

# BMJ Open Mindfulness for internet use disorder: a study protocol of a systematic review and meta-analysis

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## ABSTRACT

**Introduction** Internet use disorder (IUD) is on the rise and is associated with detrimental health consequences. Growing evidence suggests that mindfulness—either as a trait or cultivated in mindfulness-based programmes (MBPs)—is promising in preventing and treating IUD. With this systematic review and meta-analysis, we will examine (1) the association between trait mindfulness (TM) and IUD and (2) the effectiveness of MBPs in reducing IUD.

**Methods and analysis** In October 2022, we will screen Medline, PsycINFO, PSYINDEX, CINAHL, Web of Science, and the Cochrane Register of Controlled Trials without language or publication date restrictions. We will conduct backward and forward citation searches of included studies and relevant reviews. We will include studies that evaluate either (1) the association between TM and IUD or (2) the effectiveness of MBPs in reducing IUD. Two reviewers will independently screen records, select and extract data, and rate the risk of bias. In total, we will conduct three meta-analyses: a first meta-analysis will be on the correlation between TM and IUD, a second meta-analysis will be on between-group data examining the effectiveness of MBPs in reducing IUD in randomised controlled trials (RCTs), and a third meta-analysis will be on within-group pre-postdata examining the effectiveness of MBPs in reducing IUD in all kinds of intervention studies. For the second and third meta-analyses, the primary outcome will be changes in IUD. We will explore moderators and sources of between-study heterogeneity and pursue a narrative synthesis of results. We will use the Grading of Recommendations Assessment, Development and Evaluation system to assess the overall quality of evidence across intervention studies.

**Ethics and dissemination** Ethics approval is not required. Results will be published in a peer-reviewed journal and presented at (inter)national conferences.

**PROSPERO registration number** CRD42022350071.

## INTRODUCTION

### Rationale

The steady pervasion of smartphones, wearables and other internet devices in society has led to profound changes in our private, social and professional lives. In 2022, 5.3 billion people are using the internet, representing a penetration of about 68% of the world's population.<sup>1</sup> Meanwhile, the proportion of mobile (155 min/day) compared with

## STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ We will conduct the first systematic review and meta-analysis (1) on the association between trait mindfulness and internet use disorder (IUD) and (2) on the effectiveness of mindfulness-based programmes (MBPs) in reducing IUD.
- ⇒ We will explore potential moderators and sources of between-study heterogeneity, including characteristics of the studied populations (eg, clinical vs non-clinical), different conceptualisations of IUD (eg, problematic smartphone use vs IUD in general), or the specific implemented treatment (eg, established MBP vs self-developed MBP).
- ⇒ We will provide a comprehensive review by considering all relevant evidence with no publication date or language restrictions.
- ⇒ We will expand a quantitative aggregation of evidence with a narrative synthesis of results.
- ⇒ The anticipated diversity of study designs, conceptualisations of IUD and implemented treatment formats might lead to considerable heterogeneity among studies and thus might limit the generalisation of results.

non-mobile internet use (37 min/day) is constantly increasing,<sup>2</sup> and the number of smartphone subscriptions will soon exceed the world's population.<sup>3</sup> Without any doubt, smartphones, wearables and other internet devices have many advantages such as navigation, easy access to information, communication, etc.<sup>4</sup> Yet, there is evidence that an (over-)use of the internet can have detrimental consequences. Symptoms of internet use disorder (IUD) are associated, among others, with affective disorders, attention deficit hyperactivity disorder (ADHD), alcoholism, musculoskeletal problems (neck and hand pain), social anxiety, productivity loss, as well as reduced sleep quality, empathy, and academic performance, a generally reduced quality of life, and even suicidality.<sup>5 6</sup> The mere presence of a smartphone in the room, even without actively checking it, has shown to impair cognitive performance.<sup>7</sup> Problematic smartphone use is on the rise<sup>8</sup> and can



taxonomically be subsumed under a generalised, unspecified form of IUD.<sup>4</sup> The term IUD represents the dysfunctional overuse of the internet in general,<sup>9</sup> comprising diverse access devices (including smartphones, wearables, tablets or desktop computers), and may be specified for different contents (gaming, gambling, streaming videos, surfing social networks, shopping, watching pornography, or aimlessly gathering or searching for information).<sup>10</sup> The prevalence of generalised IUD is about 7% but varies considerably dependent on measurement tool and target population.<sup>11</sup> The rate of people at risk for IUD that do not yet show a manifest disorder but already suffer from negative consequences is probably much higher. However, as IUD concerns ubiquitous, everyday behaviours (eg, communication, information seeking, shopping, sexuality), it has been claimed to avoid over-pathologising and to apply a conservative approach to its diagnosis.<sup>9</sup>

Cognitive-behavioural therapy is considered as mainstay of addiction treatment<sup>12</sup> and has been shown to be effective against IUD.<sup>10</sup> However, in the realm of smartphones and other novel internet devices, mainstream treatment options have been criticised for relating too much on the rationale in substance addiction treatment, which demands to separate the addict from the substance (ie, abstinence) as well as from the social environment using or abusing that particular substance.<sup>5</sup> Due to the pervasive and ubiquitous nature of smartphones and other modern internet devices, however, such treatments could be unfeasible, inappropriate, counterproductive, or even destructive in the treatment of IUD.<sup>5</sup> Accordingly, there is a need for alternative, effective and accessible, low-threshold prevention and treatment approaches against IUD.

A promising, low-threshold approach in the treatment of IUD that does not necessitate separation from the addictive object or behaviour is the practice of mindfulness, which is often taught in mindfulness-based programmes (MBPs).<sup>13</sup> Mindfulness 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.<sup>14</sup> By frequent and regular training (eg, through MBPs), mindfulness can become a stable, trait-like characteristic in everyday life—a process that is linked to neuroplastic changes in the brain structure.<sup>12</sup> In the context of addiction, a mechanistic theoretical account conceptualises MBPs as a mental training for neurocognitive processes that have become dysregulated in the process of addiction,<sup>12</sup> including reward processing, self-regulation, executive control, stress susceptibility, and emotion regulation.<sup>15</sup> For example, participants of an MBP for addiction might learn to adopt a metacognitive stance that helps them notice and deconstruct addictive craving urges into its sensory, affective, and cognitive components.<sup>15</sup> This ability, in turn, might help to consciously and adaptively respond to such urges, rather than automatically react to them in

form of maladaptive addictive behaviour.<sup>15</sup> In that sense, MBPs can be seen as capacity-enhancing strategy that aims at reinforcing self-control and emotion-regulation abilities.<sup>5</sup> As such, a major advantage of MBPs is that, by cultivating mindfulness, the addict could be relieved from addictive symptoms (eg, craving, preoccupation, loss of control), even if exposure to the addictive object or behaviour could not be prevented. Due to the pervasive and ubiquitous nature of smartphones, wearables, and other internet devices this is especially relevant in the context of IUD. MBPs have been shown to be effective for a variety of mental and physical disorders among a wide range of clinical<sup>16</sup> and non-clinical populations,<sup>17</sup> and in the treatment of addictive disorders, especially in substance addictions.<sup>18</sup>

In the context of IUD, in recent years, cross-sectional studies have shown that trait mindfulness (TM) is associated with less IUD.<sup>19 20</sup> Moreover, a growing number of studies on the potential of MBPs in reducing IUD were published,<sup>21 22</sup> and further studies are expected to be available soon.<sup>23</sup> However, a systematic review of the available evidence is missing, including a systematic review on (1) the association between TM and IUD as well as (2) the effectiveness of MBPs in reducing IUD.

## Objectives

With the planned systematic review and meta-analysis, we will investigate two research questions: first, we will examine the association between TM and IUD. Second, we will examine the effectiveness of MBPs in reducing IUD. Moreover, we will explore moderators and sources of between-study heterogeneity, including characteristics of the studied populations (eg, clinical vs non-clinical sample), different conceptualisations of IUD (eg, problematic smartphone use vs generalised IUD) or the specific implemented treatment (eg, established MBP vs self-developed MBP). In addition, we will provide a comprehensive narrative synthesis of the study characteristics and results. In summary, we will provide healthcare policy makers, practitioners and researchers with a comprehensive overview of the current body of knowledge in a growing field of health research with a high relevance for patient care (ie, mindfulness as promising approach in preventing and treating IUD).

## METHODS

We prepared this protocol in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analysis Protocols (PRISMA-P)<sup>24</sup> and provide the corresponding PRISMA-P checklist in online supplemental material. We will prepare the report of the final systematic review and meta-analysis in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.<sup>25</sup> We will follow the methodology established by the authors in previous reviews.<sup>26 27</sup>

**Table 1** Inclusion and exclusion criteria

Criterion	Inclusion	Exclusion
Population	Clinical and non-clinical samples	None
Intervention	Programmes explicitly based on practicing mindfulness	Programmes without explicit focus on mindfulness
Comparator	Randomised controlled trials and non-randomised trials, including non-controlled before-after studies	Case-control studies, single case studies, systematic reviews and meta-analyses, clinical case studies, qualitative studies
Outcome	To investigate the association between TM and IUD, assessments must be made by validated self-report instruments. To investigate the effectiveness of MBPs in reducing IUD, assessments of IUD must be made by validated self-report instruments, preintervention and postintervention and must deploy distinct pathological conceptualisations of IUD	Studies that assess IUD solely by screen time. Studies that use outcome measures of internet usage patterns with conceptualisations that are not necessarily pathological
Language	All languages	None
Publication date	All dates	None

IUD, internet use disorder; MBPs, mindfulness-based programmes; TM, trait mindfulness.

## Eligibility criteria

### Population

We seek to draw conclusions about (1) the association between TM and IUD and (2) the effectiveness of MBPs in reducing IUD in the whole population. Therefore, we do not restrict the investigation to a specific population but rather plan to investigate potential differences between populations by subgroup analyses (eg, clinical vs non-clinical samples). Inclusion and exclusion criteria are displayed in [table 1](#).

### Interventions

Standardised programmes such as Mindfulness-Based Stress Reduction (MBSR),<sup>14</sup> Mindfulness-Based Cognitive Therapy (MBCT),<sup>28</sup> or Mindfulness-Based Relapse Prevention (MBRP)<sup>29</sup> are among the most popular and most evaluated MBPs.<sup>16 17</sup> Nevertheless, to investigate the effectiveness of MBPs in reducing IUD, we aim to provide a summary of programmes in their practical application. Hence, we do not restrict our analyses to MBSR, MBCT, or MBRP, but include all eligible references that explicitly state that the implemented programme is based on practicing mindfulness. However, we will exclude programmes that might be informed by mindfulness or might integrate mindfulness elements, but do not explicitly state to be based on practicing mindfulness.

### Study design and comparators

To investigate the association between TM and IUD, we will include studies of various designs that provide a correlation between TM and IUD, including cross-sectional and intervention studies. We will include intervention studies, if the association between TM and IUD was assessed preintervention. To investigate the effectiveness of MBPs in reducing IUD, we will include RCTs as well as non-randomised trials (NRTs), including non-controlled before-after studies (NCBAS). To investigate

the effectiveness of MBPs in reducing IUD, we will perform two separate meta-analyses. A first meta-analysis will be performed on RCTs using between-group effects, accepting all kinds of comparators and control conditions. A second meta-analysis will be performed on all kinds of intervention studies using within-group pre-posteffects. We decided on this approach for the following reason: while RCTs allow the most accurate effect estimate,<sup>30</sup> an exclusion of NRTs may lead to neglecting evidence.<sup>31</sup> At the same time, the combination of NRTs with RCTs may overestimate the treatment effect.<sup>32</sup> Consequently, to investigate the effectiveness of MBPs in reducing IUD, we will perform two separate meta-analyses: one on between-group data in RCTs and one on within-group pre-postdata in all kinds of intervention studies.

### Outcome measures

For the first research question (ie, the association between TM and IUD), the outcome of interest will be the correlation between TM and IUD, with both constructs assessed with validated self-report instruments. For the second research question (ie, the effectiveness of MBPs in reducing IUD), the primary outcome will be the changes in IUD from preintervention to postintervention. As we are interested in the clinical potential of mindfulness in preventing and treating IUD, we will include studies that use outcome measures with distinct pathological conceptualisations of IUD (ie, conceptualisations in the realm of addiction research) and will exclude studies that use outcome measures of internet usage patterns with conceptualisations that are not necessarily pathological (eg, online vigilance<sup>33</sup>). We will exclude studies where assessments of IUD were based solely on screen time (ie, absolute time spent using a device such as a smartphone, wearable, tablet, or desktop computer), because the screen time—although it is an important indicator of

IUD—is not pathognomic for a disorder.<sup>4</sup> However, we will include screen time as a secondary outcome for the second research question.

### Search strategy

In October 2022, we will search Medline, PsycINFO, PSYINDEX, CINAHL, Web of Science, and Cochrane Register of Controlled Trials without language or publication date restrictions. We will translate articles in languages other than English, German, or French with the help of neural machine translation, as we did in previous reviews.<sup>26 27</sup> Search terms will be related to (1) mindfulness or MBPs and (2) IUD, using text words and subject headings (including MeSH terms). The search strategy for all databases is in online supplemental material. We will perform backward and forward citation searches of included studies and relevant reviews.<sup>5 34 35</sup> To find references in the grey literature, we will contact authors of included studies and relevant conference abstracts of unpublished studies.

### Study selection

We will use Rayyan<sup>36</sup> to screen references and Zotero<sup>37</sup> to manage references. Two reviewers will independently screen titles and abstracts. Full texts will be obtained if at least one reviewer judges a reference to meet inclusion criteria. Subsequently, two reviewers will independently perform a full-text screening of hitherto included references. We will resolve possible discrepancies through discussion and consensus and will calculate Cohen's kappa to determine the agreement between reviewers.<sup>38</sup> We will record reasons for study exclusion after the full text screening and will illustrate the process of study selection in a PRISMA flow chart.<sup>25</sup>

### Data extraction

Two reviewers will independently extract data from the eligible studies using a standardised extraction form. We will pilot test the standardised extraction form and modify it if necessary. We will resolve discrepancies through discussion and consensus. We will extract data on (1) the study: authors, publication date, country, design, and type of control (for the case of intervention studies; eg, waitlist, treatment-as-usual, active); (2) the population: career stage (eg, students, workers), sample size (treatment, control), dropout, mean age, sex proportion; (3) the intervention (for the case of intervention studies): implemented programme (eg, MBSR, MBCT, MBRP, self-developed), delivery format (online, offline, mixed), duration of an average single session, number of sessions, treatment standardisation (yes, no), group setting (yes, no), group size, background of treatment instructors; (4) the outcomes: we will extract the correlation between IUD and TM and its corresponding sample size. Moreover, we will extract means and SD for IUD and screen time for all conditions preintervention, postintervention, and follow-up intervention (if applicable). We will enter the extracted data into the statistical software R. We will

contact the authors of included studies, if the provided data is insufficient.

### Risk of bias and quality assessment in individual studies

Two reviewers will independently assess the studies' risk of bias. We will resolve discrepancies through discussion and consensus. We will use the Effective Public Health Practice Project Quality Assessment tool for quantitative studies (EPHPP) to rate the study quality of NRTs, including NCBAS and cross-sectional studies, because the EPHPP allows for the assessment of various study designs.<sup>39</sup> With the EPHPP tool, 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 will be rated as 'strong', 'moderate' or 'weak'. Based on the ratings in these eight domains, a corresponding overall rating will be derived. We will calculate Cohen's kappa to determine the inter-rater reliability.<sup>38</sup> In addition, we will use the Revised Cochrane Risk of Bias Tool for randomised trials (ROB 2.0) to rate the risk of bias in RCTs.<sup>40</sup> The ROB 2.0 can be used for a domain-based rating considering: (1) bias arising from the randomisation 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 will be rated as 'low risk of bias', 'some concerns', or 'high risk of bias'. Based on the domain-based ratings, a corresponding overall rating will be derived. We will perform sensitivity analyses by excluding studies with overall weak study quality (ratings made with EPHPP) or high overall risk of bias (ratings made with ROB 2.0), respectively.

### Risk of bias across studies

We will inspect funnel plots and compute Egger's regression test<sup>41</sup> to assess potential publication bias. To assess the overall quality of evidence across the intervention studies (ie, the risk of bias across studies reversely coded) we will use the Grading of Recommendations Assessment, Development, and Evaluation approach (GRADE).<sup>42</sup> With GRADE, the overall quality of evidence across the intervention studies is rated on five dimensions: (1) risk of bias, (2) inconsistency of results, (3) indirectness of evidence, (4) imprecision of effect size, and (5) publication bias.<sup>42</sup> Two reviewers will rate the overall quality of evidence into 'high', 'moderate', 'low', or 'very low' quality, reflecting the degree of confidence in the aggregated effect estimate.

### Data synthesis

In total, we will calculate three meta-analyses: (1) a first meta-analysis will be on the correlation between TM and IUD, (2) a second meta-analysis will be on between-group data examining the effectiveness of MBPs in reducing IUD in RCTs, and (3) a third meta-analysis will be on within-group pred-postdata examining the effectiveness of MBPs

in reducing IUD in both RCTs and NRTs, including NCBAS. For the first meta-analysis, we will aggregate the correlation coefficients. For the second meta-analysis, we will calculate standardised mean differences (SMDs) by standardising the difference of the pre-postintervention change between treatment and control with the pooled standardised preintervention SD. Using change values instead of postintervention values in between-group analysis will increase power and precision<sup>43</sup> and will allow to control for baseline differences between groups.<sup>44</sup> For the third meta-analysis, we will calculate SMDs by standardising the pre-postintervention change in treatment groups with the preintervention SD.<sup>45</sup> For the second and third meta-analysis, we will compute and aggregate Hedges' g values, their 95% CIs, and associated p values. For all three meta-analyses, we will analyse the identified studies using the intention-to-treat principle, weigh the studies using the inverse-variance method, use a random effects model to undertake meta-analytic pooling, and produce forest plots. We will assess heterogeneity of included studies by providing  $\tau$  and  $I^2$  statistics.<sup>46</sup> We will interpret  $I^2$  values as unimportant ( $I^2 < 40\%$ ), moderate (30%–60%), substantial (50%–90%), or considerable heterogeneity ( $> 75\%$ ).<sup>30</sup> Furthermore, we will explore moderators and sources of between-study heterogeneity, including characteristics of the studied populations (eg, clinical vs non-clinical), different conceptualisations of IUD (eg, problematic smartphone use vs IUD in general), or the implemented treatments (eg, established MBP vs self-developed MBP), using subgroup analyses and meta-regressions. For the second and the third meta-analysis, we will conduct sensitivity analyses to examine whether results are maintained when taking follow-up instead of postintervention data. Finally, we will conduct a comprehensive narrative synthesis of studies' characteristics. The latter is of special relevance if the heterogeneity of the included studies is considerably large.

### Patient and public involvement

Patients and/or the public were not involved in the design of the study.

### Ethics and dissemination

Ethics approval is not required. Results will be published in a peer-reviewed journal and presented at national and international conferences.

## DISCUSSION

IUD is on the rise and is associated with detrimental health consequences. Growing evidence suggests that mindfulness—either as a trait or cultivated in MBPs—is promising in preventing and treating IUD. However, a systematic review of the available evidence is missing. With this systematic review and meta-analysis, we will examine (1) the association between TM and IUD and (2) the effectiveness of MBPs in reducing IUD. Moreover, we will narratively synthesise the study characteristics and

results. We will provide healthcare policy makers, practitioners, and researchers with a comprehensive overview of the current body of knowledge in a growing field of health research with a high relevance for patient care. If MBPs prove to be effective, they should be recommended and incorporated as low-threshold prevention and treatment approach against IUD.

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**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**Patient consent for publication** Not applicable.

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