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Internet-based interventions for behavioral addictions: A systematic review

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Journal of Behavioral Addictions

11 (2022) 3, 620–642

DOI:

10.1556/2006.2022.00054

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Received: September 6, 2021 • Revised manuscript received: May 1, 2022; June 13, 2022 • Accepted: July 12, 2022
Published online: August 4, 2022

REVIEW ARTICLE



ABSTRACT

Background and aims: Behavioral addictions are a public health problem that causes harm to both individuals and society. Internet-based interventions offer potential benefits over face-to-face therapy for the treatment of behavioral addictions, including their accessibility, perceived anonymity, and low costs. We systematically reviewed the characteristics and effectiveness of these interventions. **Methods:** A systematic literature search was conducted in: PubMed, PsycINFO, Embase, and the Cochrane Central Register of Controlled Trials. A standardized methodological quality assessment was performed on all identified studies via the *Effective Public Health Practice Project (EPHPP) Quality Assessment Tool*. **Results:** Twenty-nine studies were assessed in this systematic review. Between them, considerable heterogeneity was noted in various study characteristics, including screening tools, inclusion criteria, and outcome measures. Attrition rates also ranged widely (9–89%), as did study quality, with three of the 29 studies rated strong, 12 moderate, and 14 weak methodologically. Twenty-two studies focused on gambling disorder, most revealing significant within-group effects for the assessed intervention on gambling-related symptoms and four of these studies identified significant between-group effects. Behavioral addictions studied in the remaining studies included gaming disorder, internet use disorder, hoarding disorder, and pornography use disorder, revealing generally-promising, albeit limited results. **Conclusions:** Internet-based interventions seem promising at reducing gambling problems, but too few studies have been published, to date, for conclusions to be drawn for other behavioral addictions. Internet-based interventions targeting other behavioral addictions – like gaming disorder, internet use disorder, hoarding disorder, and pornography use disorder – remain under-examined, warranting considerable additional research to assess their effectiveness.

KEYWORDS

behavioral addiction, impulse control disorders, internet-based interventions, effectiveness, systematic review

INTRODUCTION

The term “behavioral addiction” was first introduced by Isaac Marks (1990). It is defined as repeated urges to engage in counter-productive behaviors that share an important overlap in symptom presentation with substance use disorders (e.g., loss of control, continued involvement despite negative consequences, cognitive salience). To date, the only recognized behavioral addictions are gambling disorder and gaming disorder, which have both been included in the eleventh edition of the International Classification of Diseases (ICD-11) in its section on “Disorders Due to Substance Use or Addictive Behaviors” (Billieux, Stein, Castro-

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Calvo, Higushi, & King, 2021; Reed et al., 2019). Other conditions (some of them listed as Impulse Control Disorders in ICD-11) are being increasingly considered as behavioral addictions, like pornography use disorder, or social networks use disorder (Brand et al., 2020). It is worth noting that many other behavioral addictions have been described in the psychiatric and psychological literature, most with limited or no available clinical data to support their relevance (Billieux, Schimmenti, Khazaal, Maurage, & Heeren, 2015; Starcevic, Billieux, & Schimmenti, 2018).

Behavioral addictions are an internationally-recognized public health problem linked to individual and societal harms (Stein et al., 2018). For example, gambling disorder is associated with debt, adverse employment consequences (e.g. loss of productivity), crime (e.g. theft), and strained relationships (Fong, 2005; Latvala, Lintonen, & Konu, 2019). Gaming disorder is associated with mental health issues – including antisocial behavior, anger control problems, emotional distress, and self-esteem problems (Wartberg et al., 2017); academic underachievement (Islam, Biswas, & Khanam, 2020); and vocational problems (Männikkö, Ruotsalainen, Tolvanen, & Kääriäinen, 2020). Multiple studies have found that problematic pornography use can negatively affect relationships, sexual satisfaction, and intimacy (Koós et al., 2021; Kraus, Martino, & Potenza, 2016).

Face-to-face psychosocial interventions have shown promising results in the treatment of behavioral addictions (Goslar, Leibetseder, Muench, Hofmann, & Laireiter, 2020; Malinauskas & Malinauskiene, 2019; Quilty, Wardell, Thiruchselvam, Keough, & Hendershot, 2019; Zajac, Ginley, Chang, & Petry, 2017). Unfortunately, however, only a minority of affected individuals seek professional treatment services (Thege, Woodin, Hodgins, & Williams, 2015). In one study, fewer than 10% of problem gamblers sought professional help (Loy, Grüne, Braun, Samuelsson, & Kraus, 2019). Potential barriers to seeking help are service unavailability, stigmatization of the addictive behavior, socio-cultural barriers, concerns about confidentiality, financial barriers, and preference on self-reliance (Clarke, Abbott, DeSouza, & Bellringer, 2007).

Internet-based interventions have a number of potential benefits over face-to-face therapy, including their ready accessibility, perceived anonymity, potential for tailored approaches, and low costs (Andersson & Titov, 2014; Rogers, Lemmen, Kramer, Mann, & Chopra, 2017). Internet-based interventions also have been demonstrated to yield promising results treating a variety of addictive disorders; most notably, substance use disorders (Boumparis, Karyotaki, Schaub, Cuijpers, & Riper, 2017; Boumparis et al., 2019; Gainsbury and Blaszczynski, 2011). In addition, promising findings have been documented in the literature assessing internet-based interventions for gambling disorders. For example, in a systematic review by Rodda (2021), in which 15 studies were evaluated – eight randomized controlled trials (RCTs) and seven non-randomized trials – positive results were apparent in certain interventions' effectiveness at reducing adverse gambling-related outcomes. Another recent meta-analysis for internet-based

interventions targeting problem gambling (Sagoe et al., 2021) found that these interventions reduce gambling-related symptoms with medium to large effect sizes. Interestingly, less research has been published on other behavioral addictions, like internet use disorder, gaming disorder, pornography use disorder, social networks use disorder, and hoarding disorder. In their review, Zajac et al. (2017) investigated internet use disorder and gaming disorder, but only a minority of the studies they identified assessed internet-based interventions, indicating insufficient research in this field.

During the COVID-19 pandemic, many individuals have been subjected to measures instigated to halt viral spread. Such measures have included physical distancing, reorganizing healthcare systems, and lockdown regulations. Consequences of those measures – such as physical inactivity and the loss of daily routines – have disrupted ordinary activities in many individuals, potentially promoting excessive and addictive behaviors (Awan et al., 2021; Håkansson, Fernández-Aranda, Menchón, Potenza, & Jiménez-Murcia, 2020; King, Delfabbro, Billieux, & Potenza, 2020; Király et al., 2020; Zattoni et al., 2020). These measures have also impacted the treatment of individuals with behavioral addictions by reducing their access to in-person care. On the other hand, they also have boosted the adoption of internet-based interventions for healthcare delivery over the past several years (Wong et al., 2022). For all these reasons, we decided to systematically assess the broader literature on internet-based interventions targeting behavioral addictions and both describe and rate the available evidence.

METHODS

Our systematic search was conducted in February 2022. Four electronic databases – PubMed, PsycINFO, Embase, and the Cochrane Central Register of Controlled Trials – were searched using various combinations of key and index terms covering the concepts of behavioral addictions and internet-based interventions. We conducted additional searches by checking all references listed in retained studies (Gainsbury & Blaszczynski, 2011; Rodda, 2021; Sagoe et al., 2021; Zajac et al., 2017). Our initial study selection was based on titles and abstracts. Subsequently, full texts of studies potentially meeting inclusion criteria were retrieved and evaluated. The PubMed search string is detailed in Appendix A.

Eligibility criteria

Studies were considered eligible if they met the following criteria: (a) they targeted gambling disorder, gaming disorder, social networks use disorder, pornography use disorder, Internet use disorder, or hoarding disorder; (b) they investigated the effectiveness of one or more interventions delivered via the Internet, or via text messaging, mobile phone/telephone, mobile application, or email; and (c) they generated quantitative data on the intervention's

effectiveness. We excluded studies that only focused on prevention, as well as studies with no control condition (active or non-active).

Study selection

To select which studies to include in our final assessment, the review management program *Covidence* (Kellermeyer, Harnke, & Knight, 2018) was used, through which multiple researchers can read studies simultaneously and vote on whether a study should be included or excluded. Given the large number of studies that required initial review, one author (SA) initially screened titles and abstracts. Subsequently, two authors (SA & SH) independently screened papers' full texts and verified if they met our inclusion criteria. Any disagreements regarding the inclusion or exclusion of specific studies were resolved by a third author (MS).

Data synthesis

The following data were extracted and presented in tabular format for further analysis and comparison: general information (author, year, country, study type, type of behavioral addiction, diagnostic criteria); study population (number of participants, recruitment strategy, group allocation, mean age, gender); intervention characteristics (mode of delivery, duration, theoretical background); outcome measures; results relating to effectiveness. Data extraction and quality assessment were conducted by one author (SA); however,

both the extraction and quality assessments were verified by a second (SH).

Assessment of study quality

To assess the methodological quality of studies included in our final review, the *Effective Public Health Practice Project Quality Assessment Tool* (EPHPP) (Effective Public Health Practice Project, 1998) was used. The EPHPP allowed us to rate each study's overall quality on the six following components: selection bias, study design, confounders, blinding, data collection, and withdrawals and dropouts. Overall methodological quality ultimately was rated on a scale of one to three, one being strong, two moderate, and three weak. The scoring was performed according to the EPHPP manual that suggests rating a study as strong if no component is rated as weak, moderate if one component is rated as weak, and weak if at least two components are rated as weak.

RESULTS

The systematic search on PubMed, PsycINFO, Embase, and the Cochrane Central Register of Controlled Trials yielded a total of 7,808 abstracts (5,163 after duplicate removal). We retrieved 101 full-text papers for possible inclusion in our systematic review, 72 of which were excluded because they failed to meet our inclusion criteria. Ultimately, 29 studies met all criteria for our systematic review. The study selection process is depicted as a flowchart in Fig. 1.

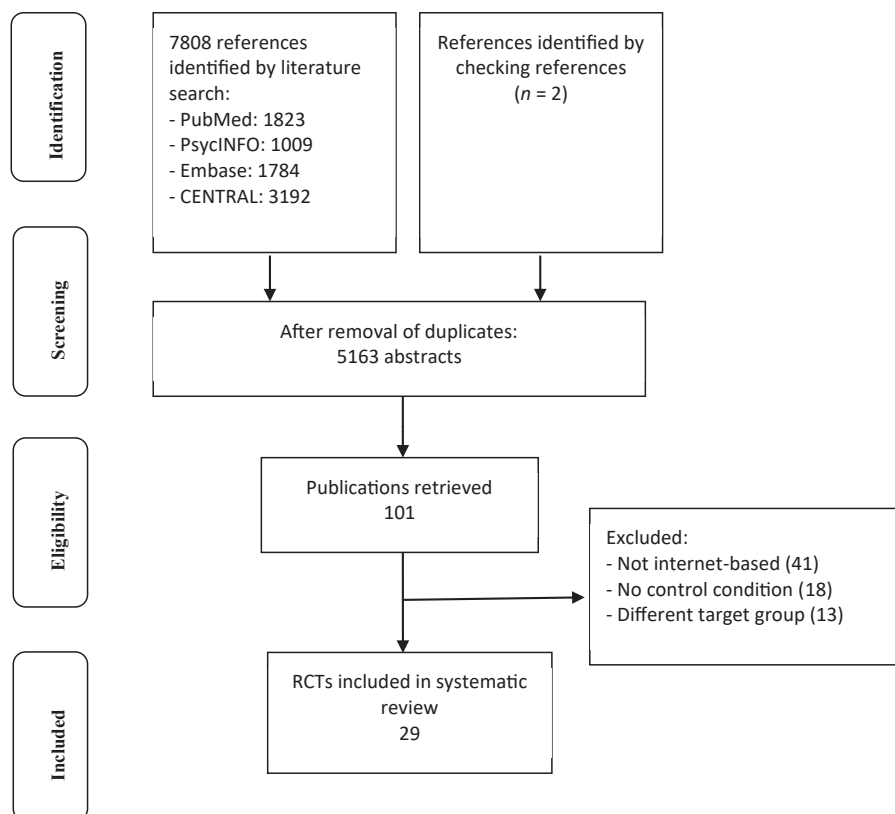


Fig. 1. Flowchart depicting the study selection process

Study characteristics

Table 1 and Appendix B summarize the characteristics of the 29 studies we assessed. All but one was an RCT, the one exception having a quasi-experimental design. Sample sizes ranged from 12 to 1122. Across the 29 studies, the percentage of males ranged from 10% to 100% and the age of participants ranged from 20 to 55 years. The largest number of studies were conducted in Canada ($n = 7$), followed by Australia ($n = 5$), the United States ($n = 4$), Germany ($n = 4$), France ($n = 3$), Sweden ($n = 2$), and China ($n = 2$). Single studies were conducted in Japan, the Republic of Korea, and Israel. A clear majority of studies targeted gambling disorder ($n = 22$). Other behavioral addictions targeted included gaming disorder ($n = 3$), hoarding disorder ($n = 2$), internet use disorder ($n = 1$) and pornography use disorder ($n = 1$).

For gambling disorder, 10 of the 22 studies used the Problem Gambling Severity Index (PGSI) (Currie, Hodgins, & Casey, 2013) to determine participant eligibility, while self-reported gambling problems was used as an inclusion criterion by four studies. Two of the studies included individuals with self-reported gambling problems and emotional distress. One study used as its inclusion criterion a cutoff score of one or more on the South Oaks Gambling Screen (SOGS) (Stinchfield, 2002), while another study used a cutoff score of two or more on the same scale. Criteria from the DSM-IV were used by one study, while one study used DSM-IV criteria in combination with a cutoff score of below 21 on the Montgomery-Asberg Depression Rating Scale (MADRS) (Svanborg & Åsberg, 1994), and another used DSM-IV criteria in combination with a cutoff score of five or more on the PGSI. The final study used the criterion of at least weekly gambling over the past six months.

For gaming disorder, one study used a cutoff score of 32 or more on the internet gaming disorder (IGD) scale (Petry et al., 2014). Another used the following criteria: playing internet games at least 30 h per week, disruption of regular life due to excessive gaming, maladaptive behaviors or distress at school or work due to excessive gaming, and a cutoff score of 50 or more on Young's Diagnostic Questionnaire (YDQ) (Young, 1998). The third study employed the criterion of playing massively-multiplayer online role-playing games more than 10 h per week for at least one year.

Regarding Internet use disorder, the only identified study used a cutoff score of five or more on the YDQ or, alternatively, between three and four on the same scale with the additional criterion of being online for more than 14 h per week. For pornography use disorder, the only identified study used the criterion self-reported problematic pornography use. For hoarding disorder, one study recruited individuals with a self-reported hoarding problem, while a second study used, as its lone criterion, having been previously involved in face-to-face treatment for a hoarding problem. Attrition rate varied widely across the 29 studies, ranging from 9% to 89%.

Study quality. Using the EPHPP tool, three of the 29 studies were rated methodologically strong, 12 moderate, and 14

weak. A detailed description of our reasoning for rating the quality of studies is provided in Appendix C.

Intervention characteristics. In the next several sections, we describe the interventions conducted for each type of behavioral addiction. The studies below are either focusing on populations diagnosed through DSM criteria, or individuals with less severe self-reported symptoms; however, for the sake of clarity, we grouped the studies according to the respective clinical disorder.

Each section describes studies conducted on individuals with clinical conditions diagnosed through DSM criteria, or individuals with less severe and/or self-reported symptoms. Each study is summarized in Table 1 and Appendix B.

Gambling disorder. Of the 22 studies on gambling disorder, the most common intervention provided was internet-based cognitive behavior therapy CBT ($n = 7$), followed by self-help interventions with varying gambling-related problem content ($n = 6$), personalized normative feedback (PNF) ($n = 4$), and cognitive bias modification ($n = 2$). The following interventions were assessed in a single study: a self-exclusion intervention; an internet-based behavioral couples intervention; chatbot delivered cognitive behavioral therapy (CBT); an analytical training task on common gambling-related judgement errors; pop-up messages of an informative or self-appraising nature; and an online workshop with interactive activities. Note that some studies assessed more than one of these interventions.

In twelve of the 22 studies the experimental condition was compared with an active control condition while 10 were compared against a non-active control condition. Seven of these 22 studies involved guided interactions between a therapist and participants, which occurred variably through emails, text messages, chat functions, or telephone contact. The aims of these contacts included providing feedback, support, and encouragement; and answering participants' questions. The duration of the interventions varied from a single session that was delivered in one day to interventions with multiple sessions over up to six months. Recurring themes or topics amongst those interventions for gambling included information on and the prevalence of problematic gambling; goal setting; monitoring behavior; identifying and responding to high-risk situations; personalized feedback; motivation to change; identifying urges or triggers and how to combat them; how to manage debt; relapse prevention; and relationships. In terms of effectiveness, most interventions yielded positive within-group effects. Only for studies identified significant differences between the groups in gambling-related outcomes (Bücker, Bierbrodt, Hand, Wittekind, & Moritz, 2018; Carlbring & Smit, 2008; Casey et al., 2017; Jonas et al., 2020). However, given that most studies assessed the feasibility and not the effectiveness of the interventions, employed active control conditions, and several studies ($n = 8$) were conducted with no power analysis performed beforehand, this finding was not surprising.



Table 1. Study and Intervention characteristics

Study, Country, Design	Recruitment	Sample	Control	Diagnostic criteria	Psychological mechanisms, guidance, duration
<i>Gambling disorder</i> Armstrong, Rockloff, Browne and Blaszczyński (2020) USA, RCT	Mechanical Turk	Target population: Problem gamblers Sample size: 94 Intervention group: Online analytical training task on common gambling-related judgement errors Mean age: 36.6 Gender ratio: 48% males	Sham control	At least weekly gambling in the past 6 months	Online analytical training task designed to educate participants on common judgement errors specific to gambling. Participants were provided performance-based feedback informing them of whether they were correct, while providing an explanation of the reason underlying the correct response. Guidance: not provided. Duration: 1 Day
Bücker et al. (2018) Germany, RCT	Online advertisements	Target population: Problem slot machine gamblers with emotional distress Sample size: 140 Intervention group: internet-based CBT Mean age: 35.71 Gender ratio: 76.4% males	WLC	Self-reported problem gambling with slot machines, and self-reported feelings of emotional distress	Internet-based CBT including behavioral activation, cognitive modification, interpersonal and problem-solving skills, and relaxation methods, complemented by acceptance and mindfulness techniques and positive psychology. Guidance: not provided. Duration: 8 weeks
Bücker et al. (2021) Germany, RCT	Online advertisements	Target population: Problem gamblers with emotional distress Sample size: 150 Intervention group: internet-based self-help intervention Mean age: 35.03 Gender ratio: 67.3% male	WLC	Self-reported gambling problems and emotional distress	Internet-based gambling intervention targeting self-esteem, sleep hygiene, problem solving strategies, mindfulness-based relaxation and attention exercises as well as gambling-specific topics such as money/debt management and impulse control. Guidance: not provided Duration: 8 weeks
Caillon et al. (2019) France, RCT	Newspapers, radio, and websites	Target population: Problem gamblers and low risk gamblers Sample size: 60 Intervention group: Self-exclusion Mean age: 35.2 Gender ratio: 73.3% male	AO	Scoring 3–7 on the PGSI, gambling at least once during the past month	In the experimental condition, the gamblers were asked to implement the self-exclusion procedure on their favourite websites. Guidance: not provided Duration: 15 days
Caillon et al. (2021) France, RCT	Newspapers, radio, and websites	Target population: Problem gamblers and low risk gamblers Sample size: 58 Intervention group: 1. Informative pop-up messages 2. self-appraisal pop-up messages Mean age: 37 Gender ratio: 78%	Blank pop-up messages	Scoring 3–7 on the PGSI, gambling at least once during the past month	1. The informative messages were informing participants of the risks of gambling, including potential negative consequences associated with gambling and corrected cognitive distortions. 2. The self-appraisal messages were designed to encourage participants to take a step back and examine their own current gambling behavior. Guidance: Via chat function with a therapist Duration: 3 Months

(continued)

Table 1. Continued

Study, Country, Design	Recruitment	Sample	Control	Diagnostic criteria	Psychological mechanisms, guidance, duration
Carlbring and Smit (2008) Sweden, RCT	Media announcements	Target population: Problem gamblers Sample size: 55 Intervention group: Internet-based CBT Mean age: 31.9 Gender ratio: 94% males	WLC	DSM-IV, MADRS score of <21	Participants were encouraged to ask for input from their relatives on gambling aspects. Modules included information and exercises and ended with essay-style questions. Participants were asked to provide their worksheets, and report on outcomes of different exercises. For each module, they were required to post at least one message in an online discussion group about a predetermined topic. Guidance: minimal therapist contact via e-mail and weekly telephone calls. Duration: 8 weeks
Casey et al. (2017) Australia, RCT	Internet, newspaper, radio advertisements	Target population: Problem gamblers Sample size: 174 Intervention group: 1. Internet-based CBT 2. Monitoring support Mean age: 44.6 Gender ratio: 41.2% males	WLC	DSM-IV	Internet-based CBT incorporating exercises on increasing awareness about the problem, managing debt, relaxation strategies, problem solving, and goal setting. Guidance: not provided Duration: 6 weeks
Cunningham et al. (2012) Canada, RCT	Random digit dialing telephone survey	Target population: Problem gamblers Sample size: 209 Intervention group: PNF Mean age: 46.6 Gender ratio: 52.6% males	WLC	PGSI score > 3	Participants are provided with a summary of the number of different types of gambling they engage in, along with a comparison of how this total number compares to other Canadians. This summary is provided descriptively in addition to a graphical figure demonstrating how their behavior fits in comparison with other Canadians. Guidance: not provided. Duration: 1 day
Cunningham et al. (2019a) Canada, RCT	online website	Target population: Problem gamblers Sample size: 321 Intervention group: Internet-based self-help intervention Mean age: 36.5 Gender ratio: 44.9% males	AO	DSM-IV PGSI \geq 5	Internet-based self-help intervention (self-assessment, setting, reaching, and maintaining goals) for problem gamblers. Guidance: not provided. Duration: 6 weeks
Cunningham et al. (2019b) Canada, RCT	Online advertisements, newspapers, bus advertisements, radio	Target population: Problem gamblers Sample size: 283 Intervention group: Internet-based intervention for gambling problems + CBT for depression Mean age: 40.4 Gender ratio: 42.9% males	Internet-based CBT-only	PGSI \geq 3	Internet-based self-help intervention (self-assessment, setting, reaching, and maintaining goals) for problem gamblers. In addition, the experimental condition was provided with CBT modules targeting mental health distress targeting depression and anxiety. Guidance: not provided. Duration: N/A

(continued)





Table 1. Continued

Study, Country, Design	Recruitment	Sample	Control	Diagnostic criteria	Psychological mechanisms, guidance, duration
Cunningham et al. (2020) Canada, RCT	Online advertisements	Target population: Problem gamblers Sample size: 282 Intervention group: Internet-based intervention with a personalized drinking assessment Mean age: 38.9 Gender ratio: 49.9% males	Online intervention for gambling problems-only	PGSI \geq 3	Internet-based self-help intervention (self-assessment, setting, reaching, and maintaining goals) for problem gamblers. In addition, the experimental condition was provided with a brief personalized drinking assessment. Guidance: not provided. Duration: 6 months
Dowling et al. (2021) Australia, RCT	Online advertisements	Target population: Problem gamblers Sample size: 206 Intervention group: Internet-based CBT Mean age: N/A Gender ratio: 64.6% males	Unguided internet-based CBT	Self-reported gambling problem	Internet-based CBT that comprises MI, behavioral, cognitive, and relapse prevention modules. Guidance: provided via email by practitioners from existing gambling treatment services Duration: 8 weeks
Hodgins et al. (2019) Canada, RCT	Print and online media announcements	Target population: Problem gamblers Sample size: 187 Intervention group: PNF Mean age: 46.8 Gender ratio: 53.0% males	Online self-assessment activities and strategies to reduce gambling	PGSI \geq 3	PNF including self-assessment, setting, reaching, and maintaining goals) for problem gamblers. Guidance: not provided. Duration: N/A
Jonas et al. (2020) Germany, RCT	N/A	Target population: Problem gamblers Sample size: 167 Intervention group: 1. Internet-based gambling intervention with interactive modules and chat function 2. email counselling about problem gambling Mean age: 33.5 Gender ratio: 71.9% males	WLC	Self-reported gambling problem	1. Internet-based intervention (assessment, establishing coping strategies, diary entries and interactive exercises, setting and maintaining goals) based on self-regulation self-control, the solution-focused approach, and MI. 2. Therapist email-counselling for problem gambling based on solution-focused approach and MI but without interactive exercises. Guidance: Via chat function with therapist Duration: 3 Months
Luquiens et al. (2016) France, RCT	Poker gambling service provider	Target population: Non-treatment seeking problem gamblers Sample size: 1122 Intervention group: (1) PNF (2) CBT self-help book with guidance, (3) weekly email CBT without guidance Mean age: 34.7 Gender ratio: 92.1% males	WLC	PGSI \geq 5	1. PNF gambling module based on PGSI score 2. CBT self-help book emailed weekly by trained psychologist 3. CBT self-help book without guidance Guidance: with trained psychologist (group 3) Duration: 12 weeks

(continued)

Table 1. Continued

Study, Country, Design	Recruitment	Sample	Control	Diagnostic criteria	Psychological mechanisms, guidance, duration
Neighbors et al. (2015) USA, RCT	University	Target population: College student problem gamblers Sample size: 252 Intervention group: PNF Mean age: 23.1 Gender ratio: 59.5% males	Attention Control	SOGS ≥ 2	PNF including participants' gambling-related behaviors; (b) participants' perceptions of other same-sex students' gambling-related behaviors; (c) actual norms of other same-sex students' gambling-related behaviors (d) a percentile ranking of participants' gambling-related behavior. Guidance: not provided Duration: 1 day
Nilsson et al. (2018) Sweden, RCT	Online advertisements and health care professionals	Target population: Problem gamblers Sample size: 18 Intervention group: Internet-based behavioral couples intervention Mean age: 39 Gender ratio: 50% males	Internet-based individual CBT intervention	PGSI ≥ 5	Internet-based treatment for problem gamblers and concerned significant others including modules about functional analysis, behavioral activation and gambling-specific components such as strategies for handling gambling cognitions. Guidance: Each module was concluded with telephone and email support from an assigned therapist. Duration: 10 weeks
Rodda et al. (2018) Australia, RCT	Online advertisements	Target population: Problem gamblers Sample size: 198 Intervention group: E-mental health portal and behavioral change techniques via text-messages Mean age: 39.3 Gender ratio: 60.1% males	E-mental health portal-only	Self-reported gambling problem	Text message program (tips on how to stop gambling, self-reflection, and feedback). Guidance: preprogrammed text messages with a "call-back" option for further help Duration: 12 weeks
Rosen et al. (2020) USA, RCT	Probation and pretrial services, flyers, online advertisements	Target population: Problem gamblers receiving probation, parole, or supervised release services Sample size: 102 Intervention group: Self-help interventions + referral to treatment Mean age: 32.5 Gender ratio: 87.4% males	Referral to treatment	PGSI ≥ 3	Self-help interventions (feedback, information on risk factors, strategies on how to limit gambling) Guidance: not provided. Duration: 1 day
So et al. (2020) Japan, RCT	Online advertisements	Target population: Problem gamblers Sample size: 197 Intervention group: Chatbot-CBT Mean age: 36.5 Gender ratio: 79.1% males	AO	PGSI ≥ 3	Chatbot-CBT incorporating monitoring, personalized feedback, triggers, coping urges, cognitive distortions. Guidance: not provided. Duration: 1 month
Wittekind et al. (2019) Germany, RCT	Online advertisements	Target population: Problem slot machine gamblers Sample size: 131	Sham control	SOGS ≥ 1	Cognitive bias modification in which slot-machine related and neutral pictures were presented. In the experimental condition all slot-

(continued)





Table 1. Continued

Study, Country, Design	Recruitment	Sample	Control	Diagnostic criteria	Psychological mechanisms, guidance, duration
		Intervention group: Cognitive bias modification Mean age: 35.3 Gender ratio: 74.8% males			machine related pictures had to be pushed and all neutral pictures had to be pulled. If the mouse was moved in the right direction, the picture disappeared. If the mouse was moved in the wrong direction, an error message appeared. Guidance: not provided. Duration: 1 day
Yakovenko and Hodgins (2021) Canada, RCT	Contacted via telephone after registration to the service	Target population: Problem gamblers Sample size: 143 Intervention group: Online workshop with interactive activities Mean age: 42 Gender ratio: 59% males	face-to-face workshop	Self-reported gambling problem	Self-management program, consisting of an online workshop on gambling behavior, consequences, self-exclusion, goals, and self-management tool on gambling urges, debt, and seeking social support. Guidance: monthly automated emails Duration: N/A
He et al. (2021) China, RCT	Players of a multiplayer online game	Target population: Individuals with gaming disorder Sample size: 48 Intervention group: Approach bias modification Mean age: 20.04 Gender ratio: 18.7% males	Sham control	IGD \geq 32	Bias modification treatment in which participants pressed the button to move away from gaming-related cues and approached neutral cues. If participants responded incorrectly, they received feedback, and needed to make a correct response before proceeding to the next trial. Guidance: not provided Duration: 4 days
Park, 2016 Republic of Korea, RCT	Advertisements posted at University Medical Center	Target population: Individuals with gaming disorder Sample size: 24 Intervention group: Virtual reality therapy Mean age: 23.9 Gender ratio: 100% males	FTF CBT	YIAS \geq 50, >30 h per week of gaming, disruption of regular life and distress due to excessive gaming	The intervention consisted of relaxation, simulation of a high-risk situation, and sound-assisted cognitive restructuring. Guidance: provided via a psychiatrist. Duration: 4 weeks
Rabinovitz and Nagar (2015) Israel RCT	Online gaming groups and forums	Target population: Individuals with gaming disorder Sample size: 38 Intervention group: Cognitive bias modification avoidance training Mean age: 22.8 Gender ratio: 100% males	Cognitive bias modification approach training	Massively multiplayer online role-playing games for >10 h a week for at least 1 year	Implicit training to avoid or to approach gaming cues by pushing or pulling a joystick Guidance: not provided. Duration: 1 day

(continued)

Table 1. Continued

Study, Country, Design	Recruitment	Sample	Control	Diagnostic criteria	Psychological mechanisms, guidance, duration
<i>Internet use disorder</i> Su et al. (2011) China, RCT	University campus	Target population: Internet addicted university students Sample size: 65 Intervention group: (1) computerized MI with interactive feedback in a laboratory environment, (2) Internet-based MI with interactive feedback, (3) computerized MI without interactive feedback in a laboratory environment Mean age: N/A Gender ratio: 31% males	WLC	YDQ \geq 5 or YDQ of 3–4 and being online for more than 14 h per week	Internet-based MI intervention for the treatment of online addiction for college students. Modules included: introduction and instructions, feedback and data on behavior, setting goals, and strategies for change. Guidance: not provided. Duration: 1 day
<i>Pornography use disorder</i> Böthe, 2021 Canada, RCT	Online advertisements	Target population: Problematic pornography users Sample size: 264 Intervention group: Internet-based CBT + MI Mean age: 33.2 Gender ratio: 96.2% males	WLC	Self-reported problematic pornography use	Internet-based CBT + MI with modules targeting identification of risk situations, behavioral activation, the identification of triggers, and challenging automatic negative thoughts Guidance: not provided. Duration: 6 weeks
<i>Hoarding disorder</i> Fitzpatrick, 2018 Australia, RCT	Self-referral, referral from mental health professionals, primary care physicians, and housing authorities	Target population: Adults with a hoarding problem Sample size: 12 Intervention group: Blended CBT intervention + TAU Mean age: 55.20 Gender ratio: 10% males	TAU + WLC	Participants previously in FTF treatment for hoarding problems	Blended CBT including content about relapse prevention, MI, relaxation, and examining barriers about de-cluttering access to educational resources on hoarding, Guidance: weekly email correspondence with therapist, Duration: 8 weeks
Muroff et al. (2010) USA, Quasi-experimental	Online self-help support group for hoarding	Target population: Adult users of an online self-help support group for hoarding Sample size: 261 Intervention group: Internet-based CBT Mean age: 51.3 Gender ratio: N/A	WLC	Self-identified as having a hoarding problem	Internet-based CBT offering exposure, cognitive restructuring, thought records, cognitive strategies, and a chat-group. Guidance: chat Duration: N/A

AO, assessment only; CBT, cognitive behavioral therapy; FTF, face-to-face; IGD, Internet gaming disorder; MADRS, Montgomery–Åsberg Depression Rating Scale; MI, motivational interviewing; N/A, not available; PGSI, problem Gambling Severity Index; PNF, personalized normative feedback; RCT, randomized controlled trial; SOGS, the South Oaks Gambling Screen; WLC, waitlist control; YDQ, Young Diagnostic Questionnaire; YIAS, Young's Internet Addiction Scale.



Gaming disorder. For gaming disorder, we identified two interventions that focused on cognitive bias modification and one that utilized virtual reality. One of these interventions offered guidance in the form of interactions between a therapist and participants. The cognitive bias modification interventions (He, Pan, Nie, Zheng, & Chen, 2021; Rabinovitz & Nagar, 2015) involved learning to avoid gaming-related cues and how to approach neutral non-gaming-related cues. The virtual reality intervention (Park et al., 2016) consisted of relaxation, simulation of high-risk situations, and sound-assisted cognitive restructuring. In terms of effectiveness, both cognitive bias modification interventions significantly reduced gaming-related outcomes relative to levels observed in controls, while the virtual reality intervention failed to demonstrate any significant benefit. Only for the study by Rabinovitz and Nagar (2015) was a prior power analysis conducted.

Internet use disorder. Su, Fang, Miller, and Wang (2011) investigated three versions of motivational interviewing (MI) applied to problematic internet use. Participants were randomized to (a) a computerized MI intervention providing interactive feedback that was conducted in a laboratory environment (under the supervision of a researcher), (b) an internet-based MI intervention providing interactive feedback that could be conducted independently from anywhere, (c) a computerized MI intervention without interactive feedback that was conducted in a laboratory environment, or (d) a waitlist control condition (WLC). In terms of effectiveness, the study failed to identify any significant difference in outcomes between the four assessed groups, though no prior power analysis had been performed.

Pornography use disorder. For pornography use disorder, Bóthe, Baumgartner, Schaub, Demetrovics, and Orosz (2021) assessed one internet-based intervention, which consisted of CBT in combination with MI. The intervention provided participants with modules targeting the identification of risk situations, behavioral activation, identification of triggers, and challenging automatic negative thoughts. At six-week follow-up, relative to WLC, the intervention group reported lower levels of problematic porn use, reduced pornography use frequency, lower self-perceived pornography addiction, reduced pornography craving, and higher pornography avoidance self-efficacy. For this study, an *a-priori* power analysis had been conducted.

Hoarding disorder. Two studies assessing interventions targeting hoarding disorder were identified. One of these studies, conducted by Fitzpatrick, Nedeljkovic, Abbott, Kyrios, and Moulding (2018), evaluated the effectiveness of a blended internet-based CBT with treatment as usual (TAU), while the other examined the effectiveness of a CBT-based online self-help support group. Blended interventions incorporate components of both face-to-face and Internet-based interventions in a sequential manner. The particular blended CBT intervention included content about relapse prevention, MI, relaxation, and examining barriers about de-

cluttering, as well as access to educational resources on hoarding, while the intervention offered by Muroff, Steketee, Himle, and Frost (2010) provided exposure, cognitive restructuring, thought records, cognitive strategies, and a chat-group. Both interventions involved guidance in the form of interactions between a therapist and participants. While Fitzpatrick et al. (2018) failed to document any significant outcome differences between their intervention and control groups, Muroff et al. (2010) reported significant improvements, over six months, in hoarding symptoms and clutter severity and clinically-significant global improvement in hoarding symptoms compared to the WLC. Neither study had conducted an *a-priori* power analysis.

DISCUSSION

The goal of the current systematic review was to provide an overview of internet-based interventions targeting behavioral addictions and assess their effectiveness at reducing behavior-related outcomes. Twenty-nine studies were identified that met our selection criteria, including 22 for gambling disorder, three for gaming disorder, two for hoarding disorder, and one each for Internet use disorder and pornography use disorder. Given that 22 versus just seven spanning four other forms of behavioral addiction, it is clear that all types of behavioral addiction besides gambling disorder were much less represented, which demonstrates not only the current dearth of evidence, but the relative sparsity of internet-based interventions for these conditions.

Our systematic review revealed promising results for internet-based interventions targeting gambling disorders, significantly reducing gambling-related symptoms in most studies. These findings are consistent with the literature on the effectiveness of face-to-face interventions targeting gambling disorder (Quilty et al., 2019) and a recent meta-analysis based on 11 RCTs that found internet-based interventions to exert medium effect sizes for reducing gambling symptoms (Sagoe et al., 2021).

Unfortunately, due to the scarcity of studies, we were unable to provide enough evidence supporting the effectiveness of internet-based interventions targeting other types of behavioral addiction. However, the few studies we found generated promising effects that are consistent with the findings of face-to-face interventions (Goslar et al., 2020), hinting towards a potentially-promising future direction for behavioral addiction researchers.

The current study has several limitations, the most obvious being the heterogeneity of studies. The outcome measures, screening tools, inclusion criteria, and primary outcomes varied greatly, which further increased the studies' heterogeneity and our ability to draw conclusions. Therefore, greater standardization, especially for screening criteria, is needed to improve the consistency of reporting and quality of future studies assessing these and similar interventions for behavioral addictions. We also suggest more research directed towards the creation of an essential



outcome measure set recommending the use of specific outcome measures to assess essential outcome domains for the reporting of efficacy and effectiveness trials involving interventions for gambling problems.

Attrition varied widely between the 29 studies, which also impairs the integrity of findings. Even though high attrition rates have also been observed in studies of face-to-face interventions targeting gambling problems (Roberts, Murphy, Turner, & Sharman, 2020), more research examining potential moderators affecting attrition and treatment outcomes should be conducted. For the interventions we identified, guidance was provided in a variety of ways, including human contact via telephone, emails, text messages, face-to-face interactions, automated emails, and text messages. Even though guidance has been linked to promising results when combined with internet-based interventions (Baumeister, Reichler, Munzinger, & Lin, 2014; Karyotaki et al., 2021), the different guidance options that have been used may have considerably different effects. Therefore, more research also is needed to assess the type of guidance offered and its differential effect on attrition and treatment outcomes.

Finally, the quality of 26 of the studies we assessed was either weak (14 studies) or moderate (12 studies), which again limits our overall confidence in the findings. More high-quality research, preferably RCTs, must be conducted to improve confidence in the effectiveness of internet-based interventions for the treatment of behavioral addictions.

CONCLUSIONS

The development and evaluation of internet-based interventions targeting behavioral addictions is a growing research field. There appear to be more interventions targeting gambling disorders than for any other behavioral addiction. Some studies currently reported in the literature suggest the potential for internet-based interventions to be effective reducing gambling-related problems. Internet-based interventions targeting other types of behavioral addictions – like gaming disorder, internet use disorder, hoarding disorder, and pornography use disorder – remain under-examined and in desperate need of considerably more research to assess their effectiveness.

Funding sources: No financial support was received for this study.

Authors' contribution: MPS and SH designed the study. SA managed the literature searches and data extraction. SA and NB wrote the manuscript. JB and HR contributed to the interpretation of the results. The drafts of the manuscript were revised by all authors. All authors contributed to and have approved the final manuscript. All authors had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Conflict of interest: The authors declare no conflict of interest. JB is an Associate Editor of the Journal of Behavioral Addictions.

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Appendix A

PubMed search string

gamb*[All Fields] OR betting[All Fields] OR video games [All Fields] OR social network[All Fields] OR gaming[All Fields] OR gamers[All Fields] OR pornography[All Fields] OR shopping[All Fields] OR buying[All Fields] OR gaming addiction[All Fields] OR Internet Addiction Disorder[All Fields] OR online gambling[All Fields] OR cybersex addiction[All Fields] OR online sex addiction[All Fields] OR Internet sex addiction[All Fields] OR Facebook addiction[All Fields] OR social network addiction[All Fields] OR compulsive Internet use[All Fields] OR excessive Internet use [All Fields] OR problem Internet use[All Fields] OR pathological Internet use[All Fields] OR social media[All Fields] OR hoarding[All Fields] OR Hoarding Disorder[All Fields] OR Technology Addiction[All Fields] OR Screen Time[All Fields] OR “Smartphone Addiction”[All Fields] OR

“gambling”[Mesh] OR “video games”[Mesh] OR “pornography”[Mesh] OR “Internet Addiction Disorder”[Mesh] OR “social media”[Mesh] OR “hoarding”[Mesh] OR “Hoarding Disorder”[Mesh] OR “Technology Addiction”[Mesh] OR “Behavior, Addictive”[Mesh] OR “Screen Time”[Mesh]

AND

“Internet”[Mesh] OR “internet”[All Fields] OR “online”[All Fields] OR “web”[All Fields] OR “e-health”[All Fields] OR “Mobile Applications”[Mesh] OR “mobile phone”[All Fields] OR “smartphone”[All Fields] OR “mobile device”[All Fields] OR “Computers”[Mesh] OR “computer”[All Fields] OR “app”[All Fields] OR “Therapy, Computer-Assisted”[Mesh] OR “computer-assisted”[All Fields] OR “telemedicine”[All Fields] OR “Telemedicine”[Mesh] OR text messag*[All Fields] OR sms[All Fields] OR “digital”[All Fields] OR “tablet”[All Fields] OR “blended”[All Fields] OR “guided”[All Fields]



Appendix B. Summary of results

Author, year	Relevant outcome measures	Effectiveness	Attrition and statistical power
<i>Gambling disorder</i> Armstrong et al. (2020)	Gambling beliefs, gambling intensity (minutes per week gambling, minutes gambling in a typical session, dollars spent per week gambling/in a typical session)	There was no significant difference between the two groups for the assessed outcome measures.	Power: not conducted Attrition: N/A
Bücker et al. (2018)	SOGS, PG-YBOCS, PHQ-9	The intervention led to a significant reduction in depressive symptoms as well as gambling-related symptoms compared to the control group, with moderate to strong effect sizes.	Power: conducted Attrition: 55.7%
Bücker, Gehlenborg, Moritz, and Westermann (2021)	PG-YBOCS, GABS, SOGS	Results of the complete cases, per protocol, intention-to-treat, and frequent user analyses showed significant improvements in both but no significant between-group differences.	Power: conducted Attrition: 56.7%
Caillon et al. (2019)	GRCS, PGSI, GACS	There was no significant difference between the two groups for the assessed outcome measures.	Power: not conducted Attrition: N/A
Caillon et al. (2021)	PGSI, GRCS, GACS	There was no significant difference between the two groups for the assessed outcome measures.	Power: conducted. Attrition: N/A
Carlbring and Smit (2008)	NODS	Gambling-related problems were significantly reduced in the intervention group. Treatment effects for the primary outcome in the experimental group, was sustained through to the 36-month follow-up.	Power: not conducted Attrition: 10.1%
Casey et al. (2017)	GSAS, SOGS, GSREQ, GRCS	Compared to the WLC, participants who completed I-CBT showed significant reductions in gambling amount, frequency, severity, urge, gambling related cognitions than those in the WLC. In addition, they were more likely to report improvements in gambling refusal. These changes were maintained across the 3-, 6- and 12-month follow-ups. Compared to the active control condition, CBT showed significantly greater reductions in gambling related cognitions, stress, and gambling urges.	Power: not conducted Attrition: 47.70
Cunningham, Hodgins, Toneatto, and Murphy (2012)	amount of money spent on gambling in the past 30 days, number of days in which gambled out of the past 30, and the most money spent on gambling in one day	The intervention and control groups did not significantly differ regarding any outcome variables.	Power: conducted Attrition: N/A

(continued)



Continued

Author, year	Relevant outcome measures	Effectiveness	Attrition and statistical power
Cunningham et al. (2019a)	NODS, number of days gambled in the last 30 days, G-SAS	The intervention and control groups did not significantly differ regarding any outcome variables.	Power: conducted Attrition: 13.4%
Cunningham et al. (2019b)	NODS, number of days gambled in the past 30 days	The intervention and control groups did not significantly differ regarding any outcome variables.	Power: conducted Attrition: 53.8%
Cunningham et al. (2020)	NODS, number of days gambled in the last 30 days, AUDIT	The intervention and control groups did not significantly differ regarding any outcome variables.	Power: conducted Attrition: 84.0%
Dowling et al. (2021)	G-SAS, number of days gambled, and amount lost on gambling activities	Participants in both conditions reported significant improvements in gambling symptom severity, urges, frequency, expenditure across the 24-month evaluation period. However, no significant differences were found between the two conditions.	Power: conducted Attrition: 77.7%
Hodgins, Cunningham, Murray, and Hagopian (2019)	Mean days spent gambling per month, NODS, mean dollars spent per gambling day, total dollars lost, and self-rated improvement	The intervention and control groups did not significantly differ regarding any outcome variables.	Power: not conducted Attrition: N/A
Jonas et al. (2020)	PGSI, number of days gambled in the past 30 days, highest stake	At the three-month follow-up, participants in the intervention group showed significant changes with small to large effect sizes in all outcomes when compared to the WLC. Email-counselling users had beneficiary results in the severity of problem gambling only. There were no major differences in effectiveness between the two conditions.	Power: conducted Attrition: 53.7%
Luquiens et al. (2016)	PGSI, amount of total deposit in the past 30 days, total amount lost, mean loss per gambling session, total stake, number of gambling sessions, multi-tabling (playing at multiple tables at the same time)	No significant differences were found between groups.	Power: not conducted Attrition: 83.0%
Neighbors et al. (2015)	Reductions in gambling frequency, quantity lost and won in the past 3 months, and gambling-related problems	No significant differences were found between groups.	Power: conducted Attrition: N/A
Nilsson, Magnusson, Carlbring, Andersson, and Gumpert (2018)	NODS, net losses due to gambling in the last month, TLFB-G	The groups did not significantly differ regarding any outcome variables.	Power: not conducted Attrition: 50%
Rodda, Dowling, Knaebe, and Lubman (2018)	G-SAS, frequency of days gambling and money spent gambling (over the past 30 days) and readiness to change	The groups did not significantly differ regarding any outcome variables.	Power: not conducted Attrition: 61.2%
Rosen, Weinstock, and Peter (2020)	PGSI, ATGS-8), gambling treatment utilization at 30-day follow-up	The groups did not significantly differ regarding any outcome variables.	Power: conducted Attrition: N/A
So et al. (2020)	PGSI, G-SAS, gambling frequency (in the last 30 days), amounts wagered (in the last 30 days)	The groups did not significantly differ regarding any outcome variables.	Power: conducted Attrition: 9%

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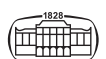


Continued

Author, year	Relevant outcome measures	Effectiveness	Attrition and statistical power
Wittekind et al. (2019)	PG-YBOCS, EIS	Both groups showed a similar reduction in gambling-related symptoms. However, the groups did not significantly differ regarding any outcome variables.	Power: conducted Attrition: 66.6%
Yakovenko and Hodgins (2021)	Gambling frequency and expenditure, PGSI	The groups did not significantly differ regarding any outcome variables.	Power: conducted Attrition: N/A
<i>Gaming disorder</i> He et al. (2021)	Response time to the gaming cues, IGD, BIS	After the modification, the response time of the experimental group to the gaming cues significantly increased, whereas the scores for Internet gaming disorder severity and craving significantly decreased.	Power: not conducted Attrition: N/A
Park et al. (2016)	YIAS	The groups did not significantly differ regarding any outcome variables.	Power: not conducted Attrition: N/A
Rabinovitz and Nagar (2015)	GAS, subjective current gaming urge, game playing intentions	It was shown that a single session of the experimental condition resulted in a significant decrease in automatic action tendencies to approach gaming cues. However, no other differences were found between the two conditions.	Power: conducted Attrition: N/A
<i>Internet use disorder</i> Su et al. (2011)	Hours spent online each week, satisfaction with internet use, YDQ	The groups did not significantly differ regarding any outcome variables.	Power: not conducted Attrition: N/A
<i>Pornography use disorder</i> Böthe et al. (2021)	Levels of problematic porn use, pornography use frequency, self-perceived pornography addiction, pornography craving and pornography avoidance self-efficacy	The intervention group reported compared to the WLC condition significantly lower levels of problematic porn use, lower pornography use frequency, self-perceived pornography addiction, pornography craving, and higher pornography avoidance self-efficacy at the six-week follow-up.	Power: conducted Attrition: 89.4%
<i>Hoarding disorder</i> Fitzpatrick et al. (2018)	SI-R, SCI	The groups did not significantly differ regarding any outcome variables.	Power: not conducted Attrition: 50%
Muroff et al. (2010)	SI-R, CIR, CGI	Significant improvements over 6 months on SIR, CIR, and CGI compared to the WLC condition.	Power: not conducted Attrition: N/A

ATSGS-8, Attitudes Towards Gambling Scale; AUDIT, Alcohol Use Disorders Identification Test; BIS, Barratt Impulsiveness Scale; CBT, Cognitive behavior therapy; CGI, Global improvement in hoarding symptoms; CIR, Clutter Image Rating; EIS, Eysenck Impulsiveness Scale; GABS, Gambling Attitudes and Beliefs Survey; GACS, The Gambling Craving Scale; GAS, Game Addiction Scale; GRCS, Gambling Related Cognitions Scale; GSREQ, The Gambling Refusal Self-Efficacy Questionnaire; G-TLFB, Gambling-Timeline Followback; IGD, internet gaming disorder scale; NODS, National Opinion Research Center DSM Screen for Gambling Problems; GSAS, The Gambling Symptom Assessment Scale; PG-YBOCS, Pathological Gambling Adaptation of the Yale-Brown Obsessive-Compulsive Scale PHQ-9, Patient Health Questionnaire; PGSI, problem Gambling Severity Index.

PG-YBOCS, Pathological Gambling Adaptation of Yale-Brown Obsessive Compulsive Scale; SCI, Saving Cognitions Inventory; SI-R, Saving Inventory—Revised; SOGS, the South Oaks Gambling Screen; WLC, waitlist control; YDQ, Young Diagnostic Questionnaire; YIAS, Young's Internet Addiction Scale.



Appendix C. Study quality

Study	Selection bias	Study design	Confounders	Blinding	Data collection	Withdrawals and drop out	Global rating	Notes
Armstrong et al. (2020)	3	1	1	1	1	1	moderate	Less than 60% of the selected participants participated, randomized controlled trial, no confounders, fully blinded, standardized psychometric measures were used, no attrition as single-session intervention.
Böthe et al. (2021)	2	1	1	3	1	3	weak	The selected individuals are likely to be representative of the target population, randomized controlled trial, no confounders, not blinded, standardized psychometric measures were used, less than 60% completion rate.
Bücker et al. (2018)	3	1	1	3	1	3	weak	Less than 60% of the selected participants participated, randomized controlled trial, no confounders, no blinding, standardized psychometric measures were used, less than 60% completion rate
Bücker et al. (2021)	3	1	1	3	1	3	weak	Less than 60% of the selected participants participated, randomized controlled trial, no confounders, no blinding, standardized psychometric measures were used, less than 60% completion rate
Caillon et al. (2019)	3	1	1	3	1	1	weak	Less than 60% of the selected participants participated, randomized controlled trial, no confounders, not blinded, standardized psychometric measures were used, no attrition.
Caillon et al. (2021)	3	1	1	1	1	1	moderate	Less than 60% of the selected participants participated, randomized controlled trial, no confounders, not blinded, standardized psychometric measures were used, no attrition.
Carlbring and Smit (2008)	1	1	2	NA	2	2	strong	Sample is likely to be representative (recruitment through advertisements and newspapers). Randomized controlled trial. Standardized psychometric measures were used; however, data is self-reported. 69% completed the 36-month follow-up.
Casey et al. (2017)	2	1	2	3	1	3	weak	Participants on the WLC, received the treatment before follow-up data were collected, thus there were no comparisons between the WLC, and the active treatment conditions at follow-

(continued)



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Study	Selection bias	Study design	Confounders	Blinding	Data collection	Withdrawals and drop out	Global rating	Notes
Cunningham et al. (2012)	3	1	1	3	1	1	weak	up. Participants and project staff were not blind to allocation. Standardized valid, and reliable psychometric measures were used. 29% completed the 12-month follow-up. Less than 60% of the selected participants participated, randomized controlled trial, no confounders, no blinding, standardized psychometric measures were used, less than 60% completion rate
Cunningham et al. (2019a)	3	1	1	3	1	1	weak	The selected individuals are likely to be representative of the target population (recruitment through crowdsourcing website). No significant differences between intervention and control conditions, prior to the intervention were found. Blinding is not described. Follow-up: 87% at 6 weeks, 87% at 6 months.
Cunningham et al. (2019b)	1	1	1	1	2	3	moderate	The selected individuals are likely to be representative of the target population (recruitment through social media and print advertisements, across Canada). Double-blinded. Standardized, valid, and reliable psychometric measures were used, data collected by clinicians. Follow-up: 38.8% at 3-months, 34.1% 6-months.
Cunningham et al. (2020)	2	1	1	3	1	1	moderate	The selected individuals are somewhat likely to be representative of the target population (recruitment through social media). At baseline, there were no significant differences between conditions on any of the demographic variables. Follow up: 80% at 3 months, 64% at 6 months.
Dowling et al. (2021)	1	1	2	2	1	3	moderate	The selected individuals are somewhat likely to be representative of the target population, randomized controlled trial, no confounders, blinded, standardized psychometric measures were used, less than 60% completion rate.
Fitzpatrick et al. (2018)	3	1	1	3	1	3	weak	The percentage of selected participants is not described, randomized controlled trial, no

(continued)

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Study	Selection bias	Study design	Confounders	Blinding	Data collection	Withdrawals and drop out	Global rating	Notes
He et al. (2021)	2	1	1	1	1	1	strong	confounders, not blinded, standardized psychometric measures were used, less than 60% completion rate. The selected individuals are likely to be representative of the target population, randomized controlled trial, no confounders, fully blinded, standardized psychometric measures were used, no attrition.
Hodgins et al. (2019)	2	1	2	1	2	1	strong	The selected individuals are likely to be representative of the target population (recruitment through social media and print advertisements across Canada). There were no significant differences between conditions on any of the demographic variables. Researchers conducting follow-up were blinded to participant allocation. 66% completed all follow-ups
Jonas et al. (2020)	1	1	1	3	1	3	weak	The selected individuals are somewhat likely to be representative of the target population. (Recruitment through the website "check-dein-spiel.de"). Randomization resulted in similar groups; potential confounders were included in the analyses. Two outcomes relied on self-report. Blinding is not described. Follow-up: 53.9% at 3 months, 47.3% at 6 months and 55% at 12 months. ITT analysis conducted.
Luquiens et al. (2016)	2	1	3	3	2	3	weak	The selected individuals are likely to be representative of the target population (recruitment directly through gambling environment). There were no exclusion criteria except for the age limit. Additional demographic characteristics or psychiatric conditions could have limited the impact of the intervention. No blinding could be applied. Attrition rate: 83%.
Muroff et al. (2010)	1	2	1	3	1	3	weak	The selected individuals are likely to be representative of the target population, quasi-experimental design, no confounders, not blinded, standardized psychometric measures were used, completion rates were not described.

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Study	Selection bias	Study design	Confounders	Blinding	Data collection	Withdrawals and drop out	Global rating	Notes
Neighbors et al. (2015)	3	1	1	1	1	1	moderate	Less than 60% of the selected participants participated, randomized controlled trial, no confounders, fully blinded, Standardized psychometric measures were used, no attrition as single-session intervention.
Nilsson et al. (2018)	2	2	3	3	1	1	weak	The selected individuals are somewhat likely to be representative of the target population (recruitment through Swedish National Gambling Helpline via an online advertisement and through health care professionals who were informed about the study).
Park et al. (2016)	3	1	1	3	1	1	weak	The percentage of selected participants is not described, randomized controlled trial, no confounders, not blinded, standardized psychometric measures were used, no attrition as single-session intervention.
Rabinovitz and Nagar (2015)	3	1	1	1	1	1	moderate	The percentage of selected participants is not described, randomized controlled trial, no confounders, not blinded, standardized psychometric measures were used, no attrition as single-session intervention.
Rodda et al. (2018)	2	1	2	2	2	3	moderate	The selected individuals are somewhat likely to be representative of the target population (recruitment through e-mental health services). There were no significant differences between conditions on any of the demographic variables, prior to treatment. Research assistants were blind to allocation. Follow-up: 4 weeks: 45%, 12-weeks: 38%
Rosen et al. (2020)	2	1	2	3	2	1	moderate	Sample may not be representative of the entire ex-offender population as some ex-offenders in these areas may not have access to the Internet or computers. It is possible that those who completed the study may already have access to more resources, which may have impacted the current results. Follow-up: 80% at 30-day follow up.
So et al. (2020)	2	1	3	1	2	1	moderate	Participants were recruited through online advertisements, however because of the incentive provided for participating, the

(continued)

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Study	Selection bias	Study design	Confounders	Blinding	Data collection	Withdrawals and drop out	Global rating	Notes
Su et al. (2011)	2	2	3	NA	2	1	moderate	<p>sample may have been biased. Quadruple blinding was applied. Gambling problems of participants was based on their self-report without an in-person interview. Follow-up: 72% post-intervention assessment. Intention-to-treat analysis conducted.</p> <p>The selected individuals are somewhat likely to be representative of the target population (students recruited from the Beijing normal University and participants volunteered to participate). Additionally, there were more female participants (69%) than male participants. Follow-up: 91% at 1-month.</p>
Wittekind et al. (2019)	3	1	1	1	1	3	weak	<p>Less than 60% of the selected participants participated, randomized controlled trial, no confounders, fully blinded, Standardized psychometric measures were used, less than 60% completion rate.</p>
Yakovenko and Hodgins (2021)	2	2	2	1	3	1	moderate	<p>More than half of participants reported currently receiving treatment for gambling problems at baseline. Participants who are seeking treatment are more likely to be motivated to engage with interventions and to achieve their recovery goals. It is possible that some participants in the face-to-face group may have had access to the internet-based program. Interviewers were blind to participant assignment. All data came from self-report. Follow-up: 70% at 12 months.</p>

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