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Mindfulness programs for problematic usage of the internet: A systematic review and meta-analysis

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META-ANALYSES

ABSTRACT

Introduction: Problematic usage of the internet (PUI) is an umbrella term for a range of uncontrolled, excessive, and potentially harmful online behaviors. Recently, numerous studies have examined the potential of mindfulness programs (MPs) for reducing PUI. We conducted a comprehensive systematic review and meta-analysis in this emerging field. *Methods:* We searched eight databases from inception to October 18, 2022, with no language restrictions. We included randomized controlled trials (RCTs) and nonrandomized trials (NRTs). The primary outcome was change in self-reported PUI, the secondary outcome was change in screen time. *Results:* Of 3,473 identified records, 19 RCTs and 20 NRTs with a total of 1,549 participants were included. Participation in an MP was associated with large reductions in PUI in between-group analysis in RCTs ($k = 19$; $g = -1.67$; 95% *CI* −2.15, −1.19) and in within-group pre-post analysis in all studies ($k = 35$; $g = -1.67$; 95% *CI* −1.99, −1.36). Screen time showed a medium reduction in within-group pre-post analysis ($k = 10$; $g = -0.65$; 95% *CI* −0.90, −0.41). The effects for PUI remained significant in a series of sensitivity analyses, such as excluding low quality studies, excluding outliers, adjusting for publication bias, or using follow-up data. Heterogeneity between studies was high and the overall quality of evidence was rated low. *Discussion and conclusions:* MPs are probably effective in reducing PUI and might be effective in reducing screen time. Shortcomings in the quality of evidence highlight the need for high-quality controlled trials with long-term follow-ups to confirm results.

KEYWORDS

problematic internet use, internet use disorder, mindfulness, social network, gaming, screen time

INTRODUCTION

Despite the numerous benefits of the internet with its myriad applications and various access devices, significant health, societal, and economic costs are associated with a problematic usage of the internet (PUI; Fineberg et al., 2022). PUI is an umbrella term that encompasses a set of potentially harmful online behaviors that are repetitive and uncontrolled, to the point that they are prioritized over other life interests and persist despite negative consequences. Behaviors falling under this concept include excessive online gaming and gambling (as acknowledged disorders due to addictive behaviors in the ICD-11), pornography viewing, social networks use, and shopping, among others (Fineberg et al., 2018). With almost thirty years of research on PUI (Griffiths, 1996; Young, 1996), related concepts have emerged such as internet use disorders, internet addiction, compulsive internet use, smartphone addiction, or technology addiction (Brand, Young, Laier, Wölfling, & Potenza, 2016; Fineberg et al., 2022), causing inconsistencies in terminology and taxonomy (Griffiths, 2021;

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Montag, Wegmann, Sariyska, Demetrovics, & Brand, 2020; Rumpf, Browne, Brandt, & Rehbein, 2020). Due to these inconsistencies, the prevalence of PUI varies depending on outcome measures and target populations. Pooled prevalence rates range between 7% (Pan, Chiu, & Lin, 2020) and 11.3% (L. Li, Xu, et al., 2018), rising particularly among adolescents and young adults (Neumann & Lindenberg, 2022; Olson et al., 2022). Excessive screen time is an important indicator of PUI, as it is often associated with it (Wegmann, Billieux, & Brand, 2022). However, screen time is not necessarily associated with addiction symptoms and is therefore not pathognomonic of a disorder. Instead, it depends on the context of internet use (Griffiths, 2021; Schneider, Lutz, Halfmann, Meier, & Reinecke, 2022) and underlying psychological mechanisms including reinforcement learning, compulsivity, and self-control (Brand, 2022) to determine whether it is detrimental or not.

Due to growing concerns about the consequences and increasing prevalence of PUI, there is a rising emphasis on developing treatment options (Basenach, Renneberg, Salbach, Dreier, & Wölfling, 2023). For substance addiction, treatments often rely on abstinence-based approaches requiring the addicted individuals to separate from both the substance and the usage environment. However, in the case of PUI, the widespread use of the internet, the ubiquity of smartphones and other access devices, as well as their necessity for daily functioning make such separation difficult, infeasible, or even counterproductive (Busch & McCarthy, 2021).

A promising low-threshold approach to reduce PUI that does not require complete abstinence and that addresses PUI's underlying mechanisms is the practice of mindfulness. Mindfulness is typically taught in mindfulness programs (MPs) and can be described as a state of metacognitive, moment-to-moment awareness that can be cultivated by intentionally paying attention to current internal and external experiences as non-judgmentally and open-heartedly as possible (Kabat-Zinn, 2005). MPs vary in duration, delivery format (e.g., group vs. individual), and setting (e.g., face-to-face vs. remote), but involve systematic and prolonged training in formal meditation (e.g., sitting meditation, body scanning) and/or informal mindfulness practices (i.e., being mindful in everyday behavior such as eating or washing) (Crane et al., 2017; Shapero, Greenberg, Pedrelli, de Jong, & Desbordes, 2018).

In the context of addiction, a mechanistic theoretical account conceptualizes mindfulness practice as form of mental training for neurocognitive mechanisms that have become dysregulated in the process of becoming and remaining addicted (Garland & Howard, 2018). With PUI, these mechanisms are (1) dysregulated reward and emotion processes (e.g., ventral striatum, amygdala), including altered positive reinforcement (e.g., pleasure) and negative reinforcement (e.g., reduced negative emotions/craving), and (2) reduced self-control capacities (e.g., anterior cingulate cortex, prefrontal cortex) to regulate these processes (Brand, 2022). MPs have been shown to modify these neurocognitive mechanisms which may explain MPs' effectiveness in treating substance (W. Li, Howard, Garland, McGovern, & Lazar, 2017) and behavioral addictive disorders (Brandtner et al., 2022). For example, a practice in mindfulness might strengthen metacognitive awareness, which helps to notice and deconstruct addictive urges into their sensory, affective, and cognitive components (Rosenthal, Levin, Garland, & Romanczuk-Seiferth, 2021). This ability, in turn, could help inhibiting such urges or enable a conscious and adaptive response, rather than automatically reacting to them in the form of habitual addictive behavior. In light of these considerations, mindfulness practice might reduce symptoms of PUI and contribute to a purposeful, goal-directed use of the internet in general. This is particularly relevant given the ubiquity of the internet and challenges associated with abstaining from it.

Accordingly, two systematic reviews of MPs for various behavioral addictions suggest promising effects of MPs (Brandtner et al., 2022; Sancho et al., 2018). However, only one of these reviews included studies on PUI (Brandtner et al., 2022), neither contained a meta-analysis, nor did they cover the growing number of international studies in the field. Thus, our first objective was to provide a comprehensive pre-registered overview of all existing studies on MPs to reduce PUI, our second objective was to provide the first meta-analytical quantification of the effectiveness of MPs to reduce PUI and screen time, and our third objective was to explore potential moderators.

METHODS

We followed the Preferred Reporting Items for Systematic Review guidelines (PRISMA; Page et al., 2021) in preparing this systematic review (see Supplemental Table S1). We pre-registered the systematic review at the International Prospective Register of Systematic Reviews (PROSPERO; #CRD42022350071) and published a detailed study protocol (Fendel & Schmidt, 2022)

Eligibility criteria

Population. We seek to draw conclusions about the effectiveness of MPs in reducing PUI in the entire population. Therefore, we did not restrict the investigation to a specific population, but examined differences between populations by moderator analyses (e.g., clinical vs. generic samples).

Interventions. We included programs with a clear emphasis on practicing mindfulness and excluded programs that may have incorporated mindfulness elements but that did not specifically emphasize it. Moreover, we included studies with established, standardized mindfulness programs such as Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn, 2005), Mindfulness-Based Cognitive Therapy (MBCT; Teasdale et al., 2000), Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 2011), or Dialectical Behavior Therapy (DBT; Linehan & Wilks, 2015).

Comparators and design. We conducted two distinct sets of meta-analyses. The first set focused on between-group data

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in randomized-controlled trials (RCTs), encompassing active, inactive, or waiting-list controls. The second set focused on within-group pre-post data in all kinds of intervention studies, encompassing both RCTs and non-randomized trials (NRTs). The NRTs encompassed controlled before-after studies (CBAs) and non-controlled before-after studies (NCBAs). With RCTs, the first set adhered to the gold standard for treatment effectiveness (Jones & Podolsky, 2015). The second set facilitated an analysis of pre-post improvements in all kinds of intervention designs and a comparison between study designs. These within-group pre-post effects may reflect a subjective benefit from the treatment, however, they do not allow for the inference of a causal treatment effect. This limitation arises because these within-group pre-post effects are influenced by various factors, including natural processes or demand effects, making it difficult to distinguish them from the actual treatment effect (Cuijpers, Weitz, Cristea, & Twisk, 2017). As we aimed to provide a comprehensive summary of all existing evidence in the emerging field of MPs for PUI, we included NRTs to ensure that important evidence wasn't overlooked at this stage.

Outcomes. The primary outcome was the change in PUI from pre- to post-intervention, assessed using validated self-report questionnaires, with or without clinical cut-offs. We treated these self-reports as dimensional indicators of PUI rather than categorical distinctions between those affected by PUI and those who are not. This is important because the use of single cut-off scores in the (self-)assessment of addictive behaviors is controversial (Billaux, Billieux, Baggio, Maurage, & Flayelle, 2023), and because there is a variety of self-report instruments for PUI, such as Young's Internet Addiction Test (IAT; Young, 1998) or the Bergen Social Media Addiction Scale (BSMAS; Andreassen et al., 2016), which are based on related but yet differing criteria. As a secondary outcome, we examined the effects of MPs on screen time, measured subjectively through self-reports or mechanically, for example, via Apps or screen shots of usage times.

Information sources and search strategy

We screened Medline, Embase, PsycINFO, PSYINDEX, the Cumulative Index of Nursing and Allied Health Literature (CINAHL), Web of Science, the Cochrane Register of Controlled Trials (CENTRAL), and Google Scholar, from data base inception to October 18, 2022. The search was not limited by language or publication date. We translated articles in languages other than English or German with the help of Google Translate, Google Lens, and DeepL (*DeepL SE*, 2023). Search terms were related to (1) mindfulness or MPs and (2) different forms of PUI. The search terms, database specific subject headings, and syntaxes are detailed in Supplemental Table S2. Furthermore, we conducted citations searches of all included studies and relevant reviews (Brandtner et al., 2022; Busch & McCarthy, 2021; Sancho et al., 2018; Sun, 2022). To find studies in the grey literature (including conference abstracts), we searched Google Scholar (search limited to study titles) and ResearchGate.

Study selection

We used EBSCOhost (*EBSCO Information Services*, 2023), the Systematic Review Accelerator (Clark et al., 2020), Rayyan (Ouzzani, Hammady, Fedorowicz, & Elmagarmid, 2016), and Zotero (Roy Rosenzweig Center for History and New Media, 2019) to remove duplicates and to screen and manage the references. Afterwards, two reviewers (JCF and AV) independently screened titles and abstracts. Full texts were obtained if at least one reviewer judged a reference to meet inclusion criteria. Subsequently, the two reviewers independently screened the full-texts of the references included up to that point. Disagreements were resolved through discussion. The chance-corrected agreement on inclusion was high both after title and abstract screening ($\kappa = 0.82$) and full-text screening ($\kappa = 0.86$).

Data extraction

Two reviewers independently extracted data from the eligible studies using a standardized Excel extraction form. We pilot tested the form with data from three studies and made modifications afterwards. Reviewers agreed on 95% of the extractions of relevant outcome data. Discrepancies were resolved through discussion. Where studies had missing or unclear data, we contacted the authors. We extracted data on the general characteristics of the study (authors, publication year, country, study design, reporting language, and type of control); the population (sample size, age, sex proportion, and studied population); the intervention (type of MP, treatment setting, format, number of sessions, duration, form of instructions, and integrity measurement); and the outcomes, including means and standard deviations (SDs) for all treatment conditions pre-intervention, post-intervention, and follow-up (if applicable). When SDs were not reported, we calculated them from standard errors (SE), or confidence intervals (CIs).

Quality of individual studies and overall quality of evidence

Two reviewers independently assessed the quality of individual studies, with disagreements being solved through discussion. For RCTs, we used the revised Cochrane risk-of-bias tool for randomized trials (RoB 2.0; Sterne et al., 2019), as it is the gold standard for rating the quality of RCTs. The RoB 2.0 tool assesses bias arising from (1) the randomization process, (2) deviations from intended interventions, (3) missing outcome data, (4) measurement of the outcome, and (5) selection of the reported result. In each domain, the evidence is rated as "low risk of bias", "some concerns", or "high risk of bias". Based on the domain-based ratings, a corresponding overall rating is derived. To account for the special nature of the studies included in this systematic review and meta-analysis (i.e., the participants could hardly be blinded), we made minor adjustments to the instrument (see Digital appendix A11).

In addition, we used the Effective Public Health Practice Project Quality Assessment tool for quantitative studies

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(EPHPP; Armijo-Olivo, Stiles, Hagen, Biondo, & Cummings, 2012) to rate the study quality of all individual studies, including RCTs and NRTs. With the EPHPP, the study quality is rated in eight domains: (1) selection bias, (2) study design, (3) confounders, (4) blinding, (5) data collection methods, (6) withdrawals and dropouts, (7) intervention integrity, and (8) quantitative analyses of single studies. In each domain, the evidence was rated as 'strong', 'moderate' or 'weak'. Based on the ratings in the first six domains, a corresponding overall rating was derived.

We assessed potential publication bias by analyzing funnel plots for asymmetry and conducting Egger's regression test (Egger, Smith, Schneider, & Minder, 1997), if the number of comparisons was at least ten (Higgins et al., 2022). We evaluated the overall quality of evidence across studies using the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) approach (Guyatt et al., 2008). With GRADE, the overall quality of evidence is evaluated separately for each outcome based on five dimensions: (1) risk of bias, (2) inconsistency of results, (3) indirectness of evidence, (4) imprecision of effect size, and (5) publication bias. The overall quality of evidence is then categorized as 'high', 'moderate', 'low', or 'very low', indicating confidence in the pooled effect for that specific outcome.

Effect measures and data syntheses

We used R (version 4.3.1) using the *meta* (Balduzzi, Rücker, & Schwarzer, 2019), *metaphor* (Viechtbauer, 2010), and *dmetar* packages (Harrer, Cuijpers, Furukawa, & Ebert, 2021). For the first set of meta-analyses on between group data in RCTs, we calculated the standardized mean differences (SMDs) by standardizing the pre-post intervention change in the treatment group minus the pre-post intervention change in the control group with the pooled standardized pre-intervention SD (Morris, 2008). By using pre-post intervention change values rather than post-intervention values, we aimed to increase the power and precision by removing between-person variability (Higgins et al., 2022). For the second set of meta-analyses on within-group pre-post data in all intervention studies, we calculated SMDs by standardizing the pre-post intervention change in MPgroups with the pre-intervention SD (Becker, 1988). We used the formulas provided by Viechtbauer (2007) to calculate the sample variance and SEs. Thereby, we assumed a correlation value of $r = 0.59$ for within-group pre-post analyses, which is the empirically derived median correlation from 811 median within-group correlations across 123 clinical trials (Balk, Earley, Patel, Trikalinos, & Dahabreh, 2012). In some cases, unclear information on dispersion values required contacting the authors and making assumptions (see Supplemental material S3).

We corrected for small samples bias by calculating *Hedges's g* values (Hedges & Olkin, 1985) and interpreted the magnitude of the effect sizes as small (0.20–0.49), medium (0.50–0.79), or large (≥0.80), according to Cohen (1988) criteria. We used the Hartung-Knapp adjusted generic inverse variance method with a random effects model in all analyses. We estimated the between-study heterogeneity using the DerSimonian-Laird estimator (DerSimonian & Laird, 1986) and evaluated it with I^2 statistic, indicating the percentage of the total variance between effects that is due to true effect-variation, with values of 0, 25, 50, and 75% being interpreted as no, low, moderate, and high heterogeneity, respectively (Higgins, 2003), as well as the prediction interval (PI), as range into which the true effect size of 95% of all populations will fall (i.e., indicator of true effect distribution; Borenstein, Higgins, Hedges, & Rothstein, 2017). We used various methods to pool the SMDs to investigate whether different pooling methods yield divergent outcomes (Cuijpers et al., 2023). For the main analysis model, we first aggregated all effect sizes available for each specific comparison in a particular study using the *aggregate* function from the *metafor* package (Viechtbauer, 2010), under the assumption of an intra-study correlation coefficient of $\rho = 0.6$ (Harrer et al., 2021). This procedure was applied when a single study measured an outcome with multiple instruments (Kim, 2012; W. Li, 2016) or when a study measured different types of the same outcome (Throuvala, Griffiths, Rennoldson, & Kuss, 2020). Afterwards, these aggregated effects were pooled across studies and comparisons. If a study contributed to more than one comparison and each comparison was included separately in the same aggregation, we divided the sample size by the number of comparisons, in order to prevent unit-of-analysis error caused by double-counting (Harrer et al., 2021). This occurred in studies comparing the effectiveness of a single MP group to multiple control groups (Maedehmoeinedini, Lotfi Kashani, & Shafiabadi, 2020).

In addition, we performed six sensitivity analyses to assess the robustness of the main analysis model. First, we merged all the effect sizes within one study to obtain a single aggregated effect size for each study (as opposed to each comparison in the main model). To combine the effect sizes of multiple control groups so that only one control group per study remained, we used the formula provided in the Cochrane Handbook (Higgins et al., 2022). Second, we excluded outliers utilizing the "non-overlapping confidence intervals" approach (Harrer et al., 2021), which regards a comparison as outlier, if the 95% confidence interval of the effect size does not overlap with the 95% confidence interval of the pooled effect size. Third, we pooled the effect sizes of all comparisons and only considered a) the smallest or b) the largest effect size in each study. Fourth, we pooled the effect sizes of all comparisons by excluding RCTs with high risk of bias in the first set of meta-analyses as well as studies with low study quality in the second set, respectively. Fifth, we considered potential publication bias using Duval and Tweedie's trim and fill procedure, which provides an estimate of the pooled effect size after adjusting for funnel plot asymmetry (Duval & Tweedie, 2000). Sixth, we assessed whether potential effects are sustained when using follow-up instead of post-intervention data. If a study provided multiple follow-up time points, we utilized the measurement furthest from baseline.

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Moderator analyses. On the basis of the main analysis model, we conducted subgroup analyses on characteristics of the studied populations (clinical versus generic), on characteristics of the implemented MPs, including the setting, the form of instructions provided, the format, and the general type of program (e.g., MBSR vs ACT), and on the varying impact of MPs on different sub forms of PUI. Regarding the classification of the characteristics of the implemented MPs, we faced the problem that 17 trials did not exhaustively report information on the setting, form of instruction, and the format. In these cases and following the standard implementation practice of MPs (Crane et al., 2017), the respective trials were classified as a guided treatment in a group format within a face-to-face setting, but only if such a setting and format were highly likely. A justification for this classification was, for example, if a single specific start date of the intervention was given for all participants. We also conducted post-hoc subgroup analyses on the type of control group in RCTs, the quality ratings in RoB 2.0 and EPHPP, the world region, and the language of report. In addition, we performed post hoc meta-regression analyses on the publication year, the gender distribution, the number of treatment sessions, and the total treatment duration. We conducted subgroup and meta-regression analyses only when data from at least ten studies were available within the respective comparison, and we omitted subgroups with fewer than three studies (Schwarzer, Carpenter, & Rücker, 2015).

Adaptations to registration and protocol

We included studies that measured screen time as an outcome of MPs, regardless of whether PUI was measured, and added screen time as a secondary outcome. Furthermore, we did not extract data on the backgrounds of treatment instructors as studies hitherto did not provide sufficient information. Finally, our initial goal was to assess the effectiveness of MPs in reducing PUI in one greater report together with the question of how is the relationship between PUI and mindfulness. However, due to the substantial differences in methodology and content, we have revised our approach and will now respond to each question separately in distinct reports.

RESULTS

Study selection

Our search yielded 3,473 records. After removing duplicates and screening titles, abstracts and full texts, 43 records met the inclusion criteria (see Supplemental Tables S4 and S5 for excluded studies along with reasons for exclusion). Notably, one study was reported in two separate records (Crosby, 2011; Crosby & Twohig, 2016), as was another study (Sniewski, 2020; Sniewski, Krägeloh, Farvid, & Carter, 2022), and one study was reported in three separate records (W. Li, 2016; W. Li, Howard, Garland, McGovern, & Lazar, 2018; W. Li, Garland, et al., 2017). These records were included as single studies, resulting in a total of 39 included studies (see Fig. 1).

Study characteristics

Detailed study characteristics are presented in Tables 1 and 2. The studies involved a total of 1,549 individuals, with 851 participating in an MBP and 698 in a control group. Among the 27 studies reporting mean age, the overall weighted mean age (weighted by sample size) was 20.6 years (SD = 3.9, range = 14.35–32.69). Out of the 33 studies that reported gender data, 44.85% of participants identified as female. Geographically, fifteen studies were conducted in East Asia (754 participants, 48.7%), ten in the Middle East (369 participants, 23.8%), five in North America (135 participants, 8.7%), four in Southeast Asia (64 participants, 4.1%), two in Europe (153 participants, 9.9%), two in South Asia (63 participants, 4.1%), and one in Oceania (11 participants, 0.7%). Twenty studies were published between 2010 and 2019, and 19 studies between 2020 and 2022. English was the reporting language for 21 studies, Persian for seven, Korean for six, Chinese for four, and Indonesian for one. The sample sizes in the included studies varied from five to 160, with a median of 30.

Twenty-two studies evaluated established types of MPs, including ACT (k = 11), MBCT (k = 4), MBSR (k = 3), and DBT (k = 2), and two studies evaluated apps or audio recordings. The remaining fifteen studies were classified as using "other" MPs, because they evaluated less-known, eclectic, or self-developed MPs. Of the 39 examined interventions, 32 were face-to-face, four remote/digital, and three were hybrid. Among these, 33 were group-based, and six were individual. Thirty-five studies used guided interventions, while four used self-help formats. The guided interventions ranged from one session (lasting several hours) to twelve, with a median of eight sessions and a median duration of 90 min per session. Intervention periods ranged from one day to twelve weeks. Only five studies reported measuring treatment fidelity, two did not, and 33 did not indicate whether they had measured it or not.

The studies employed a number of different instruments to measure PUI (see Tables 1 and 2). Out of the thirty-five studies providing data on PUI, twelve focused on unspecified PUI in general and 13 on mobile phone overuse. Nine studies measured specific types of PUI, with three examining pornography overuse, three online gaming, and four social media overuse. Among the ten studies providing data on screen time, nine used self-reported measures, and only one study used an Android application to capture screen time mechanically (Nam, Cho, & Noh, 2019).

Effects of MPs in reducing PUI

The results for the main and the sensitivity analyses for PUI are in Table 3. A forest plot for PUI in the between-group analysis in RCT is in Fig. 2, a forest plot for the within-group pre-post analysis in all studies is in Fig. 3. Participation in an MP was associated with a large reduction in PUI both as compared to control groups in RCTs and in within-group

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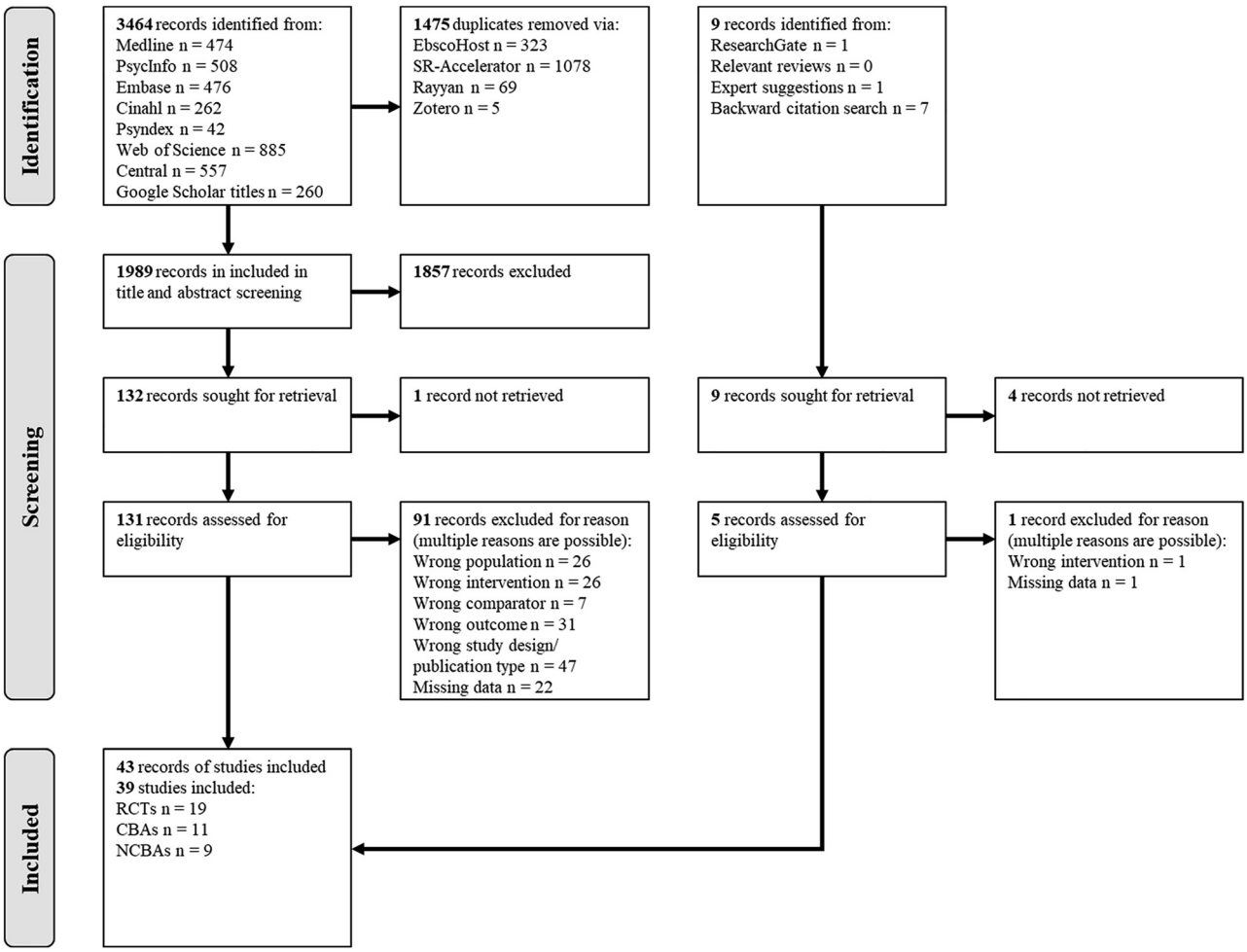

Fig. 1. PRISMA flowchart showing the inclusion and exclusion of records in a systematic review and meta-analysis on mindfulness programs for problematic usage of the internet

pre-post analysis. Both estimates revealed high heterogeneity.

Most sensitivity analyses showed comparable results. Specially, after removing seven outliers in RCTs and 16 outliers in within-group pre-post analysis, the effect sizes remained large, but the heterogeneity decreased to being moderate in RCTs and low in within-group pre-post analysis, with the prediction intervals no longer including zero. Egger's tests indicated publication bias in both sets of meta-analyses (see Supplemental Figs S6 and S7 for funnel plots). After adjustment with the trim and fill procedure, the effect sizes decreased considerably, while heterogeneity remained high. Taking follow-up data increased the effect sizes in RCTs and in within-group pre-post analysis, while high heterogeneity remained, but the prediction interval did not include zero in the within-group pre-post analysis.

Moderator analyses. The results of the subgroup analyses are in Table 4. For the between-group analysis in RCTs, inactive or waiting-list control groups were the predominant type of control group, showing larger effects than active control groups. Effects in studies from the Middle East were larger than those from East Asia, reducing heterogeneity to moderate, with a prediction interval no longer including zero. Similarly, studies reported in Persian had larger effects than those in English or Chinese. Furthermore, studies rated at high risk in ROB 2.0 showed larger effects than studies with some concerns.

For the within-group pre-post analysis, studies with clinical samples showed larger effects than those with generic samples. In addition, face-to-face programs showed larger effects than remote or hybrid settings and guided group formats showed larger effects than self-help individual programs. Furthermore, MPs were associated with larger effects on unspecified PUI for general internet overuse compared to overuse of mobile phones, social media, pornography, or online gaming. Studies conducted in the Middle East showed larger effects compared to East Asia, Southeast Asia, and North America. Studies reported in Chinese, Persian, or Korean were associated with larger effects than studies reported in English. The post-hoc meta-regression analyses did not find significant associations for publication year, gender distribution, number of treatment sessions, or total treatment duration.

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Table 1. Characteristics of studies and interventions of randomized-controlled trials (RCTs), included in a systematic review and meta-analysis on mindfulness programs for reducing problematic usage of the internet

Authors	Country Language of report	Control group (Details from publication)	Sample (Details from publication)	N (Interv./ Cntrl.)[a]	Male/ Female/ Other[b]	Age (SD)/ Range	Intervention Description (Length)	Intervention Setting, guidance, format	Follow-up	Primary outcome Measurement	Secondary outcome Measurement
Ahmadi, Nikomanesh, and Farnam (2021)	Iran Persian	Inactive/ Waiting-list (2 training sessions after post-test for the control group)	Generic (Male high school students)	40 (20/20)	40/0/0	n.i.	Mindfulness therapy training based on MBSR (8 1-hour sessions, 8 weeks)	Face-to-face, guided, group[c]	n.a.	Internet IAT (Young, 1998)	n.a.
Berenjabadi et al. (2021)	Iran Persian	Inactive/ Waiting-list[c]	Clinical (Male secondary school students with high scores on internet addiction)	40 (20/20)	40/0/0	15.58 (0.7)	ACT (8 2-hour sessions, 4 weeks)	Face-to-face, guided, group	4 weeks	Internet IAT (Young, 1998)	n.a.
Boroujen, Davoodi, and Zargrar (2020)	Iran Persian	Waiting-list	Clinical (High school students with a tendency to be addicted to the internet)	30 (15/15)	30/0/0	n.i.	ACT (10 sessions)	Face-to-face[c], guided, group	n.a.	n.a.	Screen time Hours of internet usage
Changrong (2021)	China Chinese	Active (Agomelatine tablets + Routine psychological counseling + Internet addiction risk education)	Clinical (Internet addiction disorder patients with depression)	88 (44/44)	52/36/0	n.i.	Mindfulness training + Agomelatine tablets + Routine psychological counseling + Internet addiction risk education (4 weeks)	Face-to-face[c], guided[c], group[c]	n.a.	Internet Internet Usage Questionnaire (IUQ; Changrong, 2021)	n.a.
Crosby (2011); Crosby and Twohig (2016)	USA (Utah) English	Waiting-list	Clinical (Male adults meeting criteria for pornography use)	27 (14/13)	28/0/0	29.3 (11.4)	ACT for problematic Internet pornography (Twohig & Crosby, 2010) (12 1-hour sessions, 12 weeks)	Face-to-face, guided, individual	12 weeks	n.a.	Screen time Daily Pornography Viewing Questionnaire (DPVQ; Collins, Parks, & Marlatt, 1985)

(continued)

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Table 1. Continued

Authors	Country Language of report	Control group (Details from publication)	Sample (Details from publication)	N (Interv./ Cntrl.)[a]	Male/ Female/ Other[b]	Age (SD)/ Range	Intervention Description (Length)	Intervention Setting, guidance, format	Follow-up	Primary outcome Measurement	Secondary outcome Measurement
Dongmei, Wenjing, Qun, and Jiaxin (2020)	China Chinese	Inactive	Clinical (College students with symptoms of mobile phone dependence)	26 (13/13)	13/13/0	n.i.	Short-term mindfulness training plus daily tasks through a mobile phone software "NOW" (2 1-hour, sessions, 2 weeks)	Mixed, guided[c], group	n.a.	Mobile phone Mobile Phone Addiction Index (MPAI; Leung, 2008)	n.a.
Ilanloo, Ahmadi, Zahrakar, and Cicognani (2022)	Iran English	Inactive	Clinical (Male high school student with high score >80 in internet addiction questionnaire)	30 (15/15)	30/0/0	n.i.	Mindfulness-based cognitive therapy group counseling (Burdick, 2014) (10 1.5-hour session, 10 weeks)	Remote, guided, group	8 weeks	Internet IAT (Young, 1998)	n.a.
Jain and Mahajan (2020)	India English	Active (Aerobic training)	Clinical (Smartphone addicted young individuals; SAS cutoff >90)	30 (15/15)	n.i.	19.8 (n.i.)/ 18–25	Mindfulness therapy with various mindfulness exercises (12 sessions, 6 weeks)	Face-to-face[c], guided[c], group	n.a.	Mobile phone Smartphone Addiction Scale (SAS; Kwon, Kim, Cho, & Yang, 2013)	n.a.
Jung and Son (2011)	South Korea Korean	Waiting-list	Clinical (College students meeting criteria for internet addiction)	24 (12/12)	9/15/0	n.i.	MBCT (10 1.5-hour sessions, 10 weeks)	Face-to-face[c], guided[c], group	4 weeks	Internet Adult Internet user self-report scale (Version of the K-Scale; Kang & Oh, 2001)	n.a.
Li (2016), Li, Garland, et al. (2017), Li, Garland, and Howard (2018)	USA (North Carolina) English	Active (Support group)	Clinical (University students and employees who self-identified with problems	29 (15/14)	24/5/1	25 (5.4)	MORE (8 2-hour sessions, 8 weeks)	Face-to-face[c], guided[c], group	12 weeks	Gaming DSM-5 internet gaming disorder diagnostic criteria (Petry & O'Brien, 2013)	n.a.

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Table 1. Continued

Authors	Country Language of report	Control group (Details from publication)	Sample (Details from publication)	N (Interv./ Cntrl.)[a]	Male/ Female/ Other[b]	Age (SD)/ Range	Intervention Description (Length)	Intervention Setting, guidance, format	Follow-up	Primary outcome Measurement	Secondary outcome Measurement
			with excessive video game playing)							and the Video Game Addiction Scale (VGAS; Lemmens, Valkenburg, & Peter, 2009).	
Li, Niu, and Mei (2017)	China Chinese	Inactive/ Waiting-list[c]	Clinical (Medical students who were determined to be addicted to smartphones)	20 (10/10)	7/13/0	19.2 (1.1)	Adapted MBSR - Mindfulness-based cognitive-behavioral group therapy (8 2,5-hour sessions, 8 weeks)	Face-to-face[c], guided[c], group	n.a.	Mobile phone Smartphone Addiction Scale (SAS; Kwon et al., 2013)	n.a.
Liu et al. (2021)	China English	Inactive (The control group received the same routine school health publicity as the intervention group)	Clinical (Adolescents diagnosed with internet addiction; cutoff ≥58 points in the internet addiction test)	121 (60/61)	91/30/0	15.25 (0.8)[d]	Logotherapy based mindfulness intervention + Routine school health publicity (8 1.5-hour sessions, 8 weeks)	Face-to-face[c], guided[c], group	n.a.	Internet Chen's Internet Addiction Scale (CIAS; Chen, Weng, & Su, 2001)	n.a.
Maedehmoeinedini et al. (2020)	Iran Persian	Waiting-list & (Integrative therapy, i.e., eclectic group therapy program)	Clinical (High school students, selected from among these students who had obtained high scores in the Internet Addiction Test)	40 (20/20)	n.i.	n.i.	DBT (8 sessions à 1.5 hours, 8 weeks)	Face-to-face[c], guided[c], group	4 weeks	Internet IAT (Young, 1998)	n.a.
Safari, Soleimanian, and Jajarmi (2022)	Iran Persian	Waiting-list	Clinical (High school girls with scores in the Internet Addiction Test above cutoff and more than 1 SD in social support below norm)	30 (15/15)	0/30/0	14–17	ACT - Matrix-Training (8 1.5 hour sessions; 8 weeks)	Face-to-face[c], guided[c], group	4 weeks	Internet IAT (Young, 1998)	n.a.

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Table 1. Continued

Authors	Country Language of report	Control group (Details from publication)	Sample (Details from publication)	N (Interv./ Cntrl.)[a]	Male/ Female/ Other[b]	Age (SD)/ Range	Intervention Description (Length)	Intervention Setting, guidance, format	Follow-up	Primary outcome Measurement	Secondary outcome Measurement
Shadbad (2017)	Iran English	Inactive	Clinical (High school girls with scores in the Internet Addiction Test above cut off >80)	24 (12/12)	0/24/0	18 (4.11)	Mindfulness-based cognitive group therapy (8 1.5 hour sessions; 8 weeks)	Face-to-face[c], guided[c], group	n.a.	Internet IAT (Young, 1998)	n.a.
Shameli, Moatamedi, and Borjali (2018)	Iran Persian	Inactive/ Waiting-list[c]	Clinical (Male students, graduated from secondary school, screened for internet gaming addiction)	64 (32/32)	64/0/0	14–16	MBCT (8 sessions, 8 weeks)	Face-to-face[c], guided[c], group	n.a.	Gaming Modified IAT (Young, 1998)	n.a.
Shorchi et al. (2020)	Iran Persian	Waiting-list	Clinical (High school girls with scores in the Internet addiction test above cutoff)	30 (15/15)	0/30/0	14.90 (5.46)[d]/ 12–18	Mindfulness group therapy focusing on the adjustment of incompatible schemas (8 1.5 hour sessions, probably 8 weeks)	Face-to-face[c], guided[c], group	4 weeks & 8 weeks	Internet IAT (Young, 1998)	n.a.
Throuvala et al. (2020)	UK English	Inactive	Generic (UK university students)	143 (72/71)	21/122/ 0	20.75 (3.49)[d]	3 Apps for mindfulness exercises (Headspace), self-monitoring and mood tracking (10 days)	Remote, self-help, individual	n.a.	Social media Bergen Social Media Addiction Scale (BSMAS; Andreassen et al., 2016)	Screen time Smartphone use/ day; Social media use/day)
Xiaoxu and Haixue (2014)	China Chinese	Active (Deprivation from smartphone weekdays from 8am–12am and	Clinical (College students from many different colleges with high scores on	60 (30/30)	39/21/0	22.02 (n.i.)	MBCT, Group counseling + family training (8 2-hour sessions, 4 weeks) +	Face-to-face, guided, group	n.a	Mobile phone Mobile Phone Addiction Index (MPAI; Leung, 2008)	n.a

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Table 1. Continued

Authors	Country Language of report	Control group (Details from publication)	Sample (Details from publication)	N (Interv./ Cntrl.)[a]	Male/ Female/ Other[b]	Age (SD)/ Range	Intervention Description (Length)	Intervention Setting, guidance, format	Follow-up	Primary outcome Measurement	Secondary outcome Measurement
		from 2pm–5pm [like intervention group])	mobile phone addiction)				Deprivation from smartphone weekdays from 8am–12pm and from 2pm–5pm				
Yu and Son (2016)	South Korea Korean	Inactive (The control group did not participate in the program. After the follow-up examination, a booklet related to ACT was provided to them along with a small gift)	Clinical (College students from three universities who gained more than 40 points [in SAPS-A scale])	18 (9/9)	7/11/0	22.69 (1.99)[d]	ACT, Restructured to focus on the treatment of smartphone addiction (8 2-hour sessions, 4 weeks)	Face-to-face, guided, group	4 weeks	Mobile phone Korean Smartphone Addiction Proneness Scale for Adults (SAPS-A; i.e., K-Scale; Shin et al., 2011)	n.a.

Abbreviations: Interv. = Intervention group; Cntrl. = Control group; SD = Standard deviation; RCT = Randomized-controlled trial; CBT = Cognitive-Behavior Therapy; DBT = Dialectical Behavior Therapy; MBSR = Mindfulness-Based Stress Reduction; MORE = Mindfulness-Oriented Recovery Enhancement; n.a. = not applicable; n.i. = no information.

[a]Number of participants taking part in the pre-intervention measurement of IUDs.

[b]Number of participants reported in the study; not necessarily equal to the number of participants taking part in the pre-intervention measurement.

[c]Not explicitly described, but probable.

[c]Mean and standard deviation were calculated by the authors themselves.

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Table 2. Characteristics of studies and interventions of non-randomized trials (NRTs), included in a systematic review and meta-analysis on mindfulness programs for problematic usage of the internet

Authors	Country Language of report	Design (Details for controls from publication)	Sample (Details from publication)	N (Interv./ Cntrl.)[a]	Male/ Female/ Other[b]	Age (SD)/ Range	Intervention Description (Length)	Intervention Setting; instruction, format	Follow-up	Primary outcome Measurement	Secondary outcome Measurement
Ahmad and Nurwianti (2020)	Indonesia English	NCBA	Clinical (Social media-addicted university students)	5	2/3/0	19.8 (1.3)[d]	ACT (4 sessions, 4 weeks)	Face-to-face, guided, group	2 weeks	Social media Bergen Social Media Addiction Scale (BSMAS; Andreassen et al., 2016)	n.a.
Eskawati, Ruhaena, and Asyanti (2019)	Indonesia Indonesian	CBA (Waiting-list)	Clinical (Adolescents with nomophobia scores in the (very) high categories)	14 (7/7)		n.i.	Adolescent mindfulness training module (8 1-hour sessions, 2 meetings with 4 sessions each)	Face-to-face, guided, group	n.a.	n.a.	Screen time Duration of smartphone use/day
Ha and Son (2016)	South Korea Korean	CBA (Inactive)	Clinical (College students with high levels of depression and smartphone addiction)	16 (8/8)		22.5 (n.i.)	ACT (8 1.5-hour sessions, 4 weeks)	Face-to-face, guided, group	6 weeks	Mobile phone Korean Smartphone Addiction Scale (K-Scale; Shin et al., 2011)	n.a.
Holas, Draps, Kowalewska, Lewczuk, and Gola (2021)	Poland English	NCBA	Clinical (Adult males with a diagnosis of compulsive sexual behavior disorder)	10	13/0/0	32.69 (5.74)	MBRP (8 2-hour session, 8 weeks)	Face-to-face[c], guided[c], group	n.a.	Pornography Brief Pornography Screener (BPS; Kraus et al., 2017),	Screen time Time spent using pornography (last week, in min.)
Jagadeesan and Sruti Lall (2019)	India English	NCBA	Generic (First year undergraduate female students)	33	0/33/0	18.3 (2.41)	Mindfulness based intervention for managing problematic usage of mobile phones (1 5-hour session, 1 day)	Face-to-face, guided, group	n.a.	Mobile phone Mobile Phone Problem Use Scale (MPPUS; Bianchi & Phillips, 2005)	n.a.
Ke and Cheng (2019)	Taiwan English	NCBA	Generic (Undergraduate and postgraduate students who are using the smartphone in past 3 months and will continue to use it in the following 3 months)	21	9/12/0	n.i.	App based mindfulness intervention: Autonomous daily mindfulness training [with] 9 mindful tasks + Group [discussions] for	Mixed, self-help, individual	n.a.	Mobile phone Smartphone Addiction Inventory (SPAI; Lin et al., 2017)	n.a.

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Table 2. Continued

Authors	Country Language of report	Design (Details for controls from publication)	Sample (Details from publication)	N (Interv./ Cntrl.)[a]	Male/ Female/ Other[b]	Age (SD)/ Range	Intervention Description (Length)	Intervention Setting; instruction, format	Follow-up	Primary outcome Measurement	Secondary outcome Measurement
							participants to discuss and promote the daily mindful practice (8 weeks)				
Kim (2012)	South Korea Korean	CBA (Attention control group)	Mixed (Second-year middle school students; high-risk user group (first recommended) and general user group)	20 (11/9)	17/3/0	14.35 (0.52)[d]	Mindfulness-based self-regulation program for internet craving (MBSRIC) (8 1-hour sessions, 4 weeks)	Face-to-face, guided, group	n.a.	Internet Korean Internet Addiction Scale (K-Scale; Kang & Oh, 2001)	Screen time Internet usage time during the week and during the weekend
Lan et al. (2018)	China English	CBA (Inactive[c])	Clinical (Students with smartphone addiction)	70 (41/29)	22/32/0	21.14 (1.66)[d]	Group mindfulness-based cognitive behavioral intervention (8 1-hour sessions, 8 weeks)	Face-to-face, guided, group	14 weeks & 20 weeks	Mobile phone Mobile Phone Internet Addiction Scale (MPIAS; Hu, Xu, Ding, & Li, 2017)	Screen time Self-reported smartphone use time
Levin, Heninger, Pierce, and Twohig (2017)	USA (Utah) English	NCBA	Clinical (Adults seeking help for problematic pornography viewing)	19	17/2/0	23.1 (4.48)	ACT self-help book on pornography viewing + weekly online check-ins (8 weeks)	Mixed, self-help, individual	8 weeks	Pornography Cyber-Pornography Use Inventory (CPUI; Grubbs, Sessoms, Wheeler, & Volk, 2010)	Screen time Weekly pornography viewing hours
Marmer and Nurwianti (2020)	Indonesia English	NCBA	Clinical (College students with social media addiction)	5	0/5/0	19.4 (1.14)[d]	ACT (4 2–3-hour sessions; 4 weeks)	Face-to-face, guided, group	n.i.	Social media Bergen Social Media Addiction Scale (BSMAS; Andreassen et al., 2016)	n.a.
Nam et al. (2019)	South Korea Korean	CBA (Stress management education)	Clinical (Undergraduate students at risk for smartphone addiction)	40 (21/19)	14/26/0	21.2 (1.51)	Mindfulness-Based Intervention, based on (Segal, Williams, & Teasdale, 2002) (4 1.5-hour sessions; 3 weeks)	Face-to-face[c], guided[c], group	2 weeks	Mobile phone Korean Smartphone Addiction Scale (K-Scale; Shin et al., 2011)	Screen time Android application to capture smartphone usage time mechanically

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Table 2. Continued

Authors	Country Language of report	Design (Details for controls from publication)	Sample (Details from publication)	N (Interv./ Cntrl.)[a]	Male/ Female/ Other[b]	Age (SD)/ Range	Intervention Description (Length)	Intervention Setting; instruction, format	Follow-up	Primary outcome Measurement	Secondary outcome Measurement
O'Connell (2020)	United Arab Emirates English	NCBA	Generic (University students)	21	7/14/0	n.i.	Adapted-ACT (training in basic mindfulness skills and values clarification as based on acceptance and commitment therapy concepts) (5 1-hour sessions, 5 weeks)	Face-to-face, guided, group	n.a.	Mobile phone Kwon's Smartphone Addiction Scale (SAS; Kwon et al., 2013)	n.a.
Siste, Hanafi, Sen, Alison, and Beatrice (2022)	Indonesia English	CBA (Online individual CBT for internet addiction, 4 sessions)	Clinical (Adults with internet addiction)	40 (20/20)	17/23/0	19.85 (1.64)[d]	DBT: Online group dialectical behavioral therapy for internet addiction (8 1.5-hour sessions, 8 weeks)	Remote, guided, group	n.a.	Internet IAT (Young, 1998)	n.i.
Sniewski (2020); Sniewski et al. (2022)	New Zealand English	NCBA	Clinical (Adult men who identify with self-perceived problematic pornography use)	11	12/0/0	31.58 (9.26)[d]	Guided meditation tracks (mindfulness [15-min] audio recordings, twice a day, 7–11 weeks)	Remote, self-help, individual		Pornography Problematic Pornography Consumption Scale (PPCS; Bőthe et al., 2018)	n.a.
Son (2017)	South Korea Korean	CBA (Waiting-list)	Clinical (College students ranked in the top 15% based on the total score of the smartphone addiction scale)	24 (12/12)	5/19/0	22.92 (2.59)[d]	MBCT (9 2-hour sessions, 9 weeks)	Face-to-face, guided, group	4 weeks	Mobile phone Behavioral Addiction Criteria-Based Smartphone Addiction Scale (Lee, Lim, Son, Kwak, & Chang, 2016)	n.a.
Twohig and Crosby (2010)	USA (Utah) English	NCBA	Clinical (Adult males who reported that their Internet pornography viewing was affecting their quality of life)	6	6/0/0	26.5 (6.69)[d]	ACT (8 1.5-hour sessions, 8 weeks; individual)	Face-to-face, guided, individual	12 weeks	n.a.	Screen time Time spent using pornography (in hours per day)

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Table 2. Continued

Authors	Country Language of report	Design (Details for controls from publication)	Sample (Details from publication)	N (Interv./ Cntrl.)[a]	Male/ Female/ Other[b]	Age (SD)/ Range	Intervention Description (Length)	Intervention Setting; instruction, format	Follow-up	Primary outcome Measurement	Secondary outcome Measurement
We, Seong-Goo, and Han (2018)	South Korea English	CBA (Inactive = The control group conducted a general class)	Generic (University students)	160 (88/72)		n.i.	Mindfulness meditation training (6 sessions, 6 weeks)	Face-to-face[c], guided[c], group[c]	n.a.	Mobile phone Korean Smartphone Addiction Scale (K-Scale; Shin et al., 2011)	n.a.
Weaver (2021)	USA (Florida) English	CBA (Inactive = Participants in the control group resumed class as normal)	Generic (High school students recruited from multiple sections of two classes; health and psychology)	54 (29/25)	32/22/0	n.i.	Mindful connections intervention, self-developed (Weaver & Swank, 2019) (5 50-min sessions, 5 weeks)	Face-to-face, guided, group	n.a.	Social Media Social Media Use Questionnaire (SMUQ; Xanidis & Brignell, 2016)	n.a.
Yao et al. (2017)	China English	CBA (Inactive = Healthy controls without intervention)	Clinical (Young adults with Internet gaming disorder; diagnosed through DSM-5 criteria plus at least 14 hours per week spent on internet gaming)	46 (25/21)		22.15 (1.94)[d]	Group behavioral intervention combining reality therapy and mindfulness meditation (6 2-hour sessions, 6 weeks)			Gaming Chen's Internet Addiction Scale (CIAS; Chen et al., 2001)	n.a.

Abbreviations: Interv. = Intervention group; Cntrl. = Control group; SD = Standard deviation; RCT = Randomized-controlled trial; CBT = Cognitive-Behavior Therapy; DBT = Dialectical Behavior Therapy; MBSR = Mindfulness-Based Stress Reduction; MBRP = Mindfulness-Based Relapse Prevention; n.a. = not applicable; n.i. = no information.

[a]Number of participants taking part in the pre-intervention measurement of IUDs.

[b]Number of participants reported in the study; not necessarily equal to the number of participants taking part in the pre-intervention measurement.

[c]Not explicitly described, but highly likely.

[c]Mean and standard deviation were calculated by the authors themselves.

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Table 3. Effects of mindfulness programs for reducing problematic usage of the internet (PUI) and screen time. Main and sensitivity analyses

Measure	*k*	*n*	*g*	*CI*	*p*	I^2	*CI* I^2	*PI*
PUI between-group, RCTs								
All comparisons	19	877	−1.67	[−2.15; −1.19]	****	88.7	[83.84; 92.10]	[−3.76; 0.42]
All studies	18	877	−1.67	[−2.14; −1.20]	****	88.29	[83.02; 91.93]	[−3.68; 0.34]
Outliers excluded	12	530	−1.37	[−1.71; −1.04]	****	64.92	[35.10; 81.04]	[−2.46; −0.28]
High risks excluded	9	493	−1.02	[−1.52; −0.52]	****	82.87	[68.88; 90.57]	[−2.72; 0.68]
One effect size per study (largest)	18	877	−1.75	[−2.25; −1.26]	****	89.01	[84.16; 92.37]	[−3.88; 0.37]
One effect size per study (smallest)	18	877	−1.57	[−2.04; −1.10]	****	88.12	[82.73; 91.82]	[−3.58; 0.44]
Adjusted for publication bias	25	1,083	−0.91	[−1.45; −0.38]	***	92.13	[89.60; 94.05]	[−3.58; 1.76]
Follow-up	7	250	−2.42	[−3.35; −1.49]	****	85.37	[71.80; 92.41]	[−5.59; 0.75]
PUI within-group pre-post, all studies								
All comparisons	35	788	−1.67	[−1.99; −1.36]	****	90.07	[87.22; 92.28]	[−3.42; 0.08]
All studies	35	788	−1.67	[−1.99; −1.36]	****	90.07	[87.22; 92.28]	[−3.42; 0.08]
Outliers excluded	18	348	−1.39	[−1.58; −1.20]	****	40.09	[00.00; 65.83]	[−1.97; −0.81]
One effect size per study (largest)	35	788	−1.69	[−2.01; −1.37]	****	90.19	[87.39; 92.36]	[−3.46; 0.07]
One effect size per study (smallest)	35	788	−1.67	[−1.98; −1.35]	****	90.05	[87.20; 92.27]	[−3.41; 0.08]
Low quality excluded	10	225	−1.44	[−1.88; −1.01]	****	81.95	[68.01; 89.82]	[−2.93; 0.04]
Adjusted for publication bias	49	1,064	−0.84	[−1.19; −0.50]	****	92.58	[90.98; 93.89]	[−3.10; 1.41]
Follow-up	15	227	−2.55	[−3.20; −1.89]	****	84.85	[76.47; 90.25]	[−5.08; −0.01]
Screen time between-group, RCTs								
All comparisons	2	n.a.	n.a.	n.a.		n.a.	n.a.	n.a.
Screen time within-group pre-post, all studies								
All comparisons	10	196	−0.65	[−0.90; −0.41]	****	55.48	[09.49; 78.10]	[−1.35; 0.04]
All studies	10	196	−0.65	[−0.90; −0.41]	****	55.48	[09.49; 78.10]	[−1.35; 0.04]
Outliers excluded	10	196	−0.65	[−0.90; −0.41]	****	55.48	[09.49; 78.10]	[−1.35; 0.04]
One effect size per study (largest)	10	196	−0.68	[−0.94; −0.42]	****	58.65	[16.77; 79.45]	[−1.42; 0.06]
One effect size per study (smallest)	10	196	−0.64	[−0.88; −0.40]	****	54.78	[07.89; 77.80]	[−1.32; 0.04]
Low quality excluded	3	62	−0.59	[−1.18; 0.01]		80.33	[38.02; 93.76]	[−7.66; 6.48]
Adjusted for publication bias	14	241	−0.44	[−0.70; −0.18]	***	67.03	[42.25; 81.17]	[−1.32; 0.43]
Follow-up	4	73	−0.36	[−0.66; −0.06]	*	42.45	[0; 80.67]	[−1.45; 0.72]

Note. We omitted main and sensitivity analyses for subgroups with fewer than three studies.
Abbreviations: *PUI* = Problematic usage of the internet, *CI* = Confidence interval, *PI* = Prediction interval.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$; $^{****}p < 0.0001$.

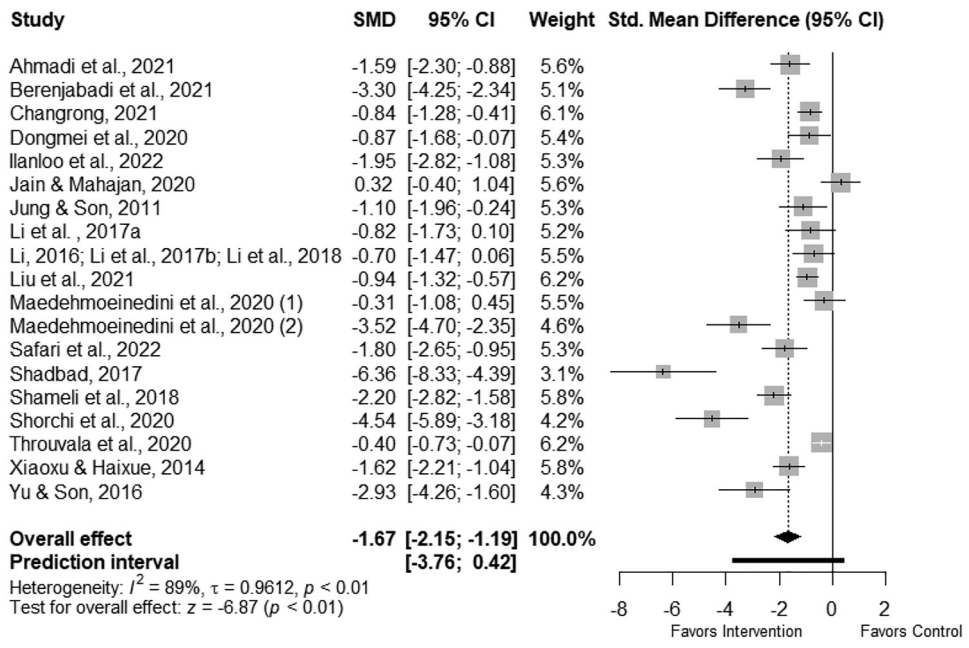

Fig. 2. Forest plot displaying the between-group effect in RCTs of mindfulness programs for reducing problematic usage of the internet

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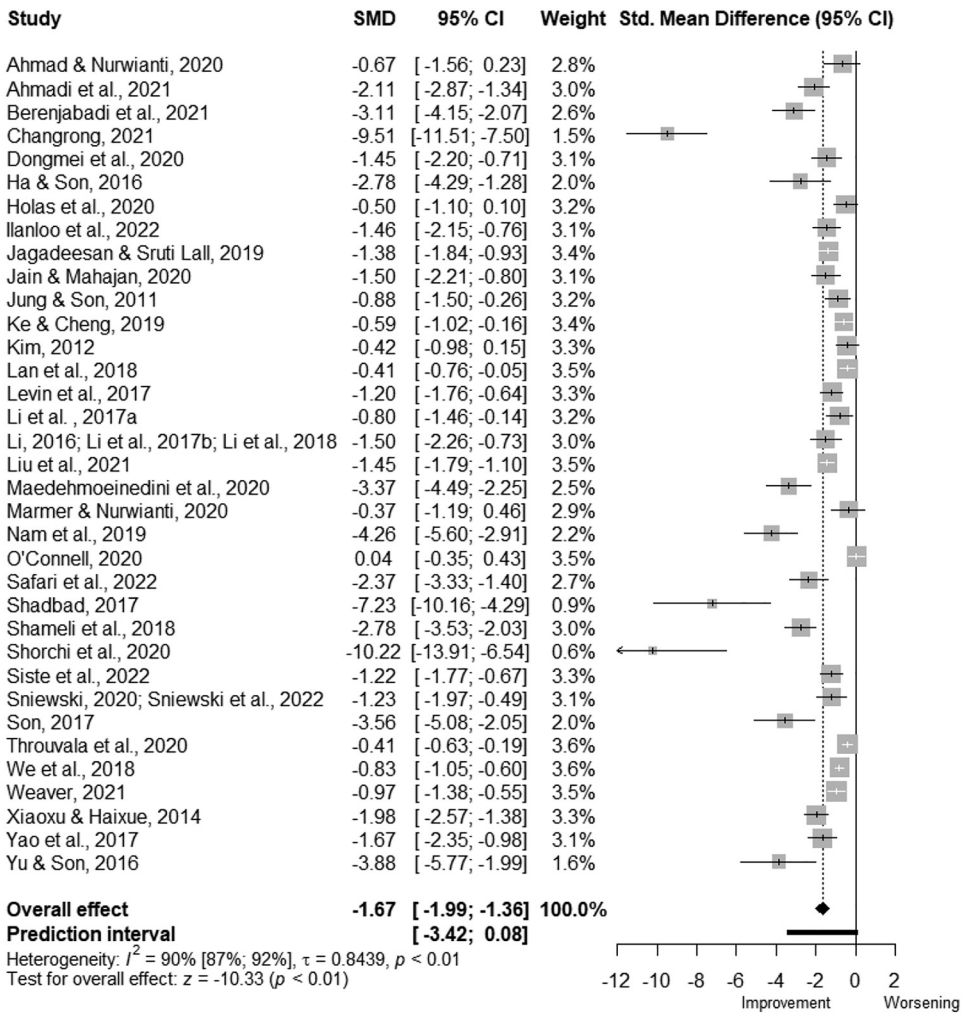

Fig. 3. Forest plot displaying the within-group pre-post effect in intervention studies of mindfulness programs for reducing problematic usage of the internet

Effects of MPs on screen time

Two RCTs examined the effect of MPs on screen time. One RCT showed an effect of an MP on social media screen time but not on unspecified smartphone screen time, when compared to an inactive control group (Throuvala et al., 2020). The other RCT reported a significant between group effect on pornography viewing when compared to a waiting-list group (Crosby, 2011; Crosby & Twohig, 2016). Ten studies provided within-group pre-post data on screen time. The results for the main and the sensitivity analyses for screen time for the within-group pre-post analysis across all studies are in Table 5, a forest plot is in Fig. 4. Participation in an MP was associated with a moderate within-group pre-post reduction in screen time. Heterogeneity was moderate, with a prediction interval including zero. After removing studies rated low quality in EPHPP, the effect was no longer significant. Egger's tests did not indicate publication bias (see Supplemental Figure S8 for a funnel plot). While still being significant, taking follow-up data decreased the effect size and heterogeneity turned low. However, with this limited number of comparisons, interpreting heterogeneity is problematic (Higgins et al., 2022).

Moderator analyses. None of the subgroup and meta-regression analyses for screen time were significant (see Table 6).

Quality assessment in included studies and overall quality of evidence

Overall, the RoB 2.0 assessment showed a high risk of bias in ten RCTs and some concerns in the remaining nine (see Supplemental Tables S9 and S10). An important driver of the high risk rating was domain 4 of RoB 2 (i.e., measurement of the outcome), where most of the studies (18 out of 19) were rated with at least some concerns. This can be explained by the fact that blinding to treatment conditions was difficult and that most outcome measures were based on self-reports. In addition, the majority of RCTs poorly described the randomization process (domain 1) and rarely reported dropout rates (domain 3). There were no

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Table 4. Subgroup analyses for mindfulness programs for reducing problematic usage of the internet (PUI)

PUI	Subgroup	*k*	*n*	*g*	*CI*	*p*	I^2	*CI* I^2	*PI*	*Q*	*p sg*
Between-group, RCTs											
Type of MP	MP	6	325	−1.31	[−2.09; −0.52]	**	88.73	[78.04; 94.21]	[−4.03; 1.41]	5.39	
	MBSR	3	124	−1.59	[−2.34; −0.85]	****	67.49	[0; 90.60]	[−10.02; 6.83]		
	ACT	3	88	−2.63	[−3.63; −1.64]	****	64.77	[0; 89.89]	[−13.68; 8.41]		
	MBCT	3	108	−2.73	[−4.65; −0.81]	**	91.46	[78.07; 96.68]	[−26.33; 20.87]		
Type of control	Inactive/ Waiting-list	14	640	−2.11	[−2.74; −1.49]	****	90.02	[85.03; 93.34]	[−4.59; 0.36]	10.64	**
	Active	5	237	−0.66	[−1.27; −0.05]	*	78.45	[48.42; 91.00]	[−2.84; 1.52]		
Outcome	Internet (general)	11	487	−2.16	[−2.87; −1.45]	****	89.56	[83.35; 93.46]	[−4.76; 0.45]	3.11	
	Mobile phone	5	154	−1.11	[−2.03; −0.18]	*	84.41	[65.07; 93.04]	[−4.5; 2.29]		
World region	Middle East	9	318	−2.65	[−3.53; −1.78]	****	87.85	[79.09; 92.95]	[−5.75; 0.44]	9.62	**
	East Asia	7	357	−1.15	[−1.52; −0.79]	****	53.76	[0; 80.24]	[−2.16; −0.15]		
Language of report	Persian	7	264	−2.38	[−3.30; −1.46]	****	87.42	[76.39; 93.30]	[−5.56; 0.79]	6.58	*
	Chinese	4	194	−1.06	[−1.48; −0.65]	****	40.23	[0; 79.74]	[−2.54; 0.41]		
	English	6	377	−1.24	[−2.05; −0.43]	**	90.42	[81.88; 94.93]	[−4.01; 1.54]		
RoB 2.0 rating	High	10	384	−2.41	[−3.26; −1.57]	****	90.08	[83.90; 93.89]	[−5.47; 0.64]	7.78	**
	Some concerns	9	493	−1.02	[−1.52; −0.52]	****	82.87	[68.88; 90.57]	[−2.72; 0.68]		
Within-group pre-post, all studies											
Population	Clinical	27	493	−2.09	[−2.53; −1.65]	****	88.81	[84.93; 91.69]	[−4.27; 0.09]	18.82	****
	Generic	7	284	−0.82	[−1.19; −0.45]	****	86.79	[75.00; 93.03]	[−2.08; 0.44]		
Setting	Face-to-face	28	617	−1.93	[−2.33; −1.52]	****	91.06	[88.24; 93.20]	[−3.97; 0.12]	9.71	**
	Mixed	3	53	−1.02	[−1.55; −0.50]	***	61.69	[0; 89.07]	[−6.76; 4.72]		
	Remote	4	118	−1.03	[−1.63; −0.42]	***	81.77	[52.72; 92.97]	[−3.71; 1.66]		
Instruction	Guided	31	665	−1.84	[−2.21; −1.48]	****	90.12	[87.09; 92.44]	[−3.77; 0.09]	14.61	***
	Self-help	4	123	−0.77	[−1.18; −0.36]	***	70.33	[14.91; 89.65]	[−2.48; 0.94]		
Format	Group	31	665	−1.84	[−2.21; −1.48]	****	90.12	[87.09; 92.44]	[−3.77; 0.09]	14.61	***
	Individual	4	123	−0.77	[−1.18; −0.36]	***	70.33	[14.91; 89.65]	[−2.48; 0.94]		
Type of MP	MP	14	410	−1.69	[−2.17; −1.20]	****	91.55	[87.56; 94.25]	[−3.56; 0.18]	2	
	ACT	8	102	−1.63	[−2.53; −0.74]	***	89.57	[81.82; 94.01]	[−4.72; 1.45]		
	MBCT	4	66	−2.78	[−4.27; −1.29]	***	88.84	[74.07; 95.20]	[−9.41; 3.85]		
	MBSR	3	62	−1.88	[−3.07; −0.70]	**	87.52	[64.77; 95.58]	[−16.49; 12.72]		
Outcome	Mobile phone	13	308	−1.47	[−1.93; −1.01]	****	88.63	[82.38; 92.66]	[−3.17; 0.24]	32.29	****
	Internet (general)	12	264	−2.8	[−3.62; −1.98]	****	92.23	[88.30; 94.84]	[−5.85; 0.25]		
	Social media	4	111	−0.06	[−0.94; −0.26]	****	47.99	[0; 82.76]	[−1.85; 0.65]		
	Pornography	3	40	−0.96	[−1.44; −0.49]	****	42.5	[0; 82.64]	[−5.64; 3.72]		
	Online gaming	3	65	−1.98	[−2.76; −1.20]	****	70.24	[0; 91.28]	[−10.86; 6.9]		
World region	East Asia	15	384	−1.83	[−2.34; −1.33]	****	91.22	[87.20; 93.97]	[−3.83; 0.16]	16.07	**
	Middle East	9	170	−2.99	[−4.19; −1.79]	****	93.97	[90.60; 96.13]	[−7.22; 1.25]		
	Southeast Asia	3	30	−0.84	[−1.37; −0.30]	**	37.06	[0; 80.08]	[−5.92; 4.25]		
Language	English	19	496	−0.98	[−1.24; −0.72]	****	81.81	[72.60; 87.92]	[−2.04; 0.08]	27.87	****
	Persian	6	122	−3.07	[−3.94; −2.19]	****	75.93	[45.87; 89.29]	[−5.88; −0.26]		
	Chinese	4	97	−3.1	[−4.99; −1.21]	**	95.5	[91.36; 97.66]	[−12.07; 5.87]		
	Korean	6	73	−2.49	[−3.80; −1.18]	***	89.85	[80.61; 94.69]	[−7.05; 2.07]		
EPHPP rating	Weak	25	563	−1.8	[−2.22; −1.38]	****	91.65	[88.91; 93.72]	[−3.81; 0.21]	0.75	
	Moderate	8	190	−1.5	[−2.04; −0.96]	****	85.69	[73.77; 92.20]	[−3.29; 0.29]		
Design	RCT	18	429	−2.45	[−3.06; −1.85]	****	92.67	[89.86; 94.70]	[−5.02; 0.11]	21.85	****
	CBA	9	234	−1.43	[−1.92; −0.93]	****	86.35	[76.06; 92.21]	[−3.06; 0.21]		
	NCBA	8	125	−0.73	[−1.14; −0.33]	***	75.81	[51.53; 87.93]	[−2.05; 0.59]		

Note. We conducted subgroup analyses only when data from at least ten studies were available within the respective comparison and omitted subgroups with fewer than three studies.

Abbreviations: *CI* = Confidence interval; *PI* = Prediction interval; *p sg* = *p*-value for subgroup comparison.

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; ****$p < 0.0001$.

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Table 5. Effects of mindfulness programs for reducing screen time – Main and sensitivity analyses

Screen time within-group pre-post, all studies	*k*	*n*	*g*	*CI*	*p*	I^2	*CI* I^2	*PI*
All comparisons	10	196	−0.65	[−0.90; −0.41]	****	55.48	[09.49; 78.10]	[−1.35; 0.04]
All studies	10	196	−0.65	[−0.90; −0.41]	****	55.48	[09.49; 78.10]	[−1.35; 0.04]
Outliers excluded	10	196	−0.65	[−0.90; −0.41]	****	55.48	[09.49; 78.10]	[−1.35; 0.04]
One effect size per study (largest)	10	196	−0.68	[−0.94; −0.42]	****	58.65	[16.77; 79.45]	[−1.42; 0.06]
One effect size per study (smallest)	10	196	−0.64	[−0.88; −0.40]	****	54.78	[07.89; 77.80]	[−1.32; 0.04]
Low quality excluded	3	62	−0.59	[−1.18; 0.01]		80.33	[38.02; 93.76]	[−7.66; 6.48]
Adjusted for publication bias	14	241	−0.44	[−0.70; −0.18]	***	67.03	[42.25; 81.17]	[−1.32; 0.43]
Follow-up	4	73	−0.36	[−0.66; −0.06]	*	42.45	[0; 80.67]	[−1.45; 0.72]

Note. We omitted main and sensitivity analyses for subgroups with fewer than three studies.
Abbreviations: *PUI* = Problematic usage of the internet, *CI* = Confidence interval, *PI* = Prediction interval.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$; $^{****}p < 0.0001$.

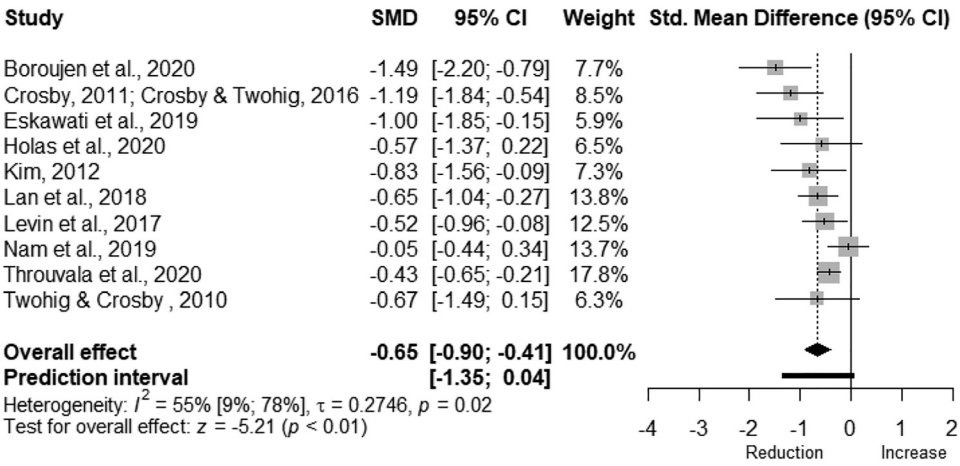

Fig. 4. Forest plot displaying the within-group pre-post effect in intervention studies of mindfulness programs for reducing screen time

Table 6. Subgroup analyses for mindfulness programs for reducing screen time

Screen time within-group pre-post, all studies	Subgroup	*k*	*n*	*g*	*CI*	*p*	I^2	*CI* I^2	*PI*	*Q*	*p sg*
Format	Group	6	85	−0.71	[−1.13; −0.29]	***	67.09	[21.69; 86.17]	[−2.01; 0.59]	0.18	
	Individual	4	111	−0.6	[−0.89; −0.30]	****	38.65	[0; 79.05]	[−1.62; 0.43]		
EPHPP rating	Weak	7	134	−0.69	[−0.96; −0.41]	****	38.3	[0; 74.03]	[−1.35; −0.02]	0.09	
	Moderate	3	62	−0.59	[−1.18; 0.01]		80.33	[38.02; 93.76]	[−7.66; 6.48]		

Note. We conducted subgroup analyses only when data from at least ten studies were available within the respective comparison and omitted subgroups with fewer than three studies.
Abbreviations: *CI* = Confidence interval; *PI* = Prediction interval; *p sg* = *p*-value for subgroup comparison.
$^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$; $^{****}p < 0.0001$.

significant signs of deviations from the intended treatment (domain 2) or selective reporting of results (domain 5).

The EPHPP rating for the within-group pre-post analyses showed similar results to the RoB 2.0 rating, with most of the studies being rated as having either a weak ($k = 28$) or moderate ($k = 9$) overall study quality, and only two studies as having a strong overall study quality (see Supplemental Tables S11 and S12). These ratings were substantially driven by challenges in blinding participants to treatment conditions, leading to a lower score in EPHPP domain 4 (i.e., blinding). Again, the EPHPP score was affected by incomplete reporting of missing outcome data, resulting in lower score in domain 6 (i.e., withdrawals and dropouts). Another source of downgraded study quality was domain 1 (i.e., selection bias), because, although most studies defined a cut-off criterion for participation, study participation was self-referred and did not involve a random selection from eligible target participants.

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GRADE

The overall quality of evidence for the results of the meta-analyses was rated as low to very low, depending on the outcome assessed, mainly because of a generally high risk of bias, inconsistency between studies, and likely publication bias (see Supplemental Table S13).

DISCUSSION

There has been a large increase in studies examining mindfulness programs to reduce problematic usage of the internet. To our knowledge, this is the first comprehensive systematic review and meta-analysis to synthesize all these studies. We identified 39 independent studies from various countries, published in five languages. We found that MPs were associated with a large effect on PUI, both when compared to controls in RCTs and within intervention groups from pre- to post-intervention. Moreover, MPs were associated with a medium reduction in screen time in within-group pre-post analysis. However, heterogeneity was high and the overall evidence was rated low to very low. Accordingly, strong conclusions should be drawn cautiously. Nonetheless, the effects were robust across an extensive series of sensitivity analyses.

We conducted moderator analyses to clarify whether specific characteristics of the MPs influence their effect. Our findings revealed no significant differences among various types of MPs in relation to PUI. Meanwhile, in RCTs, the effect of MPs was smaller compared to active controls than to inactive or waiting-list controls. This finding aligns with previous meta-analyses and may be associated with inflated effect sizes in trials employing waiting-list or inactive control group designs (Cuijpers et al., 2021, 2023). The fact that the majority of the included RCTs used waiting-list or inactive controls relativizes the large aggregated between-group effect that we found for PUI. Moreover, the effect-sizes were larger for intervention groups in RCTs than in CBAs and even more so than in NCBAs. This could be explained by the notion that the highly structured environment of RCTs, and to some extent that of CBAs too, might encourage better treatment adherence (Etzelmueller et al., 2020). When comparing subtypes of PUI, MPs were associated with larger within-group pre-post effect sizes on measures of unspecified PUI compared to measures of mobile phone overuse or specific forms of PUI. This might be a matter of assessment tools, where measuring more specific behaviors may lead to narrower effects because they are more limited in scope and applicability. Moreover, MPs in face-to-face settings were associated with larger within-group pre-post effects for PUI than remote or hybrid settings, consistent with a meta-analysis on psychological interventions for gambling disorder (Eriksen et al., 2023). Similarly, guided group formats were associated with larger within-group pre-post effects for PUI than individual self-help programs, which might be due du perceived group cohesiveness and bond (Hall & Larkin, 2020). However, these finding should be interpreted cautiously because many studies did not provide comprehensive descriptions of treatment characteristics. Finally, the finding that clinical samples showed a larger within-group pre-post effects in PUI than generic samples could be due to a floor effect, as individuals with less severe conditions have less room for improvement.

Significant differences were observed between world regions and reporting languages in terms of their impact on PUI. Studies conducted in the Middle East or published in Persian had significantly larger between-group effects than those conducted in Asia or published in English or Chinese. This may be because RCTs from the Middle East or trials published in Persian were often rated to be high risk studies, which generally showed larger effects than those rated with some concerns. However, in the within-group pre-post analysis, effect sizes in studies reported in Persian, Chinese or Korean were similar in size and all of them were larger than those reported in English. Future international multicenter studies should investigate these potential geographic and cultural influences.

Concerning screen time, with only two RCTs, meta-analytical pooling for a between-group effect was not appropriate. Nevertheless, within-group pre-post analysis indicated that MPs were associated with a medium reduction in screen time. This effect remained robust in the sensitivity analyses, except when excluding low quality studies.

In summary, the potential effects of MPs on PUI and screen time could be explained by the notion that when participants cultivate greater mindfulness, they might engage with the internet more purposefully, moving away from impulsive attempts to cope with negative affect (Wegmann, Schiebener, & Brand, 2023). This may lead to less excessive use and less time intensity, resulting in fewer symptoms of PUI.

Quality of the evidence and future perspectives

When interpreting the results and planning future studies, the following aspects should be considered. Importantly, the overall quality of the evidence was rated as low to very low, highlighting the need for more rigorous, systematic, and high-quality methodological research approaches in the field. In particular, RCTs described randomization procedures poorly and rarely compared MPs with active controls, making it difficult to assess specific treatment effects (Boot, Simons, Stothart, & Stutts, 2013). In addition, heterogeneity between studies was high, treatment fidelity was rarely assessed (with the exception of e.g. Crosby, 2011; Crosby & Twohig, 2016; Levin et al., 2017; Li, 2016; Li et al., 2017, 2018; Sniewski, 2020; Sniewski et al., 2022; Twohig & Crosby, 2010), and PUI measurements lacked consistent cutoffs and validation by structured diagnostic interviews (with the exception of e.g. Crosby, 2011; Crosby & Twohig, 2016; Holas et al., 2021; Li, 2016; Li et al., 2017, 2018; Twohig & Crosby, 2010; Yao et al., 2017) that are based on

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uniform psychopathological criteria. These inconsistencies clearly indicate the need to achieve consensus in the ongoing taxonomic and nosological debate in the field to reduce measurement variations and minimize heterogeneity (Basenach et al., 2023). Moreover, only one study measured screen time mechanically, while all others used potentially inaccurate self-reports (Sewall, Bear, Merranko, & Rosen, 2020). Further, the predominantly student samples with a low weighted mean age pose a limitation to the generalizability of the findings and future studies should cover a broader demographic range. Importantly, because adolescents and young adults seem to be disproportionately affected by PUI compared to other age groups (Neumann & Lindenberg, 2022; Olson et al., 2022), it is important to consider the developmental appropriateness of mindfulness training for this age group. Notably, the response to mindfulness training varies across developmental periods (e.g., middle childhood, early to late adolescence), likely due to distinctive changes in specific brain regions and networks during these periods, and such changes may predispose individuals to differentially respond to mindfulness training (Carsley, Khoury, & Heath, 2018). Despite these variations, meta-analyses consistently demonstrate the feasibility and effectiveness of mindfulness training among youth (Klingbeil et al., 2017), particularly during late adolescence (15–18 years; Carsley et al., 2018), aligning with findings from studies included in our systematic review and meta-analysis involving late adolescents (Berenjabadi, Pourhosein, & Ghasemi Argene, 2021; Kim, 2012; Liu, Jiang, & Zhang, 2021; Shorchi, Javadi, Davaie, & Farokhi, 2020). The heightened plasticity of the adolescent brain may provide a "window of opportunity" for MPs to be effective in this age group (Roeser & Pinela, 2014). However, as MPs are increasingly integrated into school settings for this age group, it is imperative that the design, implementation, and future research account for factors such as developmental stage, cognitive abilities, pedagogical demands, motivation, and peer support/pressure to ensure students' adherence to the programs and to maximize the benefits they experience (Carsley et al., 2018). Moreover, the included studies inadequately reported information on potential adverse effects of the MPs, despite their recognized significance (Baer, Crane, Miller, & Kuyken, 2019). This lack to acknowledge potential adverse effects is common in research and dissemination of MPs and needs to be addressed in future research (Goldberg, Riordan, Sun, & Davidson, 2022). Importantly, because PUI often co-occurs with other adverse conditions (Müller et al., 2023), reducing PUI does not guarantee overall stable mental health. Therefore, future studies should also examine transfer effects of MPs on general well-being, mental health, and social functioning. Finally, many moderator analyses were limited by the small number of studies, making it challenging to detect potential influences. Additionally, some moderators examined may not have been entirely independent. For instance, studies with clinical samples more often applied ACT or MBCT compared to studies with generic samples. Thus, future studies should directly compare various characteristics of MPs (e.g., self-help vs. individual) or even different types of MPs (e.g., ACT vs. MBCT vs. other programs) to elucidate which treatment features contribute to treatment effects.

In summary, existing research indicates that mindfulness practice can positively alter neurocognitive mechanisms associated with the development, maintenance, and resolution of symptoms of PUI and other addictive disorders (Brandtner et al., 2022; Rosenthal et al., 2021). The present study contributes evidence supporting the effectiveness of MPs in reducing these symptoms. Future studies should explore the link between these two areas of research by investigating how the altered neurocognitive mechanisms mediate the observed reductions in symptoms of PUI through mindfulness practice. These insights could provide valuable contributions to the advancement of MPs for PUI.

Strengths and limitations of the review process

The present systematic review and meta-analysis has strengths. First, we pre-registered the study at PROSPERO and published a detailed study protocol. Moreover, two independent reviewers conducted all steps of the screening process, data extraction, and risk-of-bias assessment, ensuring a high degree of consistency. Additionally, we employed a comprehensive search strategy without language or date restrictions. This approach improved the generalizability of the findings by guarding against potential bias towards "WEIRD" samples, which tends to include primarily samples from western, educated, industrialized, rich, and democratic societies (Henrich, Heine, & Norenzayan, 2010).

The present work also has limitations. First, balancing the study objectives was challenging. On the one hand, synthesizing all available evidence on MPs for PUI including all kinds of interventional designs required broad inclusion criteria. Specifically, we included ACT and DBT under the umbrella term *mindfulness programs*, which differs from other systematic reviews and meta-analyses that only included so-called *mindfulness-based programs* such as MBSR and MBCT (Goldberg et al., 2018). ACT and DBT may or may not incorporate formal mindfulness meditation practices (Crane et al., 2017), but rather teach non-meditative mindfulness techniques that promote mindfulness skills using experiential exercises, stories, and metaphors (Burke, 2010; Shapero et al., 2018). Nevertheless, mindfulness is considered as core component of both ACT and DBT curricula (Shapero et al., 2018), and these programs are often studied alongside mindfulness-based programs in systematic reviews and meta-analyses under the broader term *mindfulness programs/interventions* (Pseftogianni, Panagioti, Birtwell, & Angelakis, 2023) or *mindfulness and acceptance-based programs* (Cavanagh, Strauss, Forder, & Jones, 2014; Johannsen, Nissen, Lundorff, & O'Toole, 2022). On the other hand, meta-analyzing this evidence would normally call for narrower inclusion criteria. To address this challenge with the resulting broad dataset, we employed a rigorous study coding process, comprehensively assessed risk of bias indicators, and performed a series of moderator analyses. Second, the search strategy included terms for PUI but not

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for screen time, limiting the comprehensiveness for the secondary outcome. Finally, we utilized AI-based translation for non-English/non-German studies, which, on the one hand, counts as a strength of the work-intensive study at hand (i.e., non-WEIRD sample), but, on the other hand, may have introduced translation errors. To address this, two reviewers double-checked the translations.

CONCLUSIONS

Based on the 39 studies included in this systematic review and meta-analysis, and taking into account the limitations mentioned above, MPs are probably effective in reducing self-reported PUI. Between-group data on screen time were insufficient, but within-group pre-post data suggest a potential effect of MPs on screen time. However, heterogeneity was high and the overall quality of evidence was rated low to very low. Therefore, more high-quality studies with larger samples, controlled study methods, standardized and reproducible treatment protocols, and long-term follow-ups are needed to confirm the results.

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Authors' contribution: JCF was mainly responsible for the study design and conduct, the data extraction, analysis, and interpretation, and wrote the first draft of the manuscript. He had full access to all data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. AV was involved in the study design, the data extraction, analysis, and interpretation. AB critically revised the manuscript, provided valuable insights and interpretations, and advised on the submission process. SS provided valuable supervision at all stages and critically revised the manuscript. All authors approved the final version of the manuscript.

Conflict of interest: The authors declare no conflict of interest.

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SUPPLEMENTARY MATERIAL

Supplementary data to this article can be found online at https://doi.org/10.1556/2006.2024.00024.

REFERENCES

Ahmad, S. F., & Nurwianti, F. (2020). Using acceptance and commitment therapy (ACT) in a group setting to increase quality of life in university students with social media addictions. *Advances in Social Science, Education and Humanities Research*, *494*, 180–188. https://doi.org/10.2991/assehr.k.201125.015.

Ahmadi, M., Nikomanesh, Z., & Farnam, A. (2021). Effectiveness of stress-based mindfulness therapy on the students' feelings of loneliness and internet addiction. *Pajouhan Scientific Journal*, *19*(4), 1–9. https://doi.org/10.52547/psj.19.4.1.

Andreassen, C. S., Billieux, J., Griffiths, M. D., Kuss, D. J., Demetrovics, Z., Mazzoni, E., & Pallesen, S. (2016). The relationship between addictive use of social media and video games and symptoms of psychiatric disorders: A large-scale cross-sectional study. *Psychology of Addictive Behaviors*, *30*(2), 252. https://doi.org/doi.org/10.1037/adb0000160.

Armijo-Olivo, S., Stiles, C. R., Hagen, N. A., Biondo, P. D., & Cummings, G. G. (2012). Assessment of study quality for systematic reviews: A comparison of the Cochrane collaboration risk of bias tool and the effective public health practice project quality assessment tool: Methodological research. *Journal of Evaluation in Clinical Practice*, *18*(1), 12–18. https://doi.org/10.1111/j.1365-2753.2010.01516.x.

Baer, R., Crane, C., Miller, E., & Kuyken, W. (2019). Doing no harm in mindfulness-based programs: Conceptual issues and empirical findings. *Clinical Psychology Review*, *71*, 101–114. https://doi.org/10.1016/j.cpr.2019.01.001.

Balduzzi, S., Rücker, G., & Schwarzer, G. (2019). How to perform a meta-analysis with R: A practical tutorial. *BMJ Ment Health*, *22*(4), 153–160. https://doi.org/10.1136/ebmental-2019-300117.

Balk, E. M., Earley, A., Patel, K., Trikalinos, T. A., & Dahabreh, I. J. (2012). *Empirical assessment of within-arm correlation imputation in trials of continuous outcomes*. Agency for Healthcare Research and Quality (US). http://www.ncbi.nlm.nih.gov/books/NBK115797/.

Basenach, L., Renneberg, B., Salbach, H., Dreier, M., & Wölfling, K. (2023). Systematic reviews and meta-analyses of treatment interventions for Internet use disorders: Critical analysis of the methodical quality according to the PRISMA guidelines. *Journal of Behavioral Addictions*. https://doi.org/10.1556/2006.2022.00087.

Becker, B. J. (1988). Synthesizing standardized mean-change measures. *British Journal of Mathematical and Statistical Psychology*, *41*(2), 257–278. https://doi.org/10.1111/j.2044-8317.1988.tb00901.x.

Berenjabadi, M., Pourhosein, M., & Ghasemi Argene, M. (2021). The effectiveness of acceptance and commitment therapy (ACT) on interpersonal difficulties and internet addiction among high school students. *Journal of Applied Psychological Research*, *12*(2), 283–301. https://doi.org/10.22059/japr.2021.310151.643639.

Bianchi, A., & Phillips, J. G. (2005). Psychological predictors of problem mobile phone use. *CyberPsychology & Behavior*, *8*(1), 39–51. https://doi.org/10.1089/cpb.2005.8.39.

Billaux, P., Billieux, J., Baggio, S., Maurage, P., & Flayelle, M. (2023). Thinking beyond cut-off scores in the assessment of

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potentially addictive behaviors: A brief illustration in the context of binge-watching. *Journal of Behavioral Addictions*, *12*(2), 303–308. https://doi.org/10.1556/2006.2023.00032.

Boot, W. R., Simons, D. J., Stothart, C., & Stutts, C. (2013). The pervasive problem with placebos in psychology: Why active control groups are not sufficient to rule out placebo effects. *Perspectives on Psychological Science*, *8*(4), 445–454. https://doi.org/10.1177/1745691613491271.

Borenstein, M., Higgins, J. P. T., Hedges, L. V., & Rothstein, H. R. (2017). Basics of meta-analysis: I^2 is not an absolute measure of heterogeneity: I^2 is not an absolute measure of heterogeneity. *Research Synthesis Methods*, *8*(1), 5–18. https://doi.org/10.1002/jrsm.1230.

Boroujen, M. A., Davoodi, I., & Zargrar, Y. (2020). Effectiveness of Acceptance and Commitment Therapy on quality of life and hours of internet use in high school boys. *Medical Journal of Mashhad University of Medical Sciences*, *62*(5.1), 503–513. https://doi.org/10.22038/mjms.2019.15124.

Bőthe, B., Tóth-Király, I., Zsila, Á., Griffiths, M. D., Demetrovics, Z., & Orosz, G. (2018). The development of the problematic pornography consumption scale (PPCS). *The Journal of Sex Research*, *55*(3), 395–406. https://doi.org/10.1080/00224499.2017.1291798.

Brand, M. (2022). Can internet use become addictive? *Science*, *376*(6595), 798–799. https://doi.org/10.1126/science.abn4189.

Brand, M., Young, K. S., Laier, C., Wölfling, K., & Potenza, M. N. (2016). Integrating psychological and neurobiological considerations regarding the development and maintenance of specific Internet-use disorders: An Interaction of Person-Affect-Cognition-Execution (I-PACE) model. *Neuroscience and Biobehavioral Reviews*, *71*, 252–266. https://doi.org/10.1016/j.neubiorev.2016.08.033.

Brandtner, A., Antons, S., King, D. L., Potenza, M. N., Tang, Y.-Y., Blycker, G. R., … Liebherr, M. (2022). A preregistered, systematic review considering mindfulness-based interventions and neurofeedback for targeting affective and cognitive processes in behavioral addictions. *Clinical Psychology: Science and Practice*, *29*(4), 379–392. https://doi.org/10.1037/cps0000075.

Burdick, D. (2014). *Mindfulness skills for kids & teens: A workbook for clinicians & clients with 154 tools, techniques, activities & worksheets*. PESI Publishing & Media.

Burke, C. A. (2010). Mindfulness-based approaches with children and adolescents: A preliminary review of current research in an emergent field. *Journal of Child and Family Studies*, *19*(2), 133–144. https://doi.org/10.1007/s10826-009-9282-x.

Busch, P. A., & McCarthy, S. (2021). Antecedents and consequences of problematic smartphone use: A systematic literature review of an emerging research area. *Computers in Human Behavior*, *114*, 106414. https://doi.org/10.1016/j.chb.2020.106414.

Carsley, D., Khoury, B., & Heath, N. L. (2018). Effectiveness of mindfulness interventions for mental health in schools: A comprehensive meta-analysis. *Mindfulness*, *9*(3), 693–707. https://doi.org/10.1007/s12671-017-0839-2.

Cavanagh, K., Strauss, C., Forder, L., & Jones, F. (2014). Can mindfulness and acceptance be learnt by self-help? A systematic review and meta-analysis of mindfulness and acceptance-based self-help interventions. *Clinical Psychology Review*, *34*(2), 118–129. https://doi.org/10.1016/j.cpr.2014.01.001.

Changrong, H. (2021). Effect observation of mindfulness training combined with agomelatine tablets in treatment of Internet addiction disorder patients with depression. *实用临床医药杂志*, *25*(3), 43–46. https://doi.org/10.7619/jcmp.20201337.

Chen, S. H., Weng, L., & Su, Y. (2001). The development of Chinese Internet Addiction Scale and its psychological dose characteristics. *Chinese Journal of Psychology*, *45*(3), 279–294.

Clark, J., Glasziou, P., Del Mar, C., Bannach-Brown, A., Stehlik, P., & Scott, A. M. (2020). A full systematic review was completed in 2 weeks using automation tools: A case study. *Journal of Clinical Epidemiology*, *121*, 81–90. https://doi.org/10.1016/j.jclinepi.2020.01.008.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum.

Collins, R. L., Parks, G. A., & Marlatt, G. A. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology*, *53*(2), 189–200. https://doi.org/10.1037/0022-006X.53.2.189.

Crane, R. S., Brewer, J., Feldman, C., Kabat-Zinn, J., Santorelli, S., Williams, J. M. G., & Kuyken, W. (2017). What defines mindfulness-based programs? The warp and the weft. *Psychological Medicine*, *47*(6), 990–999. https://doi.org/10.1017/S0033291716003317.

Crosby, J. M. (2011). *Acceptance and commitment therapy for the treatment of compulsive pornography use: A randomized clinical trial*. Utah State University. https://digitalcommons.usu.edu/etd/999.

Crosby, J. M., & Twohig, M. P. (2016). Acceptance and commitment therapy for problematic internet pornography use: A randomized trial. *Behavior Therapy*, *47*(3), 355–366. https://doi.org/10.1016/j.beth.2016.02.001.

Cuijpers, P., Miguel, C., Ciharova, M., Ebert, D., Harrer, M., & Karyotaki, E. (2023). Transdiagnostic treatment of depression and anxiety: A meta-analysis. *Psychological Medicine*, 1–12. https://doi.org/10.1017/S0033291722003841.

Cuijpers, P., Quero, S., Noma, H., Ciharova, M., Miguel, C., Karyotaki, E., … Furukawa, T. A. (2021). Psychotherapies for depression: A network meta-analysis covering efficacy, acceptability and long-term outcomes of all main treatment types. *World Psychiatry*, *20*(2), 283–293. https://doi.org/10.1002/wps.20860.

Cuijpers, P., Weitz, E., Cristea, I. A., & Twisk, J. (2017). Pre-post effect sizes should be avoided in meta-analyses. *Epidemiology and Psychiatric Sciences*, *26*(4), 364–368. https://doi.org/10.1017/S2045796016000809.

DeepL Übersetzer: Der präziseste Übersetzer der Welt (2023). https://www.DeepL.com/translator.

DerSimonian, R., & Laird, N. (1986). Meta-analysis in clinical trials. *Controlled Clinical Trials*, *7*(3), 177–188. https://doi.org/10.1016/0197-2456(86)90046-2.

Dongmei, M., Wenjing, G., Qun, Z., & Jiaxin, S. (2020). The effect of short-term mindfulness training on overusing of cell phone of college students. *Theory and Practice of Psychological Counseling*, *2*(9), 615–625. https://doi.org/10.35534/tppc.0209046.

Duval, S., & Tweedie, R. (2000). Trim and fill: A simple funnel-plot–based method of testing and adjusting for publication bias in meta-analysis. *Biometrics*, *56*(2), 455–463. https://doi.org/10.1111/j.0006-341X.2000.00455.x.

Brought to you by Library and Information Centre of the Hungarian Academy of Sciences MTA | Unauthenticated | Downloaded 11/14/24 02:43 PM UTC

EBSCO Information Services (2023). https://www.ebsco.com/.

Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *BMJ*, *315*(7109), 629–634. https://doi.org/10.1136/bmj.315.7109.629.

Eriksen, J. W., Fiskaali, A., Zachariae, R., Wellnitz, K. B., Oernboel, E., Stenbro, A. W., … Petersen, M. W. (2023). Psychological intervention for gambling disorder: A systematic review and meta-analysis. *Journal of Behavioral Addictions*, *12*(3), 613–630. https://doi.org/10.1556/2006.2023.00034.

Eskawati, D., Ruhaena, L., & Asyanti, S. (2019). Efektivitas pelatihan mindfulness untuk menurunkan nomophobia pada remaja. [Dissertation]. Universitas Muhammadiyah Surakarta.

Etzelmueller, A., Vis, C., Karyotaki, E., Baumeister, H., Titov, N., Berking, M., … Ebert, D. D. (2020). Effects of internet-based cognitive behavioral therapy in routine care for adults in treatment for depression and anxiety: Systematic review and meta-analysis. *Journal of Medical Internet Research*, *22*(8), e18100. https://doi.org/10.2196/18100.

Fendel, J. C., & Schmidt, S. (2022). Mindfulness for internet use disorder: A study protocol of a systematic review and meta-analysis. *BMJ Open*, *12*(9), e067357. https://doi.org/10.1136/bmjopen-2022-067357.

Fineberg, N. A., Demetrovics, Z., Stein, D., Ioannidis, K., Potenza, M., Grünblatt, E., … Chamberlain, S. (2018). Manifesto for a European research network into problematic usage of the internet. *European Neuropsychopharmacology*, *28*(11), 1232–1246. https://doi.org/10.1016/j.euroneuro.2018.08.004.

Fineberg, N. A., Menchón, J. M., Hall, N., Dell'Osso, B., Brand, M., Potenza, M. N., … Zohar, J. (2022). Advances in problematic usage of the internet research – A narrative review by experts from the European network for problematic usage of the internet. *Comprehensive Psychiatry*, *118*, 152346. https://doi.org/10.1016/j.comppsych.2022.152346.

Garland, E. L., & Howard, M. O. (2018). Mindfulness-based treatment of addiction: Current state of the field and envisioning the next wave of research. *Addiction Science & Clinical Practice*, *13*(1), 14. https://doi.org/10.1186/s13722-018-0115-3.

Goldberg, S. B., Riordan, K. M., Sun, S., & Davidson, R. J. (2022). The empirical status of mindfulness-based interventions: A systematic review of 44 meta-analyses of randomized controlled trials. *Perspectives on Psychological Science*, *17*(1), 108–130. https://doi.org/10.1177/1745691620968771.

Goldberg, S. B., Tucker, R. P., Greene, P. A., Davidson, R. J., Wampold, B. E., Kearney, D. J., & Simpson, T. L. (2018). Mindfulness-based interventions for psychiatric disorders: A systematic review and meta-analysis. *Clinical Psychology Review*, *59*, 52–60. https://doi.org/10.1016/j.cpr.2017.10.011.

Griffiths, M. D. (1996). Internet addiction: An issue for clinical psychology? *Clinical Psychology Forum*, *97*, 32–36.

Griffiths, M. D. (2021). Internet use disorders: What's new and what's not? Commentary on: How to overcome taxonomical problems in the study of Internet use disorders and what to do with "smartphone addiction"? (Montag et al., 2019). *Journal of Behavioral Addictions*, *9*(4), 934–937. https://doi.org/10.1556/2006.2020.00072.

Grubbs, J. B., Sessoms, J., Wheeler, D. M., & Volk, F. (2010). The Cyber-Pornography Use Inventory: The development of a new assessment instrument. *Sexual Addiction & Compulsivity*, *17*(2), 106–126. https://doi.org/10.1080/10720161003776166.

Guyatt, G. H., Oxman, A. D., Vist, G. E., Kunz, R., Falck-Ytter, Y., Alonso-Coello, P., & Schünemann, H. J. (2008). GRADE: An emerging consensus on rating quality of evidence and strength of recommendations. *BMJ*, *336*(7650), 924–926. https://doi.org/10.1136/bmj.39489.470347.AD.

Ha, J. M., & Son, C. N. (2016). Effects of acceptance and commitment therapy (ACT) on self-control, depression, and smartphone addiction level in university students with high level of depression and smartphone addiction. *Korean Journal of Addiction Psychology*, *1*(1), 1–16.

Hall, P., & Larkin, J. (2020). A thematic analysis of clients' reflections on the qualities of group work for sex and pornography addiction. *Sexual Addiction & Compulsivity*, *27*(1–2), 1–11. https://doi.org/10.1080/10720162.2020.1751360.

Harrer, M., Cuijpers, P., Furukawa, T., & Ebert, D. (2021). *Doing meta-analysis with R: A hands-on guide* (1st ed.). Chapman and Hall/CRC. https://doi.org/10.1201/9781003107347.

Hayes, S. C., Strosahl, K. D., & Wilson, K. G. (2011). *Acceptance and commitment therapy: The process and practice of mindful change* (2nd ed.). Guilford press.

Hedges, L. V., & Olkin, I. (1985). *Statistical methods for meta-analysis*. Academic Press.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, *33*(2–3), 61–83. https://doi.org/10.1017/S0140525X0999152X.

Higgins, J. P. (2003). Measuring inconsistency in meta-analyses. *BMJ*, *327*(7414), 557–560. https://doi.org/10.1136/bmj.327.7414.557.

Higgins, J. P., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. J., & Welch, V. A. (2022). *Cochrane handbook for systematic reviews of interventions, Version 6.3 (updated February 2022)*. Cochrane. https://doi.org/10.1002/9780470712184.fmatter.

Holas, P., Draps, M., Kowalewska, E., Lewczuk, K., & Gola, M. (2021). A pilot study of mindfulness-based relapse prevention for compulsive sexual behaviour disorder. *Journal of Behavioral Addictions*, *9*(4), 1088–1092. https://doi.org/10.1556/2006.2020.00075.

Hu, D. D., Xu, Y., Ding, J. E., & Li, J. (2017). Development of mobile phone internet addiction scale for college students. *Chinese Journal of Health Education*, *33*(6), 505–508.

Ilanloo, H., Ahmadi, S., Zahrakar, K., & Cicognani, E. (2022). The effectiveness of group counseling of mindfulness-based cognitive therapy on internet addiction and cognitive emotion regulation in high school students. *Iranian Journal of Learning & Memory*, *4*(16), 19–28. https://doi.org/10.22034/iepa.2022.150225.

Jagadeesan, N., & Sruti Lall, S. (2019). Mindfulness-based intervention for managing problematic usage of mobile phones. *Global Journal for Research Analysis*, *8*(6), 11–13.

Jain, A., & Mahajan, A. (2020). Effect of aerobic training and mindfulness therapy on smartphone addicted young individuals. *Indian Journal of Physiotherapy & Occupational Therapy*, *14*(3), 13–17. https://doi.org/10.37506/ijpot.v14i3.9660.

Johannsen, M., Nissen, E. R., Lundorff, M., & O'Toole, M. S. (2022). Mediators of acceptance and mindfulness-based

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therapies for anxiety and depression: A systematic review and meta-analysis. *Clinical Psychology Review*, *94*, 102156. https://doi.org/0.1016/j.cpr.2022.102156.

Jones, D. S., & Podolsky, S. H. (2015). The history and fate of the gold standard. *The Lancet*, *385*(9977), 1502–1503. https://doi.org/10.1016/S0140-6736(15)60742-5.

Jung, E. S., & Son, C. N. (2011). Effects of mindfulness-based cognitive therapy on Internet addiction level, anxiety, and stress in college students with Internet addiction. *Korean Journal of Clinical Psychology*, *30*(4), 825–843.

Kabat-Zinn, J. (2005). *Coming to our senses: Healing ourselves and the world through mindfulness*. Hachette.

Kang, M. C., & Oh, I. S. (2001). Development of Korean internet addiction scale. *Korean Journal of Youth Counseling*, *9*, 114–135.

Ke, C. L., & Cheng, S.-T. (2019). Applied mindfulness smartphone app helps mitigating smartphone addiction. *European Neuropsychopharmacology*, *29*, S530–S531. https://doi.org/10.1016/j.euroneuro.2018.11.786.

Kim, S. J. (2012). *The development and verification of mindfulness-based self-regulation program for Internet craving*. Dissertation. Chungnam National University. https://m.riss.kr/search/detail/ssoSkipDetailView.do?p_mat_type=be54d9b8bc7cdb09&control_no=4fc3d8819778c593ffe0bdc3ef48d419.

Klingbeil, D. A., Renshaw, T. L., Willenbrink, J. B., Copek, R. A., Chan, K. T., Haddock, A., … Clifton, J. (2017). Mindfulness-based interventions with youth: A comprehensive meta-analysis of group-design studies. *Journal of School Psychology*, *63*, 77–103. https://doi.org/10.1016/j.jsp.2017.03.006.

Kraus, S. W., Gola, M., Kowalewska, E., Lew-Starowicz, M., Hoff, R. A., Porter, E., & Potenza, M. N. (2017). OP-55: Brief pornography screener: A comparison of US and Polish pornography users. *Journal of Behavioral Addictions*, *6*(S1), 27–28. https://doi.org/10.1016/j.jsxm.2019.11.259.

Kwon, M., Kim, D.-J., Cho, H., & Yang, S. (2013). The smartphone addiction scale: Development and validation of a short version for adolescents. *Plos One*, *8*(12), e83558. https://doi.org/10.1371/journal.pone.0083558.

Lan, Y., Ding, J.-E., Li, W., Li, J., Zhang, Y., Liu, M., & Fu, H. (2018). A pilot study of a group mindfulness-based cognitive-behavioral intervention for smartphone addiction among university students. *Journal of Behavioral Addictions*, *7*(4), 1171–1176. https://doi.org/10.1556/2006.7.2018.103.

Lee, J. H., Lim, J. M., Son, H. B., Kwak, H. W., & Chang, M. S. (2016). Development and validation of a smartphone addiction scale based on behavioral addiction criteria. *The Korean Journal of Counseling and Psychotherapy*, *28*(2), 425–443. https://doi.org//10.1371/journal.pone.0056936.

Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2009). Development and validation of a game addiction scale for adolescents. *Media Psychology*, *12*(1), 77–95. https://doi.org/10.1080/15213260802669458.

Leung, L. (2008). Linking psychological attributes to addiction and improper use of the mobile phone among adolescents in Hong Kong. *Journal of Children and Media*, *2*(2), 93–113. https://doi.org/10.1080/17482790802078565.

Levin, M. E., Heninger, S. T., Pierce, B. G., & Twohig, M. P. (2017). Examining the feasibility of acceptance and commitment therapy self-help for problematic pornography viewing: Results from a pilot open trial. *The Family Journal*, *25*(4), 306–312. https://doi.org/10.1177/1066480717731242.

Li, W. (2016). *Mindfulness-Oriented Recovery Enhancement for video game addiction in US emerging adults*. Dissertation. The University of North Carolina at Chapel Hill.

Li, W., Garland, E. L., & Howard, M. O. (2018). Therapeutic mechanisms of Mindfulness-Oriented Recovery Enhancement for internet gaming disorder: Reducing craving and addictive behavior by targeting cognitive processes. *Journal of Addictive Diseases*, *37*(1–2), 5–13. https://doi.org/10.1080/10550887.2018.1442617.

Li, W., Garland, E. L., McGovern, P., O'Brien, J. E., Tronnier, C., & Howard, M. O. (2017). Mindfulness-oriented recovery enhancement for internet gaming disorder in US adults: A stage I randomized controlled trial. *Psychology of Addictive Behaviors*, *31*(4), 393. https://doi.org/10.1037/adb0000269.

Li, W., Howard, M. O., Garland, E. L., McGovern, P., & Lazar, M. (2017). Mindfulness treatment for substance misuse: A systematic review and meta-analysis. *Journal of Substance Abuse Treatment*, *75*, 62–96. https://doi.org/10.1016/j.jsat.2017.01.008.

Li, L., Niu, Z., & Mei, S. (2017). The mindfulness cognitive-behavioral group therapy of medical student ' smartphone addiction in group counseling course. *China Higher Medical Education*, *5*, 37–38. https://doi.org/10.3969/j.issn.1002-1701.2017.05.016.

Li, L., Xu, D.-D., Chai, J.-X., Wang, D., Li, L., Zhang, L., … Xiang, Y.-T. (2018). Prevalence of internet addiction disorder in Chinese university students: A comprehensive meta-analysis of observational studies. *Journal of Behavioral Addictions*, *7*(3), 610–623. https://doi.org/10.1556/2006.7.2018.53.

Lin, Y.-H., Pan, Y.-C., Lin, S.-H., & Chen, S.-H. (2017). Development of short-form and screening cutoff point of the Smartphone Addiction Inventory (SPAI-SF). *International Journal of Methods in Psychiatric Research*, *26*(2), e1525. https://doi.org/10.1002/mpr.1525.

Linehan, M. M., & Wilks, C. R. (2015). The course and evolution of dialectical behavior therapy. *American Journal of Psychotherapy*, *69*(2), 97–110. https://doi.org/10.1176/appi.psychotherapy.2015.69.2.97.

Liu, X., Jiang, J., & Zhang, Y. (2021). Effects of logotherapy-based mindfulness intervention on internet addiction among adolescents during the COVID-19 pandemic. *Iranian Journal of Public Health*, *50*(4), 789–797. https://doi.org/10.18502/ijph.v50i4.6005.

Maedehmoeinedini, M., Lotfi Kashani, F., & Shafiabadi, A. (2020). The effectiveness of dialectical behavior therapy compared to integrative psychotherapy in defensive styles and internet addiction. *Journal of Applied Family Therapy*, *1*(4), 105–124. https://doi.org/10.22034/aftj.2021.256280.1023.

Marmer, L. W., & Nurwianti, F. (2020). Group acceptance and commitment therapy to reduce psychological distress among college students with social media addiction. *Advances in Social Science, Education and Humanities Research*, *494*, 132–143.

Montag, C., Wegmann, E., Sariyska, R., Demetrovics, Z., & Brand, M. (2020). How to overcome taxonomical problems in the study of Internet use disorders and what to do with "smartphone addiction". *Journal of Behavioral Addictions*, *9*(4), 908–914. https://doi.org/10.1556/2006.8.2019.59.

Brought to you by Library and Information Centre of the Hungarian Academy of Sciences MTA | Unauthenticated | Downloaded 11/14/24 02:43 PM UTC

Morris, S. B. (2008). Estimating effect sizes from pretest-posttest-control group designs. *Organizational Research Methods*, *11*(2), 364–386. https://doi.org/10.1177/1094428106291059.

Müller, K. W., Dreier, M., Beutel, M. E., Ruckes, C., Batra, A., Mann, K., … Wölfling, K. (2023). The impact of life satisfaction in the treatment of gaming disorder and other internet use disorders: Results from a randomized controlled trial. *Journal of Behavioral Addictions*, *12*(1), 159–167. https://doi.org/10.1556/2006.2022.00091.

Nam, S., Cho, Y., & Noh, S. (2019). Efficacy of a mindfulness-based intervention for smartphone overuse, functional impairment, and mental health among undergraduate students at risk for smartphone addiction and the mediating role of self-regulation. *Korean Journal of Clinical Psychology*, *38*(1), 29–44. https://doi.org/10.15842/kjcp.2019.38.1.003.

Neumann, I., & Lindenberg, K. (2022). Internetnutzungsstörungen unter deutschen Jugendlichen vor und während der COVID-19-Pandemie. *Kindheit und Entwicklung*, *31*(4), 193–199. https://doi.org/10.1026/0942-5403/a000390.

O'Connell, C. (2020). How FOMO (fear of missing out), the smartphone, and social media may be affecting university students in the Middle East. *North American Journal of Psychology*, *22*(1), 83–102.

Olson, J. A., Sandra, D. A., Colucci, É. S., Al Bikaii, A., Chmoulevitch, D., Nahas, J., … Veissière, S. P. L. (2022). Smartphone addiction is increasing across the world: A meta-analysis of 24 countries. *Computers in Human Behavior*, *129*, 107138. https://doi.org/10.1016/j.chb.2021.107138.

Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan—A web and mobile app for systematic reviews. *Systematic Reviews*, *5*(210), 1–10. https://doi.org/10.1186/s13643-016-0384-4.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., … Moher, D. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Systematic Reviews*, *10*(1), 89. https://doi.org/10.1186/s13643-021-01626-4.

Pan, Y.-C., Chiu, Y.-C., & Lin, Y.-H. (2020). Systematic review and meta-analysis of epidemiology of internet addiction. *Neuroscience and Biobehavioral Reviews*, *118*, 612–622. https://doi.org/10.1016/j.neubiorev.2020.08.013.

Petry, N. M., & O'Brien, C. P. (2013). *Internet gaming disorder and the DSM-5*.

Pseftogianni, F., Panagioti, M., Birtwell, K., & Angelakis, I. (2023). Mindfulness interventions for obsessive–compulsive and related disorders: A systematic review and meta-analysis of randomized controlled trials: Clinical psychology: Science and practice. *Clinical Psychology: Science and Practice*, *30*(3), 233–243. https://doi.org/10.1037/cps0000132.

Roeser, R. W., & Pinela, C. (2014). Mindfulness and compassion training in adolescence: A developmental contemplative science perspective. *New Directions for Youth Development*, *2014*(142), 9–30. https://doi.org/10.1002/yd.20094.

Rosenthal, A., Levin, M. E., Garland, E. L., & Romanczuk-Seiferth, N. (2021). Mindfulness in treatment approaches for addiction—Underlying mechanisms and future directions. *Current Addiction Reports*, *8*(2), 282–297. https://doi.org/10.1007/s40429-021-00372-w.

Roy Rosenzweig Center for History and New Media (2019, October 23). *Zotero | Your personal research assistant*. https://www.zotero.org/.

Rumpf, H.-J., Browne, D., Brandt, D., & Rehbein, F. (2020). Addressing taxonomic challenges for Internet Use Disorders in light of changing technologies and diagnostic classifications. Commentary on: "How to overcome taxonomical problems in the study of Internet use disorders and what to do with 'smartphone addiction'?" (Montag et al., 2020). *Journal of Behavioral Addictions*, *9*(4), 942–944. https://doi.org/10.1556/2006.2020.00094.

Safari, S., Soleimanian, A. A., & Jajarmi, M. (2022). The effectiveness of acceptance and commitment therapy matrix training on reducing internet addiction and perceiving the family social support of adolescent girls during the outbreak of Corona. *Journal of North Khorasan University of Medical Sciences*, *13*(4), 12–20. https://doi.org/10.52547/nkums.13.4.12.

Sancho, M., De Gracia, M., Rodríguez, R. C., Mallorquí-Bagué, N., Sánchez-González, J., Trujols, J., … Menchón, J. M. (2018). Mindfulness-based interventions for the treatment of substance and behavioral addictions: A systematic review. *Frontiers in Psychiatry*, *9*(95), 1–9. https://doi.org/10.3389/fpsyt.2018.00095.

Schneider, F. M., Lutz, S., Halfmann, A., Meier, A., & Reinecke, L. (2022). How and when do mobile media demands impact well-being? Explicating the integrative model of mobile media use and need experiences (IM ^{3} UNE). *Mobile Media & Communication*, *10*(2), 251–271. https://doi.org/10.1177/20501579211054928.

Schwarzer, G., Carpenter, J. R., & Rücker, G. (2015). *Meta-analysis with R* (Vol. *4784*). Springer.

Segal, Z. V., Williams, J. M. G., & Teasdale, J. D. (2002). *Mindfulness-based cognitive therapy for depression: A new approach to preventing relapse* (Vol. *13*). Guilford press.

Sewall, C. J. R., Bear, T. M., Merranko, J., & Rosen, D. (2020). How psychosocial well-being and usage amount predict inaccuracies in retrospective estimates of digital technology use. *Mobile Media & Communication*, *8*(3), 379–399. https://doi.org/10.1177/2050157920902830.

Shadbad, N. R. (2017). The effectiveness of mindfulness-based group therapy on reducing internet addiction and increasing the general health of adolescent girls. *Indian Journal of Public Health Research & Development*, *8*(4), 44–48. https://doi.org/10.5958/0976-5506.2017.00311.4.

Shameli, M., Moatamedi, A., & Borjali, A. (2018). The effectiveness of cognitive therapy based on mindfulness of internet game addiction intermediary variables with self-control and sensation seeking, in boy adolescents in the city of Tehran. *Counseling Culture and Psycotherapy*, *9*(33), 137–161. https://doi.org/10.22054/qccpc.2018.25865.1635.

Shapero, B. G., Greenberg, J., Pedrelli, P., de Jong, M., & Desbordes, G. (2018). Mindfulness-based interventions in psychiatry. *Focus: Journal of Life Long Learning in Psychiatry*, *16*(1), 32–39. https://doi.org/10.1176/appi.focus.20170039.

Shin, K. W., Kim, D. I., Jung, Y. J., Lee, J., Lee, Y., & Kim, M. (2011). *Development of Korean smart phone addiction proneness scale for youth and adults* (Vol. *24*, pp. 231–238). Seoul: Korean National Information Society Agency.

Shorchi, F., Javadi, M. J., Davaie, M., & Farokhi, N. (2020). The effectiveness of mindfulness-based group therapy with respect

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to the modification of early maladaptive schemas in reducing Internet addiction in high school girls. *Medical Journal of Mashhad University of Medical Sciences*, *63*(4), 2534–2549. https://doi.org/10.22038/mjms.2020.17662.

Siste, K., Hanafi, E., Adrian, Sen, L. T., Alison, P., & Beatrice, E. (2022). Online dialectical behavioral therapy for adults with internet addiction: A quasi-experimental trial during the COVID-19 pandemic. *Psychiatry Research*, *315*(114698), 1–7. https://doi.org/10.1016/j.psychres.2022.114698.

Sniewski, L. (2020). Change through stillness: Qualitative explorations of heterosexual men as they utilise meditation as an intervention for self-perceived problematic pornography use. Dissertation. Auckland University of Technology. https://openrepository.aut.ac.nz/items/e43e876d-b166-41e3-b692-c0e78dab51a9.

Sniewski, L., Krägeloh, C., Farvid, P., & Carter, P. (2022). Meditation as an intervention for men with self-perceived problematic pornography use: A series of single case studies. *Current Psychology*, *41*(8), 5151–5162. https://doi.org/10.1007/s12144-020-01035-1.

Son, H. B. (2017). The effects of the mindfulness-based cognitive-behavioral therapy (MBCT) program on loss of control, craving, mindfulness level in self-regulation of smartphone addictive tendencies. Master's thesis. Kyungpook National University.

Sterne, J. A. C., Savović, J., Page, M. J., Elbers, R. G., Blencowe, N. S., Boutron, I., … Higgins, J. P. T. (2019). RoB 2: A revised tool for assessing risk of bias in randomised trials. *BMJ*, *366*, l4898. https://doi.org/10.1136/bmj.l4898.

Sun, X. (2022). A review of mindfulness and social media excessive use. *Advances in Social Science, Education and Humanities Research*, *631*, 1286–1294. https://doi.org/10.2991/assehr.k.220105.238.

Teasdale, J. D., Segal, Z. V., Williams, J. M., Ridgeway, V. A., Soulsby, J. M., & Lau, M. A. (2000). Prevention of relapse/recurrence in major depression by mindfulness-based cognitive therapy. *Journal of Consulting and Clinical Psychology*, *68*(4), 615–623. https://doi.org/10.1037/0022-006X.68.4.615.

Throuvala, M. A., Griffiths, M. D., Rennoldson, M., & Kuss, D. J. (2020). Mind over matter: Testing the efficacy of an online randomized controlled trial to reduce distraction from smartphone use. *International Journal of Environmental Research and Public Health*, *17*(4842), Art. 13. https://doi.org/10.3390/ijerph17134842.

Twohig, M. P., & Crosby, J. M. (2010). Acceptance and commitment therapy as a treatment for problematic internet pornography viewing. *Behavior Therapy*, *41*(3), 285–295. https://doi.org/10.1016/j.beth.2009.06.002.

Viechtbauer, W. (2007). Approximate confidence intervals for standardized effect sizes in the two-independent and two-dependent samples design. *Journal of Educational and Behavioral Statistics*, *32*(1), 39–60. https://doi.org/10.3102/1076998606298034.

Viechtbauer, W. (2010). Conducting meta-analyses in *R* with the metafor Package. *Journal of Statistical Software*, *36*(3), 1–48. https://doi.org/10.18637/jss.v036.i03.

We, O.-G., Seong-Goo, J., & Han, J. (2018). The effects of meditation training on stress and smartphone addiction of university students. *Korean Management Consulting Review*, *18*(3), 127–134.

Weaver, J. L., & Swank, J. M. (2019). Mindful connections: A mindfulness-based intervention for adolescent social media users. *Journal of Child and Adolescent Counseling*, *5*(2), 103–112. https://doi.org/10.1080/23727810.2019.1586419.

Weaver, J. L., & Swank, J. M. (2021). An examination of college students' social media use, fear of missing out, and mindful attention. *Journal of College Counseling*, *24*(2), 132–145. https://doi.org/10.1002/jocc.12181.

Wegmann, E., Billieux, J., & Brand, M. (2022). Internet-use disorders: A theoretical framework for their conceptualization and diagnosis. In D. J. Stein, N. A. Fineberg, & S. R. Chamberlain (Eds.), *Mental health in a digital world* (pp. 285–305). Academic Press. https://doi.org/10.1016/B978-0-12-822201-0.00022-8.

Wegmann, E., Schiebener, J., & Brand, M. (2023). Social-networks use as adaptive or maladaptive strategy for coping with stress. *Scientific Reports*, *13*(1), Art. 1. https://doi.org/10.1038/s41598-023-39042-4.

Xanidis, N., & Brignell, C. M. (2016). The association between the use of social network sites, sleep quality and cognitive function during the day. *Computers in Human Behavior*, *55*, 121–126. https://doi.org/10.1016/j.chb.2015.09.004.

Xiaoxu, Z., & Haixue, Z. (2014). The intervention effect of mindfulness-based cognitive therapy on college students with mobile phone addiction. *Studies of Psychology and Behavior*, *12*(3), 391–394.

Yao, Y.-W., Chen, P.-R., Li, C. R., Hare, T. A., Li, S., Zhang, J.-T., … Fang, X.-Y. (2017). Combined reality therapy and mindfulness meditation decrease intertemporal decisional impulsivity in young adults with Internet gaming disorder. *Computers in Human Behavior*, *68*, 210–216. https://doi.org/10.1016/j.chb.2016.11.038.

Young, K. S. (1996). Psychology of computer use: XL addictive use of the internet: A case that breaks the stereotype. *Psychological Reports*, *79*(3), 899–902. https://doi.org/10.2466/pr0.1996.79.3.899.

Young, K. S. (1998). *Caught in the net: How to recognize the signs of internet addiction—And a winning strategy for recovery*. John Wiley & Sons.

Yu, H.-G., & Son, C. (2016). Effects of ACT on smartphone addiction level, self-control, and anxiety of college students with smartphone addiction. *Journal of Digital Convergence*, *14*(2), 415–426. https://doi.org/10.14400/JDC.2016.14.2.415.

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