HHS Public Access

Author manuscript

Psychol Addict Behav. Author manuscript; available in PMC 2018 June 01.

Published in final edited form as:

Psychol Addict Behav. 2017 June ; 31(4): 393–402. doi:10.1037/adb0000269.

Mindfulness-Oriented Recovery Enhancement for Internet Gaming Disorder in U.S. Adults: A Stage 1 Randomized Controlled Trial

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Abstract

Empirical studies have identified increasing rates of Internet Gaming Disorder (IGD) and associated adverse consequences. However, very few evidence-based interventions have been evaluated for IGD or problematic video gaming behaviors. This study evaluated Mindfulness-Oriented Recovery Enhancement (MORE) as a treatment for IGD. Thirty adults (*M age* = 25.0, *SD* = 5.4) with IGD or problematic video gaming behaviors were randomized to 8 weeks of group-based MORE or 8 weeks of a support group (SG) control condition. Outcome measures were administered at pre-and posttreatment, and 3-month following treatment completion using self-report instruments. Linear mixed models were used for outcome analyses. MORE participants had significantly greater reductions in the number of DSM-5 IGD criteria they met, craving for video gaming, and maladaptive cognitions associated with gaming than SG participants, and therapeutic benefits were maintained at 3-month follow-up. MORE is a promising treatment approach for IGD.

Keywords

video game addiction; Internet Gaming Disorder; mindfulness intervention; randomized controlled trial; support group

Internet Gaming Disorder (IGD) is a recurrent and compulsive pattern of video game playing (on computers, game consoles, or mobile devices; online and offline) associated with adverse psychosocial consequences (American Psychiatric Association [APA], 2013).

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Study pre-post findings were presented orally at the 2017 Society of Social Work and Research Conference in January, 2017.

IGD is characterized by signs and symptoms similar to substance use and gambling disorders, and is evidenced by a) a preoccupation with playing video games on the Internet and offline; b) a need to increase the amount of time they engage in video gaming in order to achieve the desired level of excitement; c) psychological withdrawal symptoms (e.g., feeling restless, irritable, or sad when attempting to reduce or stop playing video games); d) repeated unsuccessful attempts to stop or reduce gaming; e) failure to engage in other hobbies or activities due to gaming; f) playing video games to escape or relieve negative moods; g) lying to others about the extent of gaming; h) continued video game playing despite negative consequences; and i) mental distress and impairments in social functioning (APA, 2013; Petry et al., 2014).

Approximately 81% of young adults in the U.S. play video games on the Internet and offline (Lenhart, Jones, & Macgill, 2008). Though precise prevalence estimates are lacking, 4% to 12% of adolescents and adults who play video games were estimated to have problematic gaming behaviors (Kuss & Griffiths, 2012). Youth and adults with IGD may experience a range of adverse consequences and comorbidities, including a) impaired physical health, such as being overweight or obese due to lack of physical activity, sleep disorders, and heightened risk for seizures (Ferrie, De Marco, Grünewald, Giannakodimos, & Panayiotopoulos, 1994; Smyth, 2007); b) psychiatric comorbidity, including depressive and somatic symptoms, social anxiety, and attention-deficit-hyperactivity-disorder (ADHD) (Dong, Lu, Zhou, & Zhao, 2011; Lo, Wang, & Fang, 2005; Romer, Bagdasarov, & More, 2009); c) behavioral problems, including substance misuse (Yen, Ko, Yen, Chen, & Chen, 2009), driving while playing video games (Li, O'Brien, Snyder, & Howard, 2015), suicidal ideation (Kohn, 2002), and hostility and violence (Bucktin, 2013; Grusser, Thalemann, & Griffiths, 2007; Kim, Namkoong, Ku, & Kim, 2008); d) loss of relationships and employment (Chappell, Eatough, Davies, & Griffiths, 2006; Jackson, von Eye, Witt, Zhao, & Fitzgerald, 2011); and e) financial debt (Beranuy, Carbonell, & Griffiths, 2013).

Although it is possible that people with IGD could benefit from interventions to forestall development of these deleterious effects, very few evidence-based treatments for IGD have been established or evaluated (King & Delfabbro, 2014). Prior studies evaluating interventions for IGD and problematic gaming behaviors suggest that pharmacological therapies (e.g., Han et al., 2009; Han, Hwang, & Renshaw, 2010), cognitive-behavioral treatment (CBT) (e.g., Han, Kim, Lee, & Renshaw, 2012), and family therapy (Kim, Han, Lee, & Renshaw, 2012) may be effective in treating IGD among youth. Further research with rigorous design is needed to provide evidence for psychotherapeutic treatment efficacy for IGD among adults (King & Delfabbro, 2014).

Mindfulness interventions are effective in treating substance use and gambling disorders (e.g., Chiesa & Serretti, 2014; Li, Howard, Garland, McGovern, & Lazar, 2017; Toneatto, Pillai, & Courtice, 2014). However, mindfulness interventions have not been evaluated with regard to their efficacy in treating IGD. As such, we adapted Mindfulness-Oriented Recovery Enhancement (MORE), an evidence-based manualized treatment for addiction and co-occurring distress (Garland, 2013), and pilot tested the adapted MORE treatment protocol for IGD with U.S. adults in a Stage 1 randomized controlled trial (RCT) (Onken, Carroll, Shoham, Cuthbert, & Riddle, 2014). MORE integrates training in mindfulness, cognitive

reappraisal skills, and savoring natural rewards into a therapeutic approach designed to modify automatic behavioral habits and hedonic dysregulation associated with addictive behaviors (Garland, 2016). Garland et al. (2010; 2014; 2016) conducted three RCTs that demonstrated therapeutic effects of MORE on addiction-related outcomes including substance misuse, craving, emotional distress, attentional bias, and hedonic regulation (see Garland, 2016 for a review of postulated therapeutic mechanisms of MORE).

This study evaluated the effects of MORE, compared to a support group (SG), in reducing IGD. The study used an active control condition to attempt to control for nonspecific therapeutic factors such as social interaction, expectancy effects, and peer support. We hypothesized that compared to SG participants, MORE participants would demonstrate significantly greater decreases in their signs and symptoms of IGD (primary outcome), and significantly greater improvements in secondary outcomes including, craving for video gaming, maladaptive cognitions associated with video gaming, psychological distress, adaptive cognitive coping, and mindfulness.

Methods

Participants

Students and employees of a large public university in the Southeast United States were recruited for this study. A recruitment email was distributed via the university LISTSERV to over 10,000 students and university employees once a week between May and September, 2015. A brief questionnaire for initial eligibility screening was developed using Qualtrics (2015), and the link to the online screening questionnaire was embedded in the recruitment email. The screening questionnaire included nine questions about DSM-5 criteria assessing IGD, and one question asking about respondents' willingness to participate in a treatment program for IGD. Potential participants who 1) met proposed DSM-5 diagnostic criteria for IGD (i.e., ≥ 5 DSM-5 criteria) or evidenced subthreshold IGD (i.e., 3 or 4 DSM-5 criteria), and 2) expressed willingness to participate in the treatment program, were scheduled for individual interviews to further assess if they met study eligibility criteria. Participants were eligible for this study if they 1) were 18 or older; 2) met ≥ 3 DSM-5 criteria for IGD; 3) were not receiving mental health services elsewhere at the time of recruitment; 4) did not meet DSM-5 criteria for schizophrenia or bipolar disorder; and 5) were not suicidal or homicidal.

Over the course of 4 months, 248 people responded to the recruitment email by logging onto the online screening questionnaire. Thirty were eligible for study participation, provided informed consent, completed pretreatment assessment, and were randomly assigned to the MORE (n = 15) or SG (n = 15) intervention. Of the 30 participants, 29 (96.7%) completed posttreatment assessments, and 24 (80.0%) completed assessments at 3-month following treatment completion. Bivariate tests identified no significant differences in sociodemographic and outcome variables between participants who completed and who did not complete 3-month follow-up assessment. Figure 1 presents the CONSORT flowchart.

Procedures

Following a preliminary screening for eligibility using the online screening questionnaire, potential participants were screened in person for study eligibility and gave informed consent, after which they completed a paper-and-pencil questionnaire that included all outcome and sociodemographic measures. Following baseline interviews, enrolled participants were randomized to MORE or SG conditions. To eliminate experimenter bias in group assignment, randomization was performed by a research team member who did not participate in the recruitment and baseline interview. A matched pairs design was used for randomization (Shadish, Cook, & Campbell, 2002). Participants were grouped into pairs based on their gender and number of DSM-5 IGD criteria they met at pretreatment assessment, and randomly assigned within each pair to one of the study conditions. To minimize differences in participants' treatment expectancies, the experimental interventions (i.e., MORE and SG) were described to participants as two group-based interventions that have not previously been examined with regard to their ability to help persons with IGD. The intent was to prevent participants from knowing which intervention the research team hypothesized was more likely to improve symptoms.

Following completion of the MORE and SG interventions, participants completed a posttreatment assessment including the same outcome measures that were administered at pretreatment. Three months after treatment completion, participants completed the same outcome assessment via online survey. Participants were provided with $20 incentive for completion of pre-and posttreatment assessments, and $10 incentive for completion of follow-up assessment. Study procedures and consent forms were reviewed and approved by the Institutional Review Board of the University of North Carolina at Chapel Hill.

Treatment condition—The protocol for the MORE treatment condition was adapted from Garland (2013) to address symptoms of IGD. The sessions involved 1) mindful awareness of automatic, addictive video gaming behaviors; 2) coping with negative affective states through the practice of mindful reappraisal instead of video games; 3) enhancing positive affective states through mindful savoring of pleasant daily experiences; 4) increasing awareness of video game craving and the use of mindfulness to cope with craving; 5) stress reduction through the practice of mindful relaxation; 6) promoting acceptance of, rather than suppression of, unwanted thoughts and distressing experiences; 7) decreasing interpersonal stress through the practice of loving-kindness meditation; and 8) developing a plan to use mindfulness skills to continue recovery.

MORE treatment consisted of 8-weekly, 2-hour group sessions. Two MORE treatment groups were conducted on campus between September and November, 2015. Each group included 7 to 8 participants. MORE groups were led by a licensed Master's-level social worker who was trained in delivering MORE and had intensive experience in leading MORE groups for individuals with substance use disorders. In addition to attending each group session, participants were asked to practice mindful breathing and body scan meditation at home guided by a MP3 audio file developed by the developer of MORE. Participants in the MORE group were also asked to log the amount of time they spent on mindfulness practice. Daily logs were examined by group facilitators and discussed during group sessions.

Control condition—The SG control condition was facilitated by a licensed Master's-level social worker and matched the MORE condition with respect to frequency (i.e., 8-weekly sessions) and duration (i.e., 2-hours) of sessions. Two SG were conducted on campus between September and November, 2015. Each group included 7 to 8 individuals. The group facilitator of the SG had intensive experience in leading SGs for individuals with substance misuse and was not trained in MORE. A SG format was selected as the control condition because SGs have been shown to be therapeutically active (c.f., Garland et al., 2010; Gaylord et al., 2011), structurally similar to the MORE intervention, and capable of controlling for non-specific factors including social support, attention by a caring professional, and expectancy of benefit.

SG sessions focused on specific pre-designated topics and involved open group discussions about participants' experiences with, or emotional reactions to, each topic. Session topics included 1) an overview of IGD, 2) thoughts and feelings related to pathological video game playing, 3) experiences of craving for video game playing and possible triggers, 4) identity and video game playing, 5) playing video games to cope with stress, 6) interpersonal relationships and video game playing, 7) positive and alternative coping strategies, and 8) review of the group experience. During each session, the group facilitator raised topics for discussion, used reflective listening techniques, and elicited interactions of group members without providing didactic information, behavioral prescriptions, or other advice.

Fidelity monitoring—All MORE and SG sessions were videotaped and reviewed by the research team to monitor therapist adherence to the MORE and SG treatment protocols via a fidelity checklist. In addition, facilitators of the MORE and SG conditions completed the same checklist after each session and evaluated their fidelity to the respective treatment protocols. Clinical supervision was provided by the developer of MORE when deviations were noted or questions were raised. Any deviations or questions raised by group facilitators were discussed during clinical supervision and corrected by facilitators in the following group sessions. No major deviations (e.g., proscribed behaviors) were noted in the MORE and SG conditions.

Variables and Measures

IGD symptoms, maladaptive cognitions associated with video gaming, cognitive coping, and dispositional mindfulness were measured at baseline and assessed experiences over the past 12 months. These variables were also measured at posttreatment and assessed experiences over the past week. These measures were again administered at 3-month follow-up and assessed experiences over the past month. The measures for craving for video game playing and mental distress assessed experiences over the past week at all three time points.

Internet Gaming Disorder (IGD)—IGD was assessed using the total number of DSM-5 criteria endorsed by participants (α = .70 in current study). DSM-5 criteria consist of nine questions that assess whether (yes or no) an individual evidences signs and symptoms of IGD (e.g., preoccupation, tolerance and withdrawal symptoms; APA, 2013). DSM-5 suggested that individuals answering “yes” to 5 or more questions met criteria for IGD; however, a valid cutoff for IGD has not been well-established (Petry & O'Brien, 2013). In

current study, participants who met ≥ 5 DSM-5 criteria were identified as IGD; and participants who met 3 or 4 DSM-5 criteria were identified as meeting subthreshold IGD.

Craving—The level of craving for video gaming was measured with a single Visual Analog Scale (VAS) anchored on a 10-point scale (1 = *not at all*, 10 = *extremely*). The VAS has demonstrated construct and concurrent validity as a measure of craving for tobacco and cocaine (Lee, Brown, Perantie, & Bobadilla, 2002; Wewers, Rachfal, & Ahijevych, 1990), and was adapted to assess level of craving for video game playing.

Maladaptive cognitions associated with video gaming—Maladaptive cognitions associated with video gaming (e.g., "I am only loved by others in the games.") were measured with the Online Cognition Scale (OCS, α = .94 in current study). The OCS is a 36-item, 7-point Likert-type scale, with a response format ranging from 1 (not true) to 7 (very true). The OCS includes four subscales that assess individuals' cognitions related to their Internet use, including loneliness/depression, diminished impulse control, preferring socialization on the Internet to socialization in the real-world, and distraction (Davis, Flett, & Besser, 2002). A higher score indicates a higher level of maladaptive cognitions related to Internet use (Davis et al., 2002). In this study, we adapted the OCS to measure maladaptive cognitions related to video game playing by replacing the phrases "Internet" and "Internet use" with "video games" and "playing video games" in each OCS item.

Mental distress—Mental distress was measured with the 18-item Brief Symptom Inventory (BSI-18; Derogatis, 2000, α = .87 in current study). Participants reported the extent to which they were distressed by each of 18 affective symptoms (e.g., "nervousness or shakiness inside" and "feeling no interest in things") in the past week on a 5-point Likert Scale, with response options ranging from 1 (not at all) to 5 (extremely).

Cognitive coping—Use of cognitive coping strategies for coping with negative affective states and emotion regulation was measured with the Cognitive Emotion Regulation Questionnaire (CERQ). The CERQ is a multidimensional questionnaire that identifies the extent to which different cognitive strategies are employed to cope with negative life events (Garnefski, Kraaij, & Spinhoven, 2001). Items are rated on a 5-point Likert-type scale, with response options ranging from 1 (almost never) to 5 (almost always). For the present study, we assessed cognitive coping via the CERQ subscales with the closest relevance to the therapeutic emphases of the MORE intervention: Positive Reappraisal (α = .77 in current study), Putting into Perspective (α = .73 in current study), Acceptance (α = .79 in current study), and Catastrophizing (α = .77 in current study).

Dispositional mindfulness—Dispositional mindfulness was measured using the Five Facet Mindfulness Questionnaire (FFMQ) (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006, α = .86 in current study). The FFMQ consists of 39 items rated on a 5-point Likert-type scale, with response options ranging from 1 (never/very rarely true) to 5 (very often/always true).

Data Analyses

Descriptive analyses were performed on all sociodemographic and outcome variables to describe the sample characteristics and participants' level of IGD and secondary outcomes (e.g., craving and maladaptive cognitions associated with gaming) at pretreatment assessment. Bivariate tests (i.e., independent t-tests and chi-square tests) were conducted on sociodemographic and outcome variables to examine the adequacy of randomization.

Intent-to-treat (ITT) analysis using linear mixed models with maximum likelihood estimation was used to compare effects of MORE vs. SG in reducing IGD, craving for video game playing, maladaptive cognitions associated with gaming, and mental distress, and increasing positive coping and mindfulness. Linear mixed models estimate the variance-covariance matrix for all available data including data from cases assessed at only one time point (Singer & Willett, 2003). Models included the main effects of time (i.e., pretreatment to 3-month follow-up) and treatment assignment (i.e., MORE vs. SG), and the treatment assignment × time interaction term, controlling for pretreatment values of outcome variables. In addition, models used participants' age and age of onset of problematic video game playing as covariates, because independent t-tests indicated statistically significant group differences in these variables at pretreatment, and these variables were likely to influence treatment outcomes.

Effect sizes of MORE vs. SG on treatment outcomes were computed using Hedges' g (i.e., standardized mean differences between treatment and control conditions on outcome variables at posttreatment or 3-momth follow-up). Compared to Cohen's d, Hedges' g allows a correction for bias due to a small sample size (Hedges, 1981). Stata 14.0 was employed for data analyses (StataCorp, 2015).

Results

Descriptive Results

Table 1 presents participants' sociodemographic information and their responses to pretreatment measures. The average age of the sample (N = 30) was 25 (SD = 5.4), with a range of 18 to 35. A majority of the sample (80%, n = 24) was men, 16.7% (n = 5) were women, and 3.3% (n = 1) identified as neither male nor female. More than half of the sample (53.3%, n = 16) identified as White, whereas 30.0% (n = 9) were Asian, 6.7% (n = 2) were African American, 3.3% (n = 1) were Hispanic, and 6.7% (n = 2) identified as other. Approximately 36.6% (n = 11) of the sample were undergraduates, 46.7% (n = 14) were graduate students, and 16.7% (n = 5) were university employees. Students represented 16 academic majors (e.g., chemistry, computer science, and business) in the university.

The age at which participants reported they first started to play video games ranged from 4 to 29, with an average age of 11 (SD = 5.6). The age at which participants reported they first thought they had a problem with excessive video game playing ranged from 10 to 33, with an average age of problem onset of 20 (SD = 5.6). The amount of time participants reported they had spent playing video games per week ranged from 2 to 70 hours (One person reported having spent 2 hours per week gaming. This person chose to report the current amount of time gaming rather than the amount of time he/she used to spend gaming, and

stated that he/she needed professional help to maintain this behavior change.), with an average of 21.6 hours (SD = 15.9). Approximately 76.6% (n = 23) of participants were identified as IGD (met ≥ 5 DSM-5 criteria). On average, participants met 6 (SD = 1.9) DSM-5 criteria for IGD. Results of bivariate tests showed that participants in the MORE group did not differ significantly from their SG counterparts across sociodemographic or outcome variables at pretreatment except for age and age of onset of problematic video game playing (p < .05). These variables were controlled for in subsequent analyses.

Primary Outcome

The ITT linear mixed model revealed a significant main effect of time for DSM-5 IGD criteria (F(2, 35.67) = 50.55, p = .000), indicating that across both treatment groups, participants reported significant reductions in IGD criteria at 3-month follow-up. The significant treatment × time interaction effect on IGD criteria (F(2, 35.67) = 5.38, p = .005) indicated that the MORE group evidenced significantly greater reductions in number of DSM-5 IGD criteria than SG at 3-month follow-up (Hedges'g = .78). Figure 2 illustrates the changes in number of DSM-5 IGD criteria that MORE and SG participants met during the study.

Chi-square analyses were conducted to examine whether significantly more participants in the MORE group evidenced clinical changes than the SG participants following treatment. Results revealed that a significantly greater proportion of participants in the MORE group (66.7%, n = 10) no longer met ≥ 3 DSM-5 IGD criteria relative to those in the SG (28.6%, n = 4) at posttreatment (χ^2 = 4.21, p = .04), and a greater proportion of MORE participants no longer met ≥ 3 DSM-5 IGD criteria (75.0%, n = 9) than SG participants (58.3%, n = 7) at 3-month follow-up (χ^2 = .75, p = .39). In addition, a greater proportion of MORE participants who met DSM-5 criteria for IGD at pretreatment (i.e., met ≥ 5 DSM-5 IGD criteria) no longer met criteria for IGD relative to SG participants at 3-month follow-up - there was a 100% (n = 11) reduction in IGD in the MORE group, compared to a 75.0% reduction in the SG (n = 6; χ^2 = 2.81, p = .09).

Secondary Outcome

Craving—The ITT linear mixed model revealed a significant main effect of time for craving (F(2, 35.67) = 3.15, p = .043). The significant treatment × time interaction effect on craving (F(2, 35.67) = 3.01, p = .049) indicated that the MORE group evidenced significantly greater reductions in craving for video game playing than the SG at 3-month follow-up (Hedges'g = 1.04). Figure 3 illustrates the changes in craving for playing video games for MORE and SG participants during the study.

Maladaptive cognitions associated with gaming—The ITT linear mixed model revealed a significant main effect of time for the Online Cognition Scale (OCS) (F(2, 35.67) = 23.49, p = .000), Diminished Control subscale (F(2, 35.67) = 26.39, p = .000), Distraction subscale (F(2, 35.67) = 15.83, p = .000), Socialization subscale (F(2, 35.67) = 11.74, p = .000), and Loneliness and Depression subscale (F(2, 35.67) = 15.27, p = .000). However, a significant treatment × time interaction effect was only observed on OCS-Loneliness and Depression subscale (F(2, 35.67) = 6.78, p = .001), indicating that the MORE group reported

a significantly greater reduction in negative feelings and thoughts associated with gaming than SG at 3-month follow-up (Hedges'g = .73).

Cognitive coping—The ITT linear mixed model revealed a significant main effect of time on the Acceptance ($F(2, 35.67) = 12.06$, $p = .000$) and Catastrophizing subscales ($F(2, 35.67) = 3.06$, $p = .047$) of the Cognitive Emotion Regulation Questionnaire (CERQ). However, no significant treatment assignment × time interaction effect was observed on any CERQ subscales.

Other outcomes—No main effects of time or treatment × time interaction effect were observed on mental distress and dispositional mindfulness.

Modified ITT Outcomes

For participants who initiated treatment, MORE participants ($n = 11$) completed an average of 6.9 hours ($SD = 4.5$) of treatment sessions, and SG participants ($n = 8$) completed an average of 8.5 hours ($SD = 6.0$) of treatment sessions. Among the group of treatment initiators, there was no significant difference in treatment dosage that participants received between MORE and SG ($p = .52$). Given that a larger number of participants in the MORE group than in the SG initiated treatment, results of ITT analyses might have overestimated treatment effects due to unequal treatment participation. Thus, we conducted modified ITT analyses for participants who received at least one treatment session (i.e., treatment initiators). Modified ITT mixed linear models revealed significant treatment × time interaction effects on IGD criteria ($F(2, 26.01) = 3.08$, $p = .046$, Hedges'g = .73) and the OCS-Loneliness and Depression subscale ($F(2, 26.01) = 11.86$, $p = .000$, Hedges'g = .73), indicating that the MORE group reported a significantly greater reduction in the number of signs and symptoms of IGD and negative feelings and thoughts associated with gaming than the SG at 3-month follow-up in the sample of treatment initiators. Though a significant treatment × time interaction effect was not observed on craving in this modified ITT sample ($F(2, 26.01) = 2.40$, $p = .09$), the effect size of MORE vs. SG on craving was still moderately large (Hedges'g = .73).

Correlations of Mindfulness Practice and Outcomes

At-home mindfulness practice during the 8-week intervention was reported by MORE participants via daily homework logs. Number of minutes of mindfulness practice per week was significantly correlated with pre-to-posttreatment changes on OCS total scale scores ($r = .72$, $p = .045$) and OCS-Diminished Impulsive Control subscale scores ($r = .84$, $p = .01$), indicating that participants who engaged in more extensive mindfulness practice evidenced the largest improvements in maladaptive cognitions related to gaming and greater control over gaming.

Discussion

This Stage 1 RCT was the first evaluation of a manualized mindfulness intervention adapted to treat IGD among adults. Results indicated that relative to an active support group (SG) control condition, participation in the 8-week Mindfulness-Oriented Recovery Enhancement

(MORE) intervention was associated with significant posttreatment reductions in signs and symptoms of IGD which were maintained by 3-month follow-up. Moreover, participants in MORE reported significant improvements in maladaptive cognitions and cravings related to video game playing, suggesting that this mindfulness-based intervention may target risk mechanisms underlying IGD.

Although participants in both the MORE and SG interventions evidenced significantly reduced signs and symptoms of IGD over the 8-week treatments and at follow-up, a large effect size difference was observed such that MORE resulted in a significantly greater improvement than the SG that was maintained for 3 months following the completion of the intervention. This finding suggests that MORE may serve as a promising approach to treating IGD. Given that MORE outperformed an active control condition which controlled for non-specific therapeutic factors, the observed clinical outcomes are likely the result of the specific intervention components of this mindfulness-based treatment, which aimed to enhance metacognitive awareness of automatized video gaming behavior as a means of fostering self-regulation of addictive habits.

In addition to alleviating signs and symptoms of IGD, participants in MORE reported significantly greater decreases in craving for video game playing than the SG. The MORE intervention might reduce craving for gaming by enhancing participants' awareness of triggers and the resultant craving response, and providing means of coping with craving through mindfulness and reappraisal practices. In that regard, in MORE participants are first taught to practice mindfulness to deconstruct craving into its sensorial, affective, and cognitive subcomponents. If craving becomes too overwhelming, participants are instructed to use mindfulness to reorient attention to the sensation of breathing, as a means of reducing craving-related arousal and disrupting ruminative thoughts. Subsequent to this attentional process, participants are taught to engage in a higher-order process of metacognitive evaluation in which they consciously contemplate the consequences of satiating the craving as well as the benefits of abstaining from the addictive behavior. This dual-stage procedure for coping with craving, which integrates mindfulness and reappraisal strategies, has been shown to reduce drug craving (Garland, Manusov et al., 2014; Garland et al., 2016) and drug cue-reactivity (Garland, Froeliger, & Howard, 2014b), and may engage top-down, conscious cognitive control over bottom-up, automatic addictive impulses (Garland, Froeliger et al., 2014a).

Similarly, we found that MORE significantly reduced participants' maladaptive cognitions associated with video game playing, including depressive thoughts and loneliness associated with gaming. Individuals with IGD may cope with such negative thoughts and feelings by playing video games to obtain a sense of dominance, mastery, and social connection (King, Delfabbro, & Griffiths, 2010; Wood, Griffiths, Chappell, & Davies, 2004; Yee, 2006). In light of the demonstrated therapeutic effects of mindfulness (Gu, Strauss, Bond, & Cavanagh, 2015) and reappraisal (Ochsner & Gross, 2005) on maladaptive cognitive processes, decreasing maladaptive cognitions associated with gaming via the therapeutic techniques taught in MORE might attenuate participants' motivations to play video games as a palliative coping strategy.

Though participation in MORE did not significantly increase dispositional mindfulness, the extent of daily mindfulness practice over the course of the intervention was significantly correlated with decreased maladaptive cognitions associated with gaming. Hence, it is plausible that mechanisms implicated in the formal practice of mindfulness meditation (e.g., attention and emotion regulation, metacognitive awareness; see Tang, Hölzel, & Posner, 2015) have direct therapeutic effects on these pathogenic processes.

Although a majority of participants completed assessments at posttreatment and 3-month follow-up, a substantial proportion of participants did not attend any treatment sessions. The time demands required by study participation, time conflicts between study participation and work/school events, and comparatively low incentives for study participation might have precluded high treatment engagement and completion rates. Future studies need to explore strategies to improve intervention adherence among adults who are not mandated to treatment for IGD. Incorporating motivational interviewing components in the MORE treatment program may enhance participants' treatment adherence (Rubak, Sandbæk, Lauritzen, & Christensen, 2005). In addition, treatment effects might have been overestimated due to nonequivalent treatment participation between groups. Considering that a greater number of participants in the MORE group received at least one treatment session than SG participants, the effects of MORE vs. SG using ITT analyses might have been overinflated. However, modified ITT analyses with the sample of treatment initiators identified consistent positive effects of MORE on IGD and maladaptive cognitions associated with gaming.

Study limitations include the small sample size and single site location of the RCT. Although a small sample may be appropriate for a pilot test, the sample size limited statistical power to detect significant changes in some secondary outcomes. Further, participants were recruited from one university. The single study site may limit generalizability of findings to other populations. Future studies are needed to replicate findings with larger samples from different settings. Also, because individuals were nested within treatment groups, cohort effects might have had an impact on outcomes, but sample size precluded including cohort effects in mixed models. Nonetheless, group cohorts within each treatment condition did not show overt differences in outcomes. Further, use of self-report measures of IGD could limit the validity of study results. Unlike substance use disorders, IGD cannot be assessed with biochemical measures (e.g., urinalysis and breathalyzer). However, collateral information from clinical interviews and standardized measurements may strengthen the validity of results regarding treatment outcomes. Future studies should explore participants' perspectives regarding treatment outcomes using qualitative interviews. Participants' self-reflections and qualitative responses regarding their own perceived changes as a result of MORE can help to contextualize current findings. The small sample size and measurement protocol precluded assessment of treatment mediators. Larger studies employing performance-based cognitive tasks and psychophysiology (e.g., Garland, Froeliger, et al., 2014b) could be used to assess mediation by changes in addiction attentional bias and other putative mediators like savoring natural rewards which were not directly tested in the present study. Lastly, although no statistically significant difference was observed in severity of IGD at baseline between MORE and SG participants, more participants in the MORE group met IGD criteria at baseline compared to SG participants.

The differential severity of IGD at baseline in combination with the small sample size might have had an impact on the statistical significance of results regarding between-group differences in clinical changes at posttreatment and 3-month follow-up.

Despite these limitations, this pilot RCT indicated that MORE was more effective than a therapeutically active control condition in reducing signs and symptoms of IGD among a sample of adults. Findings from this early stage trial demonstrate the feasibility and preliminary efficacy of MORE as a treatment for IGD, an emerging psychosocial problem for which few empirically-supported interventions are available.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

This study was funded by a University of North Carolina at Chapel Hill University Research Council Research Grant and Armfield-Reeves Innovation Fund Grant. Neither the University of North Carolina at Chapel Hill University Research Council or Armfield-Reeves Innovation Fund had any role in the interpretation of the data and preparation, review, or approval of the manuscript. Eric L. Garland was supported by R01DA042033 during the preparation of this manuscript. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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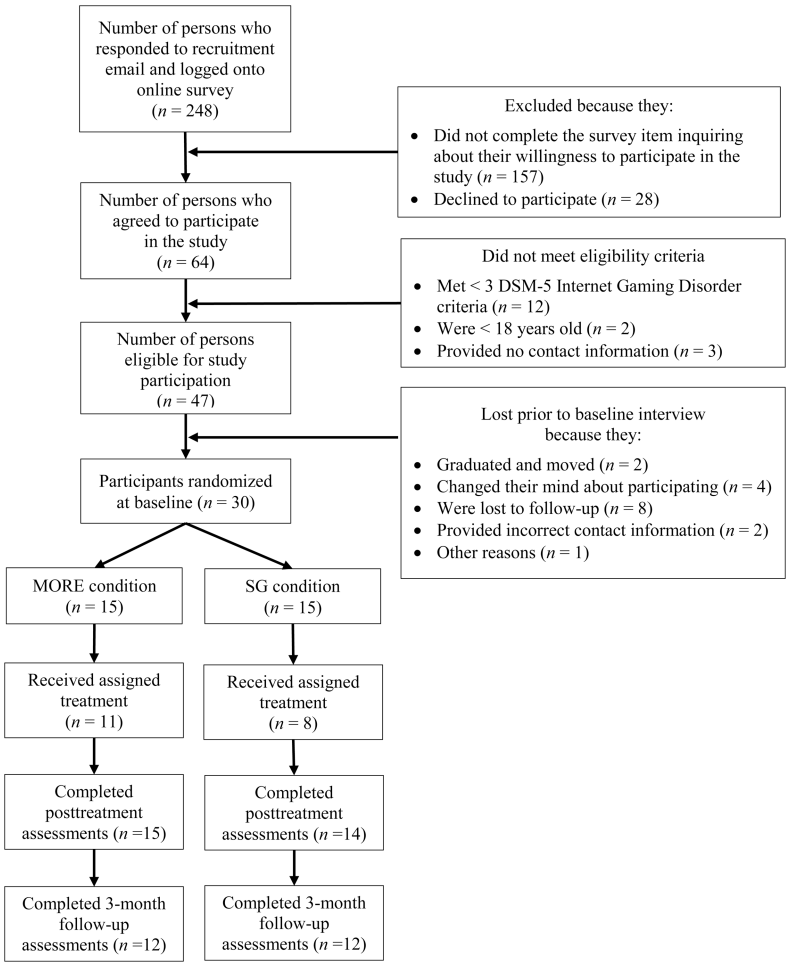

Figure 1.

CONSORT diagram for sampling and recruitment protocol for Mindfulness-Oriented Recovery Enhancement randomized controlled trial (ITT: intent-to-treat).

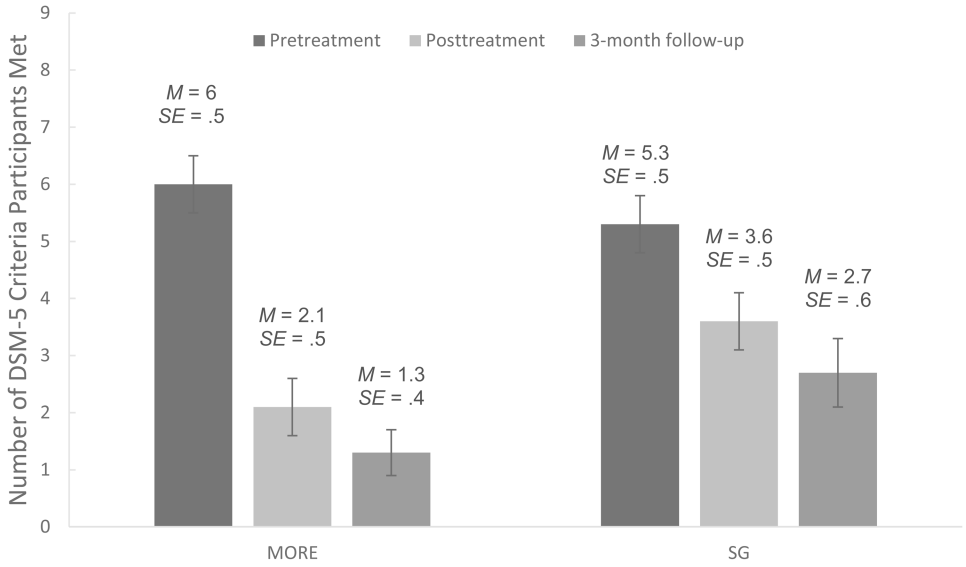

Figure 2.

Changes of Internet Gaming Disorder (IGD) for MORE and SG participants over the course of study. Note: DSM-5 Criteria for IGD was used to assess participants' IGD at pretreatment, posttreatment, and 3-month follow-up. Higher scores indicate more signs and symptoms of IGD.

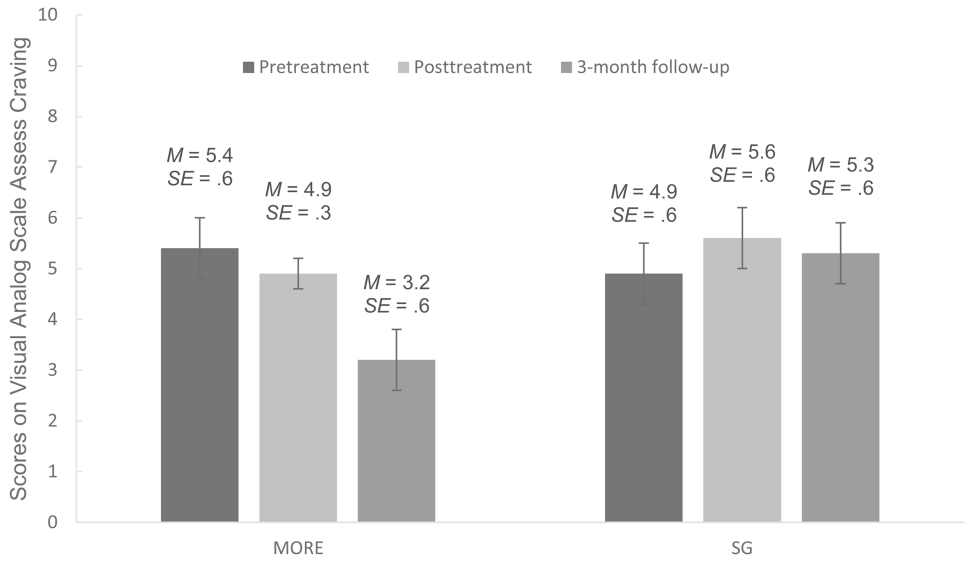

Figure 3.

Changes of craving for video game playing for MORE and SG participants over the course of study. Note: Visual analog scale was used to assess participants' craving for gaming at pretreatment, posttreatment, and 3-month follow-up. Higher scores indicate higher levels of craving for gaming.

Table 1
Sample Characteristics and Participants' Responses on Pretreatment Measures

	Overall Sample (*N* = 30)	MORE (*n* = 15)	SG (*n* = 15)
Age: *M* (*SD*)	25.0 (5.4)	22.2 (3.8) *	27.8 (5.5) *
Gender: *%* (*N*)			
Male	80% (24)	93.3% (14)	66.7% (10)
Female	16.7% (5)	6.7% (1)	26.7% (4)
Other *	3.3% (1)	0% (0)	3.3% (1)
Race: *%* (*N*)			
White	53.3% (16)	53.3% (8)	53.3% (8)
African American	6.7% (2)	6.7% (1)	6.7% (1)
Asian	30.0% (9)	26.7% (4)	33.3% (5)
Hispanic	3.3% (1)	6.7% (1)	0% (0)
Other	6.7% (2)	6.7% (1)	6.7% (1)
School/work: *%* (*N*)			
Undergraduate students	36.7% (11)	53.3% (8)	20.0% (3)
Graduate students	46.7% (14)	40.0% (6)	53.3% (8)
Work	16.7% (5)	6.7% (1)	26.7% (4)
Age at which participants first started to play video games: *M* (*SD*)	10.7 (5.6)	9.7 (3.3)	11.8 (7.2)
Age at which participants first recognized having a problem with excessive video game playing: *M* (*SD*)	19.6 (5.6)	17.1 (4.2) *	22.1 (5.8) *
Number of hours participants spent on gaming per week: *M* (*SD*)	21.6 (15.9)	21.9 (19.5)	20.5 (11.9)
DSM-5 Criteria for IGD: *M* (*SD*)	5.7 (1.9)	6.0 (1.8)	5.4 (2.0)
Number of participants who met ≥ 5 criteria: *%* (*N*)	76.6% (23)	86.7% (13)	66.7% (10)
Number of participants who met 3 or 4 criteria: *%* (*N*)	23.3% (7)	13.3% (2)	33.3% (5)
Online Cognition Scale (OCS): *M* (*SD*)	136.2 (34.5)	139.5 (30.4)	132.9 (30.1)
OCS-Diminished Impulse Control	39.3 (10.8)	41.0 (10.1)	37.6 (11.5)
OCS-Distraction	33.8 (8.0)	35.2 (5.1)	32.3 (10.1)
OCS-Preferring socialization in the video games to socialization in the real-world	44.3 (14.6)	43.3 (13.2)	45.3 (16.2)
OCS-Feelings of Loneliness/Depression	18.8 (7.0)	20.0 (7.2)	17.7 (6.8)
Visual Analog Scale Assessing Craving (VAS): *M* (*SD*)	5.2 (2.3)	5.4 (2.4)	4.9 (2.2)
Brief Symptom Inventory-18 item (BSI): *M* (*SD*)	32.5 (9.6)	32.4 (2.5)	32.7 (9.8)
Cognitive Emotion Regulation Questionnaire (CERQ): *M* (*SD*)			
CERQ-Acceptance	14.4 (3.1)	15.5 (2.4)	13.8 (3.6)
CERQ-Positive Reappraisal	14.9 (3.3)	15.4 (3.8)	14.3 (2.9)
CERQ-Putting into Perspective	14.4 (3.5)	14.1 (4.0)	14.5 (3.1)
CERQ-Catastrophizing	9.4 (3.6)	9.5 (3.2)	9.4 (4.0)
Five Facet Mindfulness Questionnaire (FFMQ): *M* (*SD*)	118.6 (14.9)	121.6 (14.6)	115.6 (15.1)

Note.

* $p < .05$;

*Other: one participant identified as neither male nor female

DSM-5 Criteria: higher scores indicate more signs and symptoms of IGD.
OCS: higher scores indicate higher levels of maladaptive cognitions associated with gaming.
VAS: higher scores indicate higher levels of craving for gaming.
BSI: higher scores indicate higher levels of psychological distress.
CERQ: the higher the subscale score, the more frequently a specific cognitive strategy is used.
FFMQ: higher scores indicate higher levels of mindfulness.