Estimate	<i>t</i>	<i>p</i>
Intercept	3.10	4.74	< 0.001
Time (Reference: Baseline)			
3-months	-0.62	-0.47	0.643
6-months	-0.54	-0.46	0.647
Intervention (Reference: G + MH)			
G - only	0.17	0.199	0.842
		<i>F</i>	<i>p</i>
Time by Intervention interaction		0.79	0.457

Note: GAD-7; Generalized Anxiety Disorder 7-item scale

Table 15. Mixed-effect model results of time, intervention, and time by intervention on depressive symptoms (PHQ-9) for gamblers with co-occurring mental health symptoms (N=214)

Effect	Estimate	<i>t</i>	<i>p</i>
Intercept	14.79	25.11	< 0.0001
Time (Reference: Baseline)			
3-months	-4.31	-5.27	< 0.0001
6-months	-5.55	-6.58	< 0.0001
Intervention (Reference: G + MH)			
G - only	-0.40	-0.47	0.638
		<i>F</i>	<i>p</i>
Time by Intervention interaction		1.25	0.288

Note: PHQ-9; Personal Health Questionnaire

Table 16. Mixed-effect model results of time, intervention, and time by intervention on anxiety symptoms (GAD-7) for gamblers with co-occurring mental health symptoms (N=214)

Effect	Estimate	<i>t</i>	<i>p</i>
Intercept	11.88	21.96	< 0.001
Time (Reference: Baseline)			
3-months	-4.01	-5.02	< 0.001
6-months	-4.39	-5.31	< 0.001
Intervention (Reference: G + MH)			
G - only	-0.79	-1.00	0.317
		<i>F</i>	<i>P</i>
Time by Intervention interaction		1.54	0.217

Note: GAD-7; Generalized Anxiety Disorder 7-item scale

Participants' use of interventions

Participants were encouraged to use the online interventions they received via three reminder emails to login to the website, and a detailed record of the amount and type of use participants made of the G-only and the G + MH was kept. While both interventions provided access to a self-help online gambling tool comprised of four modules and a workbook, the G + MH intervention included additional access to an online mental health intervention (i.e., MoodGYM) which included an introductory component, five modules and a separate workbook. Furthermore, it is important to note that while participants were able to complete modules of the gambling self-help tool in any order, access to each module within MoodGYM is dependent on the completion of the preceding module. Overall, 45% (n=127) of the whole sample accessed the gambling self-help tools, and 41% (n=117) completed at least two modules. Conversely, of the 141 participants randomized to receive access to MoodGYM, only 26% (n=37) accessed it and 7% (n=10) completed at least two modules. The proportion of participants who used the self-help online gambling tools and MoodGYM, within each of the G-only and G + MH interventions is presented in Table 17.

Table 17. Proportion of participants using different components of each online intervention.

Component of Intervention used	% within intervention (n)
G – only Intervention (N=142)	
Self-help gambling tools	47.9 (68)
G + MH Intervention (N=141)	
Self-help gambling tools only	16.3 (23)
MoodGYM only	0.7 (1)
Self-help gambling tools & MoodGYM	25.5 (36)

Participant feedback on interventions

In addition to exploring the effectiveness and usage of the Internet interventions, we also sought to understand participants' overall receptivity towards the G-only and G + MH interventions. In total, 35.7% (n=101) of the sample was followed-up at 6-months and provided feedback on the intervention they had received. The majority of the followed-up sample felt positive about the online intervention they received, with 69% reporting that they had felt satisfied or very satisfied with their experience using the online program, and only 2% reporting dissatisfaction (Table 18). In addition, participants were also asked to specifically comment on the aspects of the online program they found particularly helpful/enjoyable, as well as the aspects that they did not find helpful. Overall, 57.4% and 47.5% of the sample who were followed-up at 6 months provided specific comments about what they liked and disliked about the intervention, respectively. The majority of the positive feedback received suggested that many participants felt the online program helped them reduce their gambling and increased their self-awareness of their gambling, giving them an opportunity to better understand their motivations for gambling and gain a greater sense of accountability for their gambling. In addition, a few participants also expressed their

appreciation for the education material provided. On the other hand, some of the criticisms of the interventions are also acknowledged, such as the long and repetitive nature of questions, the lack of “contact with a person”, and experiencing negative feelings or cravings while engaging with the intervention. A few comments from participants are listed below as examples:

“The ability to chart my monthly gambling spending, put things into perspective a bit, made it easier to find help and support to significantly decrease the amount I gamble and make it just a game again. Overall I think that the online program helped me get a better handle on my gambling and other aspects of my day to day spending as well. I found it useful.”

“It helped me realize my motivations for gambling. It also made me more determined to set limits, which I did. It's also moved me a step closer to self-exclusion which I think is the best way to stop gambling in the casino. I did stop online gambling online on Playnow.com!! :) No more internet gambling. Thank you for helping me realize how serious my casino habit is.”

“This was good as it did make me more aware of my issues and how deep they really were. I was able to talk to my psychiatrist and have a dialogue based on the evaluations provided by the program.”

“No real life contact with help or support / face to face.”

Table 18. Participant satisfaction with online interventions.

Satisfaction	N = 101 % (n)
Very satisfied	21.8 (22)
Satisfied	47.5 (48)
Neutral	28.7 (29)
Dissatisfied	1.0 (1)
Very dissatisfied	1.0 (1)

Discussion

The large majority of problem gamblers will not access formal treatment (Cunningham, 2005; Slutske, 2006; Suurvali et al., 2008). Many problem gamblers also suffer from co-occurring depression or anxiety (Bischof et al., 2013; Desai & Potenza, 2008; Kessler et al., 2008; Lorains et al., 2011; Martin et al., 2014 ; Petry et al., 2005). Given the widespread use of the Internet, the provision of online services for problem gamblers has been recognized as one promising means of overcoming many of the barriers to accessing formal treatment as Internet interventions can be accessed in the person’s home or other convenient locations.

The goal of the current trial was to determine whether there was advantage to providing an online intervention for mental health symptoms along with one for gambling. We predicted that there would be benefit in providing both interventions for people with gambling concerns who also have co-occurring psychological distress and that the addition of the intervention for depression and anxiety would not disadvantage those people with gambling concerns for participants without co-occurring psychological distress. We found that, while participants who were followed-up displayed a reduction in the amount that they gambled, there was no apparent advantage to providing the online intervention for depression and anxiety, irrespective of whether the participant was experiencing mental health concerns.

While there was reasonable use of the gambling intervention, with 45% of all participants in the trial accessing the intervention and 41% completing at least 2 of the 4 modules, there was limited use of the online intervention for depression and anxiety. Only, 26% accessed the MoodGYM intervention, 10% completed 2 of the 5 intervention modules, and just one participant only used MoodGYM but did not use the gambling intervention (out of the 141 participants provided access to MoodGYM). This indicates a lack of interest in being provided assistance for depression and anxiety among participants seeking online help for their gambling. This is notable, particularly as 75.6% of the study sample scored 22 or more on the K10 scale, indicating substantial psychological distress. One possibility to consider is that the online intervention for depression and anxiety chosen for this study (MoodGYM), while being an excellent example of a high quality online intervention with an extensive evidence base, may not be suitable for the role it was put to in the current trial. MoodGYM provides a multi-module program for addressing depression and anxiety. Perhaps some form of briefer assistance would be better suited as an adjunct to an online intervention for gambling (or even a link to other services for those interested). However, there appears to be very little research conducted to-date on brief interventions for depression and anxiety.

A significant limitation of the current trial was the poor follow-up rate. While such rates are not unusual in eHealth research, they were not expected by the current research team given our prior experience with running online interventions, albeit for unhealthy alcohol use. While we have put in place a range of quality improvements in our next trial in this line of research to improve follow-up rates for our upcoming research (e.g., telephone follow-up interviews, honorarium for baseline survey, incremental honorarium for completion of study), this does not change the fact that the poor follow-up rates in the current trial reduces the strength of any conclusions we can make.

Summary

There was a reduction in the amount gambled, and severity of gambling problems, among participants who completed the trial. While we cannot say that the gambling intervention was the cause of this reduction because the trial was not designed to test this question, these results can be taken as promising and, combined with the qualitative feedback from participants, it appears that the online gambling intervention developed for this trial is a useful service for problem gamblers and merits continued availability after the completion of the trial.

Providing an online intervention for depression and anxiety in addition to gambling did not appear to result in any improvement in gambling or depression outcomes, even among participants with these co-occurring disorders. The limited use of the online depression and anxiety intervention indicates that providing access to this intervention, or at least an intervention on the scale of MoodGYM, might not be a useful adjunct for online gambling services. However, some form of briefer service, or even links to other online services for depression, might be of benefit.

The co-occurrence of problem gambling with other mental health and addictions concerns is common. As the majority of people with gambling concerns (as well as mental health and other addictions concerns) do not seek formal treatment, there is great need to develop alternate services for people to access help. The current research is one of only a limited number of trials conducted on this topic to-date and provides important information that can inform both future research in this area as well as decisions on the current provision of online services for problem gamblers.

Declarations

Ethics approval and consent to participate

Ethics approval for this study was obtained from the standing ethics committees of the Centre for Addiction and Mental Health (Canada) and the Australian National University. All participants will provide informed consent as part of the study registration process.

Competing interests

The authors declare that they have no competing interest. Dr Hodgins has received consulting fees from the Australian National University for development of the online gambling tool.

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