

MEDITATION-RELATED ADVERSE EFFECTS

Prevalence of meditation-related adverse effects in a population-based sample in the United States

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Author note

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MEDITATION-RELATED ADVERSE EFFECTS

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MEDITATION-RELATED ADVERSE EFFECTS

Abstract

Objective: Meditation practice and meditation-based psychotherapies have become increasingly popular. Although psychological benefits associated with meditation are well-documented, potential risks are unclear. **Method:** We conducted a population-based survey to evaluate the occurrence of a broad range of meditation-related adverse effects (MRAE).

Results: 953 participants completed our screening survey, 470 endorsed lifetime exposure to meditation practice, and 434 completed a follow-up survey assessing MRAE (92.3% response rate). A higher proportion than hypothesized reported occurrence of MRAE (general item = 32.3%, 1+ specific item = 50.0%) and MRAE duration ≥ 1 month (10.4%). Anxiety, traumatic re-experiencing, and emotional sensitivity were the most common MRAE. Some degree of functional impairment was reported by 10.6% of participants, with impairment lasting ≥ 1 month for 1.2%. Childhood adversity was associated with elevated risk for MRAE. Participants reporting MRAE were equally glad to have practiced meditation as those not reporting MRAE. Additional correlates of MRAE were identified in exploratory analyses. **Conclusion:** MRAE are common, even in a sample with relatively modest amounts of experience. Identifying individuals at elevated risk for MRAE, being transparent and realistic about the possible range of effects, and increasing trauma-sensitivity are warranted to maximize benefits and minimize risks of meditation.

Keywords: adverse effects; meditation; mindfulness; harm; mindfulness-based interventions

Clinical or Methodological Significance

Using a broad definition of adverse effects, this study suggests that many individuals experience adverse effects when practicing meditation, even in relatively modest amounts. Factors that may increase risk include both person-related (childhood adversity) and practice-related variables (amount of meditation). More systematic evaluation of prevalence and predictors of adverse effects associated with meditation training can help providers and consumers accurately evaluate potential costs and benefits.

MEDITATION-RELATED ADVERSE EFFECTS

In the past several decades, meditation practice and evidence-based interventions centered on meditation practice such as mindfulness-based stress reduction (MBSR; Kabat-Zinn, 2013) and mindfulness-based cognitive therapy (MBCT; Segal et al., 2013) have entered into the mainstream of popular culture and medicine. Meditation apps are far and away the most widely used mental health apps (Wasil et al., 2020), mindfulness training is being used as primary prevention in elementary school settings (e.g., van de Weijer-Bergsma et al., 2014), and past year utilization of meditation tripled between 2012 and 2017 (Clarke et al., 2018). Although some media claims regarding meditation are inaccurate (Van Dam et al., 2018), the results of hundreds of randomized trials testing standardized mindfulness-based interventions suggest these approaches generally confer benefits superior to waitlist controls and on par or superior to other active therapies across a wide range of populations, clinical conditions, and outcome types (Dunning et al., 2019; Goldberg et al., 2021; Goldberg et al., 2018).

In parallel to rising popularity, there has been growing concern regarding the possibility that meditation practice may also cause harm (Baer et al., 2019). The notion of side effects is well-known in medicine. In psychopharmacology, for example, clinical potency is commonly coupled with elevated risk for adverse effects, with many of the most effective psychopharmacological agents (e.g., antipsychotic medications) also carrying the highest side effect burden (Haddad & Sharma, 2007). It has likewise long been recognized that psychological interventions can produce both benefit and harm (Bergin, 1966; Lilienfeld, 2007). Despite the acknowledgement of potential harm in other mental health interventions, investigation of adverse effects in meditation-based interventions has been comparatively minimal and primarily occurred only the past 10 years (Farias et al., 2020). This coupling of increased utilization with inadequate acknowledgment of potential risks highlights the need to more fully characterize the range of effects that meditation training can produce.

Meditation-related adverse effects (MRAE)

MEDITATION-RELATED ADVERSE EFFECTS

The World Health Organization (WHO, 2010) International Classification for Patient Safety defines a *side effect* as “a known effect, other than that primarily intended, related to a medicine’s pharmacological properties” (p. 17). *Adverse effects* are defined as negatively valenced (i.e., subjectively unpleasant) side effects which vary in degree of severity. Although WHO (2010) guidelines were not originally written with reference to psychological interventions, psychotherapy researchers have applied similar notions of side effects and adverse effects in psychotherapy. Adverse effects can occur as a result of incorrect treatment (malpractice reaction) or correct treatment (adverse treatment reaction; Linden, 2013) and range in severity from mild (e.g., crying in session) to extremely severe or life threatening (e.g., suicide; Linden & Schermuly-Haupt, 2014). Adverse effects also vary in duration, from transient to sustained (Duggan et al., 2014), although even short duration adverse effects may be clinically important (e.g., acute suicidality). Adverse effects and treatment benefits can co-occur and may occur in one domain (e.g., target problem) and not another (i.e., non-target problem; Dimidjian & Hollon, 2010). Thus, a broad, multi-dimensional approach that avoids arbitrarily defining certain experiences as “harm” (and others as “not harm”) and captures the full range of severity can be helpful for a thorough evaluation of adverse effects in psychosocial interventions.

There is no reasonable doubt that meditation can cause challenging experiences. Discussion of a wide variety of distressing consequences of meditation practice appear in both traditional contemplative sources (e.g., Sayadaw, 2016) and are now widely documented in the scientific literature (Anderson et al., 2019; Britton et al., in press; Dobkin, Irving, & Amar, 2012; Farias et al., 2020; Lindahl et al., 2017). However, several open questions remain, questions whose answers are important for efforts to increase the safety, acceptability, and efficacy of meditation-based interventions and provide accurate information to consumers. Key questions include the population-level prevalence and types of adverse effects occurring in meditation (i.e., meditation-related adverse effects [MRAE]); the subjective appraisal of MRAE; and

MEDITATION-RELATED ADVERSE EFFECTS

participant-, provider-, and intervention-related factors associated with elevated risk for MRAE (Baer et al., 2019).

Frequency estimates of MRAE vary widely, and depend heavily on study design, sample, and how MRAE are defined and measured. A systematic review of meditation studies found an overall rate of 8.3% that varied by study design: 3.7% for experimental studies (e.g., randomized controlled trials [RCT]) and 33.2% for observational studies (Farias et al. 2020). Cross-sectional online survey studies (Cebolla et al., 2017; Schlosser et al., 2019; Vieten et al., 2018) which variously queried “unwanted or adverse reactions with potential harm to your health” (Cebolla et al 2017) and particularly unpleasant experiences (e.g., anxiety, fear, distorted emotions or thoughts, altered sense of self or the world; Schlosser et al., 2019; Vieten et al., 2018) have produced MRAE prevalence rates between 25.4-32%.

Three studies have systematically examined MRAEs in the context of standardized 8-week mindfulness-based interventions (MBSR/MBCT). In two samples ($ns < 100$), Baer et al. (2020) reported rates of 67–73% for “unpleasant experiences” and rates of 2 to 7% for “harm,” which was defined as being “worse off, in any way, after the course, than you would have been if you hadn’t done the course.” In a sample MBSR participants ($n = 2,311$), Hirshberg et al. (2020) reported rates of 15.2- 43.7% for increased symptoms, 6.8-32.3% for >35% symptom increase and 3.6- 4.4% for “clinically significant harm” which was defined as psychological distress worsening from functional to clinical levels. Rates across all three indices were similar to or lower than rates in a waitlist group. In three variants of MBCT ($n = 96$), Britton et al. (in press) found rates of 58% for negatively valenced experiences, and 6% for negative impacts on functioning lasting more than 1 month.

Both RCTs and observational studies provide worthwhile perspectives for clarifying prevalence of MRAE. In theory, RCTs can be used to establish causality (i.e., whether meditation training caused a particular adverse effect), although the existing literature is limited in important ways. In two meta-analyses of RCTs of mindfulness-based interventions, Kuyken et

MEDITATION-RELATED ADVERSE EFFECTS

al. (2016) and Wong et al., (2018) reported serious (i.e., life threatening) adverse events occurring for $\leq 2\%$ of participants and at similar rates across meditation and non-meditation control conditions. However, similar to psychotherapy generally (Jonsson et al., 2014), both meta-analyses note that adverse events were not consistently reported; more than 80% of RCTs do not provide any adverse effects statements (Wong et al., 2018), and less severe adverse effects whose assessment may not be required by regulatory bodies are almost never reported. Moreover, if assignment to the non-meditation control condition itself causes adverse effects (e.g., placebo effects when using waitlist controls, although this possibility is debated; Furukawa et al., 2014; Munder et al., 2019), comparative rates of adverse effects may underestimate their occurrence within meditation-based interventions. Randomized controlled trials also often lack the statistical power for examining other key questions such as factors correlated with occurrence of adverse effects.

Cross-sectional observational studies, such as those included in Farias et al.'s (2020) review, have been important for characterizing MRAE in the general population and can capture effects associated with varying degrees of meditation exposure. At once, the available studies also have important limitations, especially in regard to sampling procedures. The most important limitation is that none of the three recent cross-sectional studies were population-based surveys (see Supplemental Materials Table 1). Cebolla et al. (2017) specifically recruited individuals who reported having had MRAE and both Vieten et al. (2018) and Schlosser et al. (2019) recruited convenience samples through various online platforms (e.g., social media, academic and meditation center listservs). To our knowledge, no study has examined the prevalence of MRAE starting with a population-based sampling method in which efforts are made to recruit a demographically representative sample. Lacking such a design, it is unclear the degree to which previous results may be influenced by self-selection bias. A second limitation is that previous studies were primarily composed of individuals who were currently practicing meditation (Vieten et al., 2018) and/or who had practiced at least two months (Cebolla et al., 2017; Schlosser et

MEDITATION-RELATED ADVERSE EFFECTS

al., 2019). These samples may omit a vital piece of the picture – individuals exposed to meditation who did not continue precisely due to adverse effects. Third, none of the three previous surveys applied the definitional boundaries of meditation that have been used in the largest representative survey of meditation practice – the National Health Interview Survey (NHIS; Centers for Disease Control and Prevention, n. d.). Sampling conducted using standardized definitions of what constitutes meditation should aid in comparability across studies. Finally, all three studies focused on MRAE broadly and did not query specific symptoms or assess the degree to which these experiences caused functional impairment.

Two additional dimensions that, to our knowledge, have not been previously investigated include the occurrence of adverse effects in relation to meditation training delivered through mobile health (mHealth) technology (e.g., smartphone apps) and the degree to which those experiencing MRAE feel glad to have practiced meditation. Meditation apps are widely used (Wasil et al., 2020) and the predominantly unguided format may contribute to the frequency of MRAE (given these experiences are more likely to occur when practicing alone; Schlosser et al., 2019). Moreover, those experiencing MRAE from mHealth may lack support from a qualified teacher, which could in turn cause greater impairment and persistence of difficulties, should MRAE occur. It is also important to evaluate whether MRAE are associated with whether or not an individual feels glad to have practiced meditation, as studies suggest that similar experiences may be experienced as helpful or harmful by different participants or even by the same participant at different times (e.g., Lindahl et al., 2020).

The Current Study

We aimed to evaluate the prevalence and correlates of a broad range of adverse effects associated with meditation practice in a population-based sample. To do so, we conducted an online survey using the Prolific platform which allows recruitment of participants in proportion with their representation in the United States (US) population based on age, gender, and race. Participants who indicated lifetime exposure to meditation using NHIS descriptions were invited

MEDITATION-RELATED ADVERSE EFFECTS

to complete a follow-up survey assessing their meditation practice background, MRAE, and whether they felt glad to have practiced meditation. In order to capture a wide range of MRAE occurring naturalistically, we intentionally did not restrict our assessment to certain degrees of severity or duration (i.e., in contrast to only assessing serious / life-threatening adverse effects). We also assessed demographic and psychological characteristics theoretically and/or previously linked to increased risk for MRAE (e.g., childhood adversity, psychiatric symptoms; Lindahl et al., 2017; Schlosser et al., 2019; Treleaven, 2018). We made four *a priori* hypotheses which were preregistered through the Open Science Framework (<https://osf.io/sjmpu>). First, we hypothesized that MRAE would occur for a minority of participants (e.g., ~25%; Schlosser et al., 2019) and would generally be mild in nature (i.e., not impairing) and not persistent (e.g., ~5% persist beyond one month). Second, we hypothesized that the most common MRAE will be anxiety (Cebolla et al., 2017). Third, we hypothesized that MRAE will be more common for participants who report early childhood adversity (Treleaven, 2018). Fourth, we hypothesized that even those reporting MRAE will generally indicate that they were glad to have practiced meditation. We conducted several exploratory analyses examining correlates of MRAE.

Method

Participants

US residents were recruited through Prolific (www.Prolific.co) using their representative sampling procedure (see Supplemental Materials Table 2 for recruitment materials). Prolific is an online participant recruitment platform with functionality similar to Amazon's Mechanical Turk. In contrast to Mechanical Turk, Prolific participants are on average more diverse, less dishonest, and more naïve to commonly used measures (Peer et al., 2017). In addition, Prolific offers demographically representative sampling in which participants are recruited in proportion to their representation in the population (Prolific.co, n. d.). Sampling is stratified based on age, gender, and race, currently using 2015 data from the US Census Bureau.

MEDITATION-RELATED ADVERSE EFFECTS

A total of 993 participants initiated the screening survey which assessed basic demographics and lifetime exposure to meditation practice, as defined using the NHIS criteria (see Measures). Of these, 953 passed the attention check item and completed screening. As shown in Supplemental Materials Table 3, relative to the US population (US Census Bureau, 2019), the overall sample was older (median age = 44 vs. 38.1), higher income (median income = \$40,000 vs. \$34,103), and more educated (50.6% with a bachelor's degree or higher vs. 32.1%). Although several racial/ethnic groups appeared at rates similar to the population (Black, multiracial, Asian), non-Hispanic White participants were overrepresented (70.6%) and Hispanic participants were underrepresented (6.0%), likely due to Prolific matching on race but not ethnicity. Participants were paid \$0.50 to \$0.55 for completing the screening survey and \$3.67 to \$4.59 for completing the follow-up survey. Study procedures were approved by the Institutional Review Board at [masked for blind review].

Almost half of participants ($n = 470$; 49.3%) endorsed having lifetime exposure to at least one of the three NHIS meditation types and were invited to complete a follow-up survey regarding their experience with meditation. Most of those invited ($n = 434$; 92.3%) completed the follow-up survey and passed the attention check item. Those completing follow-up did not differ from those invited but not completing the follow-up survey on most demographic characteristics (age, gender, education, income; $r_s = -.05$ to $.05$, $p_s > .284$). However, non-Hispanic White participants were more likely to complete follow-up ($r = .15$, $p = .001$).

Measures

Demographics. Participants provided their age, gender identity, race/ethnicity, educational background (i.e., highest degree), and annual income. For use as covariates in analyses, demographic variables (except age) were dichotomized: gender (not male as reference group), race/ethnicity (racial/ethnic minority as reference group), education (not college graduate as reference group), and income (income below US population per capita median [\$34,103] as reference group; US Census Bureau, 2019).

MEDITATION-RELATED ADVERSE EFFECTS

Meditation practice background. Several items assessed participants' meditation practice background. To assess lifetime exposure to meditation, we included an item from the NHIS (Centers for Disease Control and Prevention, n. d.) in the screening survey. Participants were asked, "Have you ever tried any of the following types of meditation, even just once?" and were provided with NHIS descriptions of mantra meditation, mindfulness meditation, and spiritual meditation (Supplemental Materials Table 4). Participants reporting lifetime exposure to meditation were asked additional questions about their meditation practice in the follow-up survey (Supplemental Materials Table 5). This included when the participant was first introduced to meditation (in years), how the participant was first introduced (e.g., through smartphone app), and how the participant has ever been exposed to meditation (e.g., through smartphone app). Although multiple types of exposure were assessed, this variable was dichotomized as first and lifetime exposure through smartphone apps, given the rising popularity of this approach (Wasil et al., 2020). Participants also indicated their average days of meditation practice per week in the past 30 days (response options 0 to 7) and their lifetime hours of practice (response options 1-10, 11-100, 101-500, 501-1000, 1001-5000, 5000+). Participants indicated whether they have ever been exposed to various styles of practice. As concentration and insight practices have been previously linked to MRAE (Lindahl et al., 2017; Schlosser et al., 2019), two dichotomous variables (yes/no) were created reflecting lifetime exposure to concentration or insight practice. Participants also indicated whether they have attended a multiday meditation retreat, as intensive meditation retreats have previously been linked to MRAE (Lindahl et al., 2017).

Depression and anxiety symptoms. Two widely used measures assessed symptoms of depression and anxiety in the past 7 days. These measures were included based on the notion that individuals more prone to common psychiatric symptoms may also be more at risk for MRAE (Schlosser et al., 2019). To assess depression and anxiety symptoms, four-item versions of the *Patient-Reported Outcome Measurement Information System (PROMIS) Depression (4a)* and *Anxiety (4a)* were used (Pilkonis et al., 2011). Items index symptoms of

MEDITATION-RELATED ADVERSE EFFECTS

depression (e.g., “I felt worthless”) and anxiety (e.g., “I felt fearful) in the past 7 days.

Responses are made on a 5-point Likert-type scale ranging from 1 (*never*) to 5 (*always*). A total score was computed by summing across times. Internal consistency was adequate in the current sample (α s = .93 and .90, for PROMIS Depression and Anxiety, respectively).

Loneliness. We used the 5-item *National Institutes of Health Loneliness* scale (Cyranowski et al., 2013) to assess loneliness. This was based on the rationale that individuals more prone to experience loneliness may be at increased risk for MRAE. Participants rated their experience in the past 7 days (e.g., “I feel alone”) on a 5-point Likert-type scale ranging from 1 (*never*) to 5 (*always*). Internal consistency was adequate (α = .94).

Adverse childhood experiences. Childhood adversity was measured using the 11-item *Adverse Childhood Experience (ACE)* module from the Behavioral Risk Factor Surveillance System (Ford et al., 2014). This measure assesses the occurrence of eleven adverse experiences including household dysfunction and occurrence of physical, emotional, and sexual abuse. Response options are dichotomous (i.e., yes/no, never/one or more times). A total score was computed by summing across all items (Ford et al., 2014). Internal consistency was adequate (Kuder-Richardson = .75).

Social desirability. Social desirability was measured based on the possibility that it influenced participants’ willingness to disclose adverse experiences. *The Socially Desirable Response Set* (Hays et al., 1989) is a widely used measure where participants indicate the degree to which each of five items is true or false for them. Items include common but socially desirable or undesirable behavior (e.g., “I sometimes feel resentful when I don’t get my way”). Ratings are made on a 5-point Likert-type scale (*definitely true* to *definitely false*). Responses are dichotomized, with 1 being assigned when a respondent indicates the maximally socially desirable response option (e.g., definitely false for a socially undesirable item). A total score is computed across all items. Internal consistency was adequate (Kuder-Richardson = .71)

MEDITATION-RELATED ADVERSE EFFECTS

MRAE and feeling glad to have practiced meditation. Items were included to assess the prevalence of a broad range of MRAE and whether participants feel glad to have practiced meditation (Tables 1 and 2, Supplemental Materials Table 5). In order to most fully capture these experiences, we included three items assessing MRAE that referred to “challenging, difficult, or distressing experiences,” an 11-item questionnaire (Britton, Lindahl, & Cooper, 2018) that assessed the occurrence of specific MRAE previously found to occur in the context of mindfulness-based programs (Lindahl et al., 2017), and a single item assessing whether participants felt glad to have practiced meditation, given potential challenging experiences.

The first item of the three-item scale examined occurrence (“I personally have had challenging, difficult, or distressing experiences as a result of my meditation practice”) with participants indicating frequency (*never, rarely, occasionally, regularly, frequently, other*). The subsequent two items assessed impairment (“My meditation-related challenging, difficult, or distressing experiences impaired my ability to function,” *not at all, somewhat, moderately, severely, other*) and duration of impairment (“How long did your impairment last?,” *1 day or less, for a few days to 1 week, 1 week to 1 month, 1 month to 1 year, 1 year or longer, other*).

The 11-item *Meditation-Related Adverse Effects Scale – Mindfulness-Based Program version* (MRAES-MBP; Britton, Lindahl, & Cooper, 2018) was used to assess the occurrence and duration of specific MRAE. This measure was derived from more than 150 qualitative interviews with Buddhist meditators, meditation teachers, and mindfulness-based program participants about distressing and/or impairing meditation-related experiences (Britton et al., in press; Lindahl et al., 2017). Items represented the ten meditation-related experiences that were most highly associated with negative impact in functioning in the context of a mindfulness-based program (e.g., hyperarousal, dissociation, “I felt anxious,” “I had difficulty sleeping,” “I felt distant or cut off from other people”). Specific items were drawn from validated clinical symptom measures (e.g., PROMIS; Cella et al., 2007). Participants were asked, “Have you ever had any of the following occur as a result of meditation?” with response options: *never, for a few days to*

MEDITATION-RELATED ADVERSE EFFECTS

1 week, 1 week to 1 month, 1 month to 1 year, 1 year or longer. The eleventh item queried the experience of “other significant symptoms” which participants could describe. The frequency of most response options was low (<5%; Table 2), therefore, items were dichotomized for use in analyses. A total score was computed across the 10 specific items. Internal consistency reliability was adequate (Kuder-Richardson = .88).

A final item assessed whether participants’ felt glad to have practiced meditation. Participants were asked to “consider the various experiences you have had through meditation, including any challenging, difficult, or distressing experiences” and then indicate their agreement with the statement “I am glad I have practiced meditation” (response options ranging from *strongly disagree* to *strongly agree* on a 6-point Likert-type scale). Responses of 4 or greater (i.e., above midpoint) were interpreted as indicating feeling glad to have practiced meditation.

Data Analysis

Data used in this study are part of a two-part project assessing utilization of meditation practice and MRAE in a population-based sample. Both parts were preregistered separately through the Open Science Framework (<https://osf.io/sjmpu>, https://osf.io/4h86s/?view_only=0e5d7ad85f87468ea40e047b3cf7c795). Data related to utilization will be published elsewhere. Some response options were simplified for use in the current study. Specifically, we reduced the types of meditation exposure to focus on exposure through smartphone apps, reduced the types of meditation practice to focus on concentration or insight, reduced the types of meditation classes attended to focus on meditation retreats, and restricted the sample to those endorsing at least one of the three NHIS meditation items.

Planned analyses were specified in our preregistration. However, we made three deviations. First, as the three MRAE items assessing occurrence, impairment severity, and duration of impairment showed low frequency of most response options (<5%; Table 2), these items were dichotomized for use in analyses (i.e., yes/no). The responses were simplified to any occurrence of MRAE, any impairment, and duration of impairment lasting longer than one day.

MEDITATION-RELATED ADVERSE EFFECTS

Second, we used correlations and partial correlations (controlling for demographics) for characterizing the association between MRAE and other study variables rather than regression models. This was done to aid in interpretation of effect size magnitude. Correlations with dichotomous variables (i.e., point biserial or phi) are simplified cases of Pearson's product moment correlation (Cohen et al., 2003). Third, we used two-proportions z-tests rather than one sample t-tests for testing the proportion of participants who indicated experiencing MRAE.

In terms of our four *a priori* hypotheses, we examined whether the proportion of participants reporting MRAE as assessed via the single occurrence item and the MRAES-MBP was higher than 25% using a two-proportions z-test. We also used this test to assess whether the duration of participants' longest lasting MRAE was one month or longer and whether impairment was reported for more than 5% of participants. We used McNemar's test for paired nominal data to examine whether anxiety was reported more frequently than other MRAE on the MRAES-MBP. We used correlations and partial correlations that controlled for demographic variables (age, gender, race/ethnicity, education, income) to examine the association between MRAE with early childhood adversity and participants' ratings of whether they felt glad to have practiced meditation. Separate models were run for each of the four MRAE variables (i.e., single-item any unwanted experiences, MRAES-MBP total score, single-item any impairment, single-item duration of impairment >1 day).

In addition to these *a priori* hypotheses, we examined the association between several variables with occurrence of MRAE. These included five demographic variables, eight meditation practice-related variables, three psychological constructs (depression, anxiety, loneliness), and social desirability. These analyses were primarily intended to be descriptive. Nonetheless, we controlled for false discovery rate (FDR) using Benjamini and Hochberg's method given the number of tests conducted. FDR adjustment was applied based on the number of tests for each of the four MRAE variables. Lifetime meditation practice hours had some low frequency response options (<10% for each of the three highest hour amounts), so

MEDITATION-RELATED ADVERSE EFFECTS

categories were collapsed for use in correlations (i.e., recoded responses to be 0-10, 11-100, and 101 or more). Lastly, in keeping with our preregistration, models were re-estimated without outliers (i.e., values three standard deviations from the mean).¹

Results

Sample descriptive statistics are presented in Table 1. With the exception of social desirability, skewness (range = -0.94 to 1.47) and kurtosis (range = -1.17 to 1.09) for all continuous variables were below the cut-offs for substantial departure from normality (skewness < 2.0, kurtosis < 7.0; Curran et al., 1996).² Most participants reported lifetime exposure to mindfulness meditation (71.0%) and/or spiritual meditation (53.2%), with 29.2% reporting exposure to mantra meditation. A plurality (41.2%) of participants reported 11-100 hours of meditation practice, with 18.9% reporting 0-10, 16.4% reporting 101-500, 9.0% reporting 501-1000, 7.1% reporting 1001-5000, and 7.4% reporting ≥ 5001 hours. A minority (6.9%) had attended a multiday residential retreat and 65.2% had meditated in the past 30 days.

The percentage of participants reporting MRAE are displayed for the overall sample and separated by lifetime meditation hours in Table 1, Figure 1, and Supplemental Materials Tables 6 and 7. Rates of endorsing either the single occurrence item (32.3%) or at least one items on the MRAES-MBP (50.0%) were higher than our *a priori* hypothesis of 25% ($ps < .001$). On the single occurrence item, 19.8% reported MRAE occurred rarely, 8.7% occasionally, 1.8% regularly, and 0.7% frequently. On the MRAES-MBP, participants' longest-lasting adverse effect lasted for a few days to a week (30.0%), 1 week to 1 month (9.4%), 1 month to 1 year (3.5%), and 1 year or longer (6.5%). The rate of symptom duration lasting one month or longer (10.4%) was higher than our *a priori* hypothesis of 5% ($p < .001$).

¹ Four continuous variables had outliers: years since first exposure ($n = 3$), ACE score ($n = 2$), social desirability ($n = 8$), and feeling glad to have practiced meditation ($n = 3$). Significance tests of associations with adverse effects were unchanged with these responses removed.

² Due to the departure from normality, we also examined results with a dichotomized social desirability variable (i.e., social desirability > 0 = 1). Significance tests of associations with adverse effects were unchanged when social desirability was dichotomized.

MEDITATION-RELATED ADVERSE EFFECTS

Some degree of functional impairment was reported by 10.6% of participants, which was higher than our hypothesized 5% ($p < .001$). Severity was endorsed as somewhat (7.1%), moderately (2.3%), and severely impairing (0.2%; Supplemental Materials Table 7). Duration of impairment was ≤ 1 day (7.1%), a few days to 1 week (2.5%), 1 week to 1 month (1.8%), 1 month to 1 year (0.7%), and 1 year or longer (0.5%). When restricted to participants with at least 11-100 hours of practice experience (i.e., similar to what one might have from MBSR or MBCT), 35.2% endorsed the single occurrence item, 52.8% endorsed at least one item on the MRAES-MBP, 11.6% endorsed some degree of functional impairment, and 1.4% endorsed impairment lasting one month or longer. Estimates were also essentially unchanged when excluding 4 participants who were exposed to meditation ≤ 2 months ago.

Occurrence and duration of specific MRAE assessed via the MRAES-MBP are displayed in Table 2. The most common MRAE were anxiety (27.0%), traumatic re-experiencing (25.8%), and emotional sensitivity (22.8%). As hypothesized, anxiety was more commonly endorsed than most other items ($ps < .01$), with the exception of traumatic re-experiencing; $p = .668$) and emotional sensitivity ($p = .054$). Traumatic re-experiencing was the second most commonly endorsed item and occurred more frequently than all other items ($ps < .01$) with the exception of anxiety and emotional sensitivity ($p = .182$).

Results from analyses examining correlates of MRAE are presented in Table 3 and Supplemental Materials Table 8. As hypothesized, participants reporting a greater number of adverse childhood experiences were more likely to report any MRAE (single item occurrence: $r = .19, p < .001$), a greater number of MRAE (MRAES-MBP total score: $r = .19, p < .001$), and were more likely to report impairment due to meditation ($r = .15, p = .002$). Adverse childhood experiences were not associated with a longer duration of impairment (i.e., >1 day; $r = .05, p = .323$). Significance tests were unchanged when controlling for demographics or applying FDR p -value adjustment.

MEDITATION-RELATED ADVERSE EFFECTS

In the full sample, 88.7% of participants reported feeling glad to have practiced meditation and 11.3% reported not feeling glad. The proportion feeling glad remained essentially unchanged when restricted to those reporting MRAE on the single item (87.9%) or MRAES-MBP total score ≥ 1 (88.2%), in all instances representing the majority of the sample ($ps < .001$). When treated continuously or dichotomously, feeling glad to have practiced meditation was not associated with any of the four MRAE variables ($rs = -.07$ to $.03$; $ps \geq .141$).

Subsequent analyses examined additional correlates of MRAE. Given the exploratory nature of these analyses, we report unadjusted statistical significance and also note instances in which FDR adjustment or controlling for demographic variables modified statistical significance. First, demographic variables were examined. Higher age was negatively associated with likelihood of MRAE (single item occurrence, MRAES-MBP total; $rs = -.12$ and $-.23$, respectively) and with likelihood of impairment ($r = -.11$), although the latter association did not survive FDR or demographic adjustment. Non-Hispanic White participants reported fewer MRAE ($r = -.18$), with this result persisting after controlling for other demographic variables (i.e., age, gender, education, income; $r = -.13$). Having a college education was associated with lower likelihood of impairment ($r = -.14$), although this association did not survive FDR adjustment.

Next, several meditation-related variables were examined. Initial exposure to meditation through a smartphone app was not associated with greater likelihood of MRAE (single item occurrence, MRAES-MBP total score; $rs = .06$). However, initial exposure through a smartphone app was associated with greater likelihood of impairment ($r = .16$) and impairment lasting longer than a day ($r = .20$), with results unchanged applying FDR adjustment or controlling for demographic variables (including age). Lifetime exposure through a smartphone app was not associated with any of the four MRAE variables. Any meditation practice in the past 30 days was associated with greater likelihood of MRAE (single item occurrence; $r = .12$), greater number of MRAE (MRAES-MBP total score; $r = .15$), and greater likelihood of impairment lasting >1 day ($r = .12$), although the associations with single item occurrence and impairment

MEDITATION-RELATED ADVERSE EFFECTS

lasting >1 day did not survive FDR adjustment. Greater lifetime hours of practice was associated with a greater likelihood of MRAE (single item occurrence; $r = .10$), greater number of MRAE (MRAES-MBP total score; $r = .14$), and greater likelihood of impairment lasting >1 day ($r = .10$), although the associations with single item occurrence and impairment lasting >1 day did not survive FDR adjustment. Lifetime concentration and lifetime insight practice were not associated with MRAE. Having attended a meditation retreat was associated with greater likelihood of impairment ($r = .11$), although this association did not survive FDR adjustment.

Next, we examined associations with depression, anxiety, and loneliness. Higher depression was associated with greater likelihood of MRAE (single item occurrence, MRAES-MBP total score; $r_s = .16$ and $.18$, respectively) and greater likelihood of impairment ($r = .15$), although the association with impairment did not survive demographic adjustment. Higher anxiety was associated with greater likelihood of MRAE (single item occurrence, MRAES-MBP total score; $r_s = .15$ and $.14$, respectively) and greater likelihood of impairment ($r = .10$), although the associations with likelihood of impairment did not survive demographic or FDR adjustment and the association with MRAES-MBP total score did not survive demographic adjustment. Higher loneliness was associated with greater likelihood of MRAE (single item occurrence, MRAES-MBP total score; $r_s = .19$ and $.17$, respectively) and greater likelihood of impairment ($r = .10$), although the latter association did not survive demographic or FDR adjustment. Lastly, none of the four MRAE variables were associated with social desirability.

Discussion

We conducted what we believe to be the first population-based survey study assessing the prevalence of a broad range of adverse effects associated with meditation practice. It is vital to understand risks of meditation practice as it is incorporated into psychological treatments (e.g., National Institute for Health Care Excellence, 2009), prevention programs (van de Weijer-Bergsma et al., 2014), and is increasingly offered in various secular settings (e.g., education, business; Van Dam et al., 2018; Zoogman et al., 2015). Consistent with prior evaluations, our

MEDITATION-RELATED ADVERSE EFFECTS

results provide clear evidence that meditation commonly results in adverse effects. Half of participants reported at least one clinically relevant symptom, with anxiety, traumatic re-experiencing, and emotional sensitivity appearing most commonly. MRAE reported ranged in duration. The most common duration for participants' longest-lasting adverse effect was a few days to a week (30.0%), although the frequency of our *a priori* definition of "persistent" (i.e., ≥ 1 month) was higher (10.4%) than our prediction (5%).

Functional impairment was reported by 10.6% of participants, which was higher than our prediction (5%). Impairment varied in severity (7.1% somewhat, 2.3% moderately, 0.2% severely impairing). Impairment that lasted a day or less was reported by 7.1% of participants and impairment lasting longer than a day occurred for 6% of the sample. Impairment lasting 1 month or longer occurred for 1.2% of participants.

Given meditation is associated with adverse effects, one may reasonably ask whether those experiencing negative consequences feel less glad to have practiced meditation (i.e., regret practicing meditation). We did not find evidence this is the case. The proportion of participants endorsing feeling glad to have practiced meditation (88.7%) was essentially unchanged when restricted to those reporting MRAE (87.9% to 88.2%). Feeling glad to have meditated was also not associated with MRAE when treated continuously.

Feeling glad to have practiced meditation despite MRAE supports the possibility that these experiences do not deter continued practice (Anderson et al., 2019; Cebolla et al., 2017). Consistent with this, we found evidence that participants with more meditation practice experience, whether current or previous, were more likely to report MRAE. Several previous studies have also found that meditation-related challenges are more likely with more practice amount or intensity (Britton et al., 2014; Britton et al., 2019; Britton et al., in press; Lindahl et al., 2017; Schlosser et al., 2019). There are several possible explanations for this. One possibility is that meditating more increases the opportunity for MRAE to occur (i.e., a "biological gradient" or dose-response; Hill, 2015). It is also possible that participants are practicing more *because* of

MEDITATION-RELATED ADVERSE EFFECTS

the MRAE. Such a possibility aligns with accounts from long-term meditation practitioners who were instructed to respond to challenging meditation experiences with more meditation (Lindahl et al., 2017; Lindahl & Britton, 2019; Lindahl et al., 2020). Alternatively, it may also be that MRAE are, at least for some, a part of the meditative process. Some level of discomfort may accompany both healing and meditative insights (Lindahl et al., 2017). Importantly, descriptions of the meditative path in early Buddhist accounts (i.e., Pali canon) clearly indicate that practice *can be* but is *not necessarily* painful (e.g., Anguttara Nikaya 4.162; Bodhi, 2012). Thus, it is important to avoid both the no pain, no gain fallacy (i.e., “worsening is to be expected and is a positive sign that therapy is working,” Hannan et al., 2005, p. 156) as well as the conclusion that MRAE are necessarily harmful (i.e., pain always means harm). The fact that participants reporting lifetime MRAEs were more likely to report elevated past week depression and anxiety symptoms supports the notion that MRAEs do not lead to decreased symptoms, although we did not assess symptoms prior to the MRAEs (i.e., did not assess change) and, as discussed below, establishing causality in cross-sectional data is generally not possible. Ultimately, instead of attempting to make global appraisals for all meditators, it may be more fruitful to consider multiple contextual and person-centered factors involved in the occurrence and appraisal of MRAEs (Lindahl et al., 2019). Careful future research is required to determine when MRAE are entirely harmful or if there are circumstances or types of MRAE that may ultimately lead to benefit. Longitudinal studies in particular could examine if, when, and for whom MRAEs may be linked with later benefits, deteriorations, or no change in outcome.

Results from correlational analyses provide preliminary indications regarding whom may be at elevated risk for MRAE. As hypothesized, adverse childhood experiences (ACEs) were associated with increased occurrence of MRAE. This may be due to a greater vulnerability to distress associated with childhood adversity (Weems et al., in press). This also highlights the need for increasing trauma-sensitivity within meditation-based interventions (Treleaven, 2018).

MEDITATION-RELATED ADVERSE EFFECTS

In exploratory analyses, symptoms of depression, anxiety, and loneliness in the past week were positively correlated with lifetime occurrence of MRAE. The correlational nature of our data and assessment of current psychiatric symptoms and loneliness makes it impossible to determine the direction of causality. Given the temporal ordering of measurement, it is possible that the causal direction flows from MRAE to increased depression, anxiety, and loneliness. Conversely, if depression, anxiety, and loneliness in the last week can be taken to reflect a more general psychological vulnerability or trait proneness to negative affect (i.e., higher neuroticism), then individuals with these symptoms may find that negatively valenced experiences also arise within the context of meditation. Should this turn out to be the case, it may be prudent to warn individuals experiencing depression, anxiety, and loneliness that meditation may result in MRAE including impairment.

We also found some evidence that younger participants and those from marginalized populations (racial/ethnic minority, without a bachelor's degree, low income) may be more likely to report MRAE, highlighting the need for increased cultural sensitivity and potential cultural adaptation to increase participant safety (Biggers et al., 2020). Lastly, the only predictor of sustained impairment (>1 day) that survived FDR correction was first exposure through a smartphone app. Due to the exploratory nature of this analysis, the small portion of the sample being initially exposed this way ($n = 17$), and the recent advent of smartphone apps, this must be interpreted cautiously. However, given the popularity of meditation apps (Wasil et al., 2020), research seeking to more deeply understand potential risks associated with first being exposed in this way is warranted. Available evidence from randomized controlled trials does not indicate that smartphone-based meditation interventions increase risk for harm but may, like in-person meditation training, actually reduce the risk of certain types of harm (e.g., target symptom worsening) relative to a waitlist control (Goldberg et al., 2020). Indeed, the social dimensions of standard in-person, group-based meditation-based interventions, such as the teacher and

MEDITATION-RELATED ADVERSE EFFECTS

meditation community, have been found to be associated with the magnitude of benefits and risks (Canby et al., 2021; Lindahl et al., 2017)

Limitations and Future Directions

Although the first population-based survey focused on MRAE, our study has important limitations. Sample demographic characteristics did not perfectly align with current demographics in the US, which raises questions of generalizability. This issue is compounded by the loss of participants during the follow-up survey, especially racial/ethnic minority participants. Relatedly, although crowdsourcing has been shown to have methodological benefits over convenience sampling (e.g., undergraduates; Behrend et al., 2011), our sample was necessarily restricted (e.g., to Internet users) and may differ from the general population in various unmeasured ways. Our sample also reported relatively few hours of meditation practice and limited retreat experience, which makes it difficult to evaluate MRAE occurring in more intensive training. This also makes comparisons with samples including more experienced practitioners (e.g., Schlosser et al., 2019) tenuous. As noted, the correlational nature of our data makes it impossible to infer causality. Also, many of the analyses we conducted were exploratory. While these were intended to be primarily descriptive in nature and applied a p -value correction, it is still likely that some of the observed associations occurred merely by chance alone. Correlations were also modest in magnitude ($r_s < .30$), highlighting that the vast majority of variance in MRAE remains unexplained at least by individual predictors. Lastly, although we attempted a multidimensional assessment of MRAE, different estimates of prevalence rates may have resulted from the use of other measures.

These limitations notwithstanding, there are several implications of this study. Given the rapidly growing popularity of meditation (Clarke et al., 2018), it is important for those offering or promoting meditation practice to be educated and transparent about the possibility of MRAE. Teachers, clinicians, researchers, and product developers involved with meditation must collectively work to avoid a Pollyannaish depiction of the practice experience as uniformly

MEDITATION-RELATED ADVERSE EFFECTS

pleasant or beneficial. It is also important to acknowledge that harm occurs, and some individuals experience sustained deterioration as a result of meditation. At once, adverse effects and benefits can (and likely do) co-occur. Thus, providers and potential consumers must weigh the risk of MRAE relative to the potential benefit meditation might provide and the opportunity cost associated with not engaging in meditation. As research in this area matures, it will be important to compare prevalence and type of adverse effects occurring in meditation-based interventions to similarly intensive psychological treatments (e.g., psychotherapy) and control conditions, using both randomized and observational designs and with sensitivity to individual differences which may moderate occurrence of MRAE. It will be results from these studies that allow clear estimation of potential costs and benefits of engaging in meditation training (e.g., evaluation of the degree to which meditation practice increases risk for adverse effects beyond what may occur in the absence of practice; Hirshberg et al., 2020). Until such data are available, it is quite difficult (and potentially misleading) to make direct comparisons between risk for adverse effects associated with meditation practice and risks associated with other psychological interventions.

As noted, it is crucial that future studies deepen our understanding of the participant-, provider-, and intervention-level factors that increase risk for MRAE and evaluate methods for reducing this risk. Both qualitative and quantitative designs could be used to further evaluate candidate factors identified in the current study such as a history of childhood adversity, symptoms of depression and anxiety, loneliness, and racial/ethnic minority status. A clearer understanding of precisely how and why MRAE may occur for certain individuals can help guide the development of meditation-based interventions, teacher training, and delivery formats that minimize risk. More consistent measurement and reporting of MRAE is also essential (Baer et al., 2019; Britton et al., in press). This may require validation of instruments specifically designed to assess MRAE, although widespread adoption of other standardized metrics (e.g., clinically significant deterioration) will also be valuable, particularly to allow comparisons with the

MEDITATION-RELATED ADVERSE EFFECTS

broader psychotherapy literature. Our results join other recent evaluations (Britton et al., in press) suggesting that items querying specific potential MRAE (e.g., via the MRAES-MBP; Britton et al., 2018) may be more sensitive to detection of a broad range of MRAE than more general items. The accumulation of accurate information regarding the likelihood of various outcomes can allow individuals considering these approaches to decide for themselves whether potential benefits outweigh the associated risk.

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MEDITATION-RELATED ADVERSE EFFECTS

Table 1. Follow-up survey sample descriptive statistics (*n* = 434)

Variables	Mean	SD	%	n	Min	Max	Skew	Kurtosis
Age	43.77	15.53			19	78	0.16	-1.17
Male			43.55	189	0	1	0.26	-1.94
non-Hispanic White			72.58	315	0	1	-1.01	-0.98
Bachelor's degree			56.91	247	0	1	-0.28	-1.93
Low income			43.09	187	0	1	0.28	-1.93
Any adverse effect			32.26	140	0	1	0.76	-1.43
Mantra meditation			29.26	127	0	1	0.91	-1.18
Mindfulness meditation			70.97	308	0	1	-0.92	-1.15
Spiritual meditation			53.23	231	0	1	-0.13	-1.99
1+ MRAES-MBP			50.00	217	0	1	0.00	-2.00
MRAES-MBP total	1.90	2.73			0	10	1.47	1.09
Any impairment			10.60	46	0	1	2.55	4.52
Impairment >1 day			5.99	26	0	1	3.70	11.69
Impairment ≥1 month			1.15	5	0	1	9.12	81.42
Years since first exposure	14.28	13.77			0	59	1.18	0.49
App first exposure			3.92	17	0	1	4.73	20.46
App ever exposure			45.85	199	0	1	0.17	-1.98
Any meditation in the past 30 days			65.21	283	0	1	-0.64	-1.60
Weekly days of meditation in the past 30 days	2.21	2.38			0	7	0.84	-0.61
Lifetime meditation hours category								
0-10			18.89	82	0	1	1.58	0.51
11-100			41.24	179	0	1	0.35	-1.88
101-500			16.36	71	0	1	1.81	1.29
501-1000			8.99	39	0	1	2.86	6.18
1001-5000			7.14	31	0	1	3.32	9.02
5001+			7.37	32	0	1	3.25	8.59

MEDITATION-RELATED ADVERSE EFFECTS

Lifetime meditation hours continuous	2.21	0.74			1	3	-0.35	-1.11
Concentration practice			84.33	366	0	1	-1.88	1.55
Insight practice			25.81	112	0	1	1.10	-0.79
Residential retreat			6.91	30	0	1	3.39	9.48
PROMIS Depression in the past week	8.53	4.26			4	20	0.7	-0.5
PROMIS Anxiety in the past week	9.24	4.01			4	20	0.48	-0.61
NIH Toolbox Loneliness in the past week	2.39	1.09			1	5	0.42	-0.79
Adverse Childhood Experiences	14.04	2.43			11	22	0.71	-0.02
Socially Desirable Response Set	0.21	0.68			0	5	4.61	25.14
Glad to have practiced meditation	4.99	1.12			1	6	-0.94	0.25
Glad to have practiced meditation dichotomous			88.71	385	0	1	-2.44	3.95

Note: MRAES-MBP = Meditation-Related Adverse Effects Scale – Mindfulness-Based Program; 1+ MRAES-MBP = whether any MRAES-MBP item was endorsed (i.e., response other than “Never”); App first exposure = first exposure to meditation through a smartphone app; App ever exposure = ever having been exposed to meditation through a smartphone app; Weekly days of meditation = average days of meditation per week in the past 30 days; Lifetime meditation hours continuous = 0 to 10 (1), 11-100 (2), 101+ (3); PROMIS = Patient-Reported Outcome Measurement Information System; NIH = National Institutes of Health; Glad to have practiced meditation dichotomous = dichotomized with responses 1 to 3 coded as 0 and 4 to 6 coded as 1.

MEDITATION-RELATED ADVERSE EFFECTS

Table 2. Frequency and duration of specific meditation-related adverse effects

MRAES-MBP Item	Any	Never	Days to 1 week	1 week to 1 month	1 month to 1 year	1 year+
1	12.44	87.56	9.45	1.84	0.46	0.69
2	26.96	73.04	21.89	2.30	1.61	1.15
3	25.81	74.19	18.66	3.92	1.61	1.61
4	22.81	77.19	15.67	4.15	1.38	1.61
5	16.13	83.87	9.22	3.46	1.61	1.84
6	17.97	82.03	11.29	3.46	1.84	1.38
7	19.35	80.65	11.52	3.23	1.38	3.23
8	15.21	84.79	10.14	1.84	1.38	1.84
9	13.82	86.18	7.14	3.00	1.84	1.84
10	19.59	80.41	13.36	2.76	2.30	1.15
11	5.76	94.24	3.00	1.15	0.23	1.38

Note: MRAES-MBP = Meditation-Related Adverse Effects Scale – Mindfulness-Based Program (Britton et al., 2018). MRAES-MBP items assess trouble thinking clearly (Item 1), anxiety (Item 2), traumatic re-experiencing (Item 3), emotional sensitivity (Item 4), trouble enjoying things (Item 5), feeling distant or cut off from others (Item 6), difficulty sleeping (Item 7), experiencing headaches and/or body pain (Item 8), sensitive hearing (Item 9), feeling disconnected from everything (Item 10), and other (Item 11). Values represent percentage of sample. $n = 434$.

MEDITATION-RELATED ADVERSE EFFECTS

Table 3. Correlations between meditation-related adverse effects with demographic, meditation practice, and psychological variables

Variable	Any adverse effect			MRAES-MBP total			Any impairment			Impairment >1 day		
	<i>r</i>	<i>p</i>	<i>p</i> _{FDR}	<i>r</i>	<i>p</i>	<i>p</i> _{FDR}	<i>r</i>	<i>p</i>	<i>p</i> _{FDR}	<i>r</i>	<i>p</i>	<i>p</i> _{FDR}
Age	-.12	.012*	.173	-.23	<.001***	<.001***	-.11	.025*	.322	-.02	.622	.999
Male	-.03	.540	.999	.03	.508	.999	-.02	.746	.999	-.07	.176	.999
Non-Hispanic White	.02	.750	.999	-.18	<.001***	.002**	-.01	.893	.999	-.06	.194	.999
Bachelor's degree	-.07	.167	.999	-.08	.114	.999	-.14	.004**	.057	-.05	.254	.999
Low income	.10	.045*	.539	.07	.141	.999	.18	<.001***	.002**	.09	.050	.803
Years since first exposure	-.01	.898	.999	-.05	.313	.999	-.01	.802	.999	.04	.375	.999
App first exposure	.06	.184	.999	.06	.251	.999	.16	.001**	.013*	.20	<.001***	.001**
App ever exposure	.09	.070	.715	.02	.605	.999	.00	.977	.999	.00	.975	.999
Any meditation in the past 30 days	.12	.012*	.173	.15	.001**	.020*	.05	.326	.999	.12	.010*	.183
Lifetime meditation hours continuous	.10	.041*	.539	.14	.004**	.047*	.03	.479	.999	.10	.038*	.654
Concentration practice	.05	.267	.999	.04	.462	.999	.05	.345	.999	.00	.967	.999
Insight practice	.09	.065	.715	.04	.398	.999	.09	.068	.678	-.02	.744	.999
Residential retreat	.01	.896	.999	.09	.062	.679	.11	.019*	.263	.08	.079	.999
PROMIS Depression in the last week	.16	.001**	.018*	.18	<.001***	.004**	.15	.001**	.022*	.09	.063	.952
PROMIS Anxiety in the last week	.15	.002**	.032*	.14	.004**	.047*	.10	.032*	.379	.08	.097	.999
NIH Toolbox Loneliness in the last week	.19	<.001***	.001**	.17	<.001***	.005**	.10	.037*	.402	.06	.219	.999
Adverse Childhood Experiences	.19	<.001***	.002**	.19	<.001***	.001**	.15	.002**	.031*	.05	.323	.999
Socially Desirable Response Set	.03	.582	.999	-.03	.486	.999	.03	.589	.999	-.01	.893	.999
Glad to have practiced meditation	-.05	.283	.999	-.02	.622	.999	-.07	.141	.999	.03	.559	.999

Note: MRAES-MBP = Meditation-Related Adverse Effects Scale – Mindfulness-Based Program; App first exposure = first exposure to meditation through a smartphone app; App ever exposure = ever having been exposed to meditation through a smartphone app; Weekly days of meditation = average days of meditation per week in the past 30 days; Lifetime meditation hours continuous = 0 to 10 (1), 11-100 (2), 101+ (3); PROMIS = Patient-Reported Outcome Measurement Information System; NIH = National Institutes of Health.

MEDITATION-RELATED ADVERSE EFFECTS

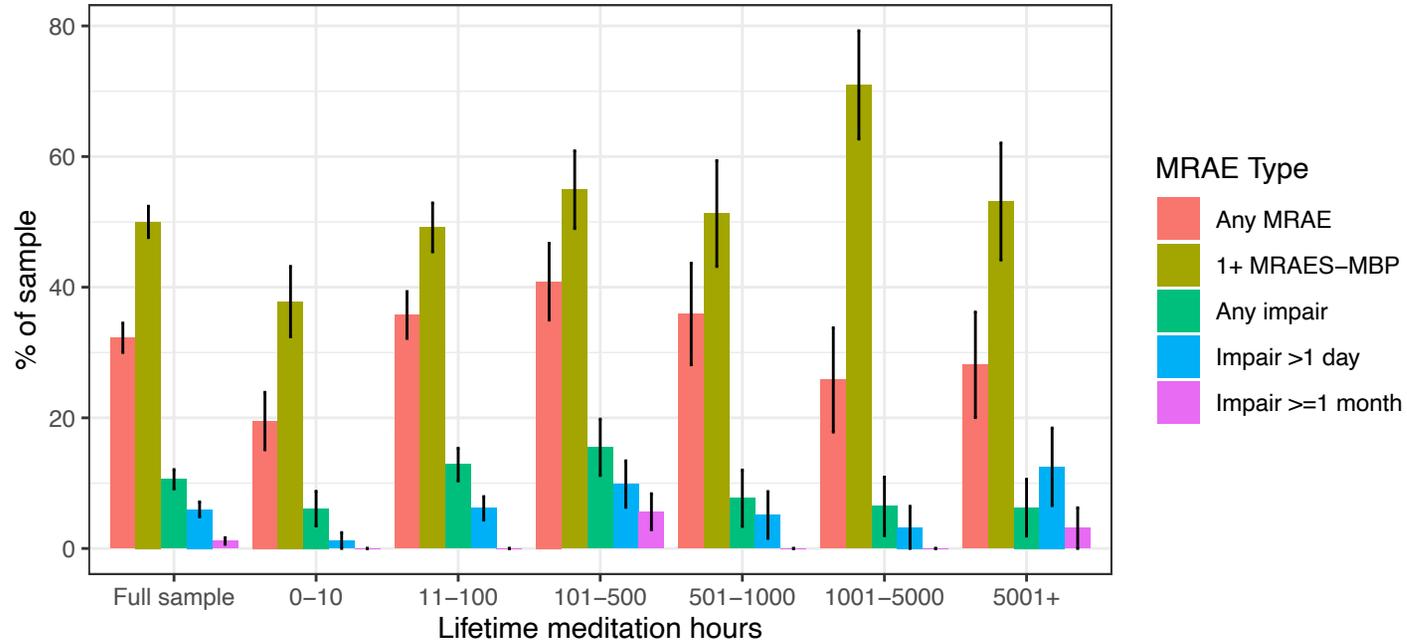


Figure 1. Frequency of meditation-related adverse effects (MRAE) by amount of lifetime meditation practice. MRAE = meditation-related adverse effects; MRAES-MBP = Meditation-Related Adverse Effects Scale – Mindfulness-Based Program (Britton et al., 2018); Impair = impairment. Bars indicate percentage of the sample endorsing any instance of each experience with error bars indicating 95% confidence intervals. See Table 1 and Supplemental Materials Table 6 for these data in tabular format.

MEDITATION-RELATED ADVERSE EFFECTS

Supplemental Materials Table 1. Prior cross-sectional studies examining prevalence and predictors of meditation-related adverse effects

Study	Method	Findings
Cebolla et al. (2017)	<p>Sample: international online survey, n = 342 completed, recruited through research webpages, mindfulness associations, meditation groups</p> <p>Description for participants: study on occurrence of unexpected and/or unwanted experiences</p> <p>Inclusion/exclusion: ≥ 2 months of meditation experience</p> <p>Meditation description: not provided</p> <p>Adverse effects: yes/no to having experienced unwanted or adverse reactions from the practice of meditation</p>	<p>Prevalence of adverse effects: 25.4% reported “any type of unwanted (not normally expected) or adverse reactions (with potential harm to your health)” (n = 87)</p> <p>Subjective experience: anxiety most common (13.8%), but no information for 53%</p> <p>Consequences: 1.1% discontinued meditation, but no information for 49.4%</p> <p>Predictors: body awareness associated with lower unwanted experiences prevalence, no association with years of practice or demographics</p>
Vieten et al. (2018)	<p>Sample: international online survey, n = 1,130 completed, recruited through social media, email, academic list-servs, directories of meditation teachers and practitioners</p> <p>Description for participants: no mention of extraordinary aspects of meditation, assess prevalence of personal experiences related to meditation, average 14.7 years of practice with 98% practicing in the past six months</p> <p>Inclusion/exclusion: past or current meditation practice</p> <p>Meditation description: "have you ever practiced meditation"</p> <p>Adverse effects: yes/no and frequency of "disturbing emotions"</p>	<p>Prevalence of adverse effects: 32% reported experiencing disturbing emotions, including fear, dread, or terror</p> <p>Subjective experience: n/a</p> <p>Consequences: n/a</p> <p>Predictors: not associated with lifetime months of meditation practice</p>

MEDITATION-RELATED ADVERSE EFFECTS

Schlosser et al. (2019)	Sample: international online survey, n = 1,232 completed, recruited through social media, Buddhist communities, meditation centers, mindfulness associations Description for participants: association between meditation and subjective experiences Inclusion/exclusion: weekly meditation practice, ≥ 2 months of experience Meditation description: "regular meditation practice" Adverse effects: yes/no "particularly unpleasant experiences" perceived to be "caused by your meditation practice"	Prevalence of adverse effects: 25.6% reported "particularly unpleasant experiences (e.g., anxiety, fear, distorted emotions or thoughts, altered sense of self or the world)" Subjective experience: n/a Consequences: n/a Predictors: more likely for males, non-religious, higher repetitive negative thinking, deconstructive practices only, meditation retreat attendees; no association with lifetime practice or session length
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Note: n/a = not available.

MEDITATION-RELATED ADVERSE EFFECTS

Supplemental Materials Table 2. Study description used during recruitment process

Screening Study

Study title: Associations between health and behavior

Payment: \$0.55

Study length: 3 minutes

The aim of this study is to better understand factors that predict health. You will be required to complete a set of surveys assessing your health behaviors along with demographic measures. You will be asked sensitive questions (e.g., about substance use). To have your submission accepted, you must also correctly answer questions designed to check if you are paying attention. Anonymized data may be made available to other researchers.

Depending on your answers, you may be invited to a follow-up survey. The follow-up survey is 20-minutes and you will be paid \$3.67 for completing it.

Please only complete this screener if you would be willing and able to complete the follow-up survey.

Follow-up study

Study title: Meditation experiences survey

Payment: \$4.59

Study length: 25 minutes

Thank you for completing our initial study! In this follow-up study we are seeking to better understand patterns of engagement with meditation practice. You are being invited because you indicated that you have practiced meditation at least once in the past. For this study, you will be required to complete a set of surveys assessing your experience with meditation and measures of health. You may be asked sensitive questions related to mental and physical health, past trauma, and experiences that may have occurred during meditation. To have your submission accepted, you must also correctly answer questions designed to check if you are paying attention. Anonymized data may be made available to other researchers.

MEDITATION-RELATED ADVERSE EFFECTS

Supplemental Materials Table 3. Full and follow-up survey sample demographics

Variables		Full Sample (<i>n</i> = 953)	Follow-Up Survey Sample (<i>n</i> = 434)
		Mean / Median / % (SD / <i>n</i>)	Mean / Median / % (SD / <i>n</i>)
Age	Mean (SD)	44.69 (16.08)	43.77 (15.53)
	Median	44	42
Income	Mean (SD)	\$53,762.05 (52150.67)	\$54,389.56 (60126.77)
	Median	\$40,000	\$40,000
	Low % (<i>n</i>)	41.66 (397)	43.09 (187)
	High % (<i>n</i>)	58.34 (556)	56.91 (247)
	\$50k or less % (<i>n</i>)	59.92 (571)	61.06 (265)
	\$50-100k % (<i>n</i>)	28.54 (272)	29.03 (126)
	\$100-150k % (<i>n</i>)	7.24 (69)	4.84 (21)
	\$150k+ % (<i>n</i>)	4.3 (41)	5.07 (22)
Race/Ethnicity	White % (<i>n</i>)	70.62 (673)	72.58 (315)
	Black % (<i>n</i>)	12.8 (122)	11.98 (52)
	Hispanic % (<i>n</i>)	5.98 (57)	5.3 (23)
	Asian % (<i>n</i>)	6.93 (66)	6.68 (29)
	Native % (<i>n</i>)	0.42 (4)	0.46 (2)
	Multiracial % (<i>n</i>)	3.25 (31)	3 (13)
Gender	Female % (<i>n</i>)	50.47 (481)	54.61 (237)
	Male % (<i>n</i>)	48.27 (460)	43.55 (189)
	Non-binary gender % (<i>n</i>)	1.26 (12)	1.84 (8)
Transgender	No % (<i>n</i>)	99.37 (947)	98.62 (428)
	Yes % (<i>n</i>)	0.63 (6)	1.38 (6)
College	No % (<i>n</i>)	49.42 (471)	43.09 (187)
	Yes % (<i>n</i>)	50.58 (482)	56.91 (247)

Note: Low / high income = below or above the US median household income; White = non-Hispanic White; College = bachelor's degree or higher.

MEDITATION-RELATED ADVERSE EFFECTS

Supplemental Materials Table 4. Screening survey items

1. What is your gender?
 - (a) Male
 - (b) Female
 - (c) Transgender (male to female)
 - (d) Transgender (female to male)
 - (e) Non-binary gender
 - (f) Other (please describe)

2. What is your age? ____ years (numeric entry)

3. What is your race? (check all that apply)
 - (a) African American
 - (b) Asian American
 - (c) White
 - (d) Native American / Pacific Islander / Alaskan Native / First Nations
 - (e) Non-US Asian
 - (f) Non-US African
 - (g) Other: _____

4. What is your ethnicity? (check all that apply)
 - (a) Hispanic or Latino
 - (b) Not Hispanic or Latino

5. What is the highest level of education you have completed? (select one)
 - (a) Some high school or less education
 - (b) High school graduate or equivalent (e.g., GED)
 - (c) Some college / community college degree (Associates)
 - (d) Four-year college graduate
 - (e) Masters degree
 - (f) Doctorate (PhD, EdD, PsyD)
 - (g) Medical degree (MD)
 - (h) Other (please describe)

6. What is your best estimate of your total income from all sources, before taxes, in the last year in US dollars? (numeric entry)

7. Have you ever tried any of the following types of meditation, even just once? (select all that apply)
 - a) Mantra meditation, including Transcendental Meditation®, Relaxation Response, or Clinically Standardized Meditation?
 - b) Mindfulness meditation, including Vipassana, Zen Buddhist meditation, Mindfulness-Based Stress Reduction, and Mindfulness-Based Cognitive Therapy
 - c) Spiritual meditation including centering prayer and contemplative meditation
 - d) Tibetan meditation including compassion, visualization, analytical meditation, Dzogchen, and Mahamudra
 - e) Yogic meditation, including kundalini, pranayama, and chakra meditation
 - f) Meditation as part of yoga, qi gong, or tai-chi
 - g) Other meditation practices including lovingkindness and body scan
 - h) Other type of meditation (please specify) (text field)

MEDITATION-RELATED ADVERSE EFFECTS

- i) I have not tried any type of meditation
8. I have been randomly selecting responses on this survey. (1 = strongly disagree, 5 = strongly agree)

MEDITATION-RELATED ADVERSE EFFECTS

Supplemental Materials Table 5. Follow-up survey items

1. Approximately how many years ago did you first try meditation? (can be partial years, e.g., 0.5)? (___ years)
2. How were you **FIRST** exposed to meditation? (select the one that applies best)
 - a) Smartphone app
 - b) Website, YouTube, video/DVD, or podcast
 - c) Book
 - d) Friend
 - e) Family member
 - f) Religious teacher or religious organization (e.g., Buddhist, Hindu, Christian, Jewish, Muslim, etc.)
 - g) Yoga class
 - h) Exercise class
 - i) At school
 - j) At work
 - k) Structured meditation course (e.g., mindfulness-based stress reduction)
 - l) Health care provider (e.g., doctor, therapist, nurse, social worker, psychologist, etc.)
 - m) I don't remember
 - n) Other (please specify) (text field)
3. Where have you **EVER** been exposed to meditation? (select all that apply, same options as previous question)
4. Which of the following have you attended? (select all that apply)
 - a) In-person meditation class
 - b) Online / web-based meditation class
 - c) Smartphone-based meditation class
 - d) Daylong meditation retreat
 - e) Multiday (i.e., residential) meditation retreat
 - f) None of these
5. Please estimate your **TOTAL LIFETIME** number of hours of meditation practice.
 - a) 0-10
 - b) 11-100
 - c) 101-500
 - d) 501-1000
 - e) 1001-5000
 - f) 5001+
6. Over the past 30 days, on average, how many days per week did you engage in sitting meditation (e.g., mindfulness, lovingkindness)? (1-7)
7. Which of the following forms of meditation have you **EVER** practiced? (select all that apply)
 - a) Concentration (shamatha, mindfulness of breathing, breath counting)
 - b) Insight (vipassana, noting / open monitoring, choiceless awareness)
 - c) Analytical meditation (e.g., contemplation of death and impermanence)
 - d) Body scan
 - e) Zazen: "just sitting" (shikantaza)
 - f) Koan
 - g) Silent illumination
 - h) Lovingkindness (metta) or compassion
 - i) Vajrayana preliminary practices (ngondro)
 - j) Visualization practices

MEDITATION-RELATED ADVERSE EFFECTS

- k) Non-dual meditation (e.g., nature of mind practice, Dzogchen, Mahamudra)
 - l) Mantra recitation or Transcendental Meditation®
 - m) Centering prayer
 - n) Kundalini
 - o) Pranayama
 - p) Chakra meditation
 - q) Meditation as part of yoga
 - r) Meditation as part of qi gong
 - s) Meditation as part of tai-chi
 - t) Other (please specify) (text field)
 - u) None of these
8. Please select the leftmost response.
9. I personally have had challenging, difficult, or distressing experiences as a result of my meditation practice.
- a. Never
 - b. Rarely
 - c. Occasionally
 - d. Regularly
 - e. Frequently
 - f. Other (please specify) (text field)
10. My meditation-related challenging, difficult, or distressing experiences impaired my ability to function. (if respond other than Never to above)
- g. Not at all
 - h. Somewhat
 - i. Moderately
 - j. Severely
 - k. Not applicable; I have not had difficulties
 - l. Other (please specify) (text field)
11. How long did your impairment last? (if respond other than Not at all to above)
- m. 1 day or less
 - n. For a few days to 1 week
 - o. 1 week to 1 month
 - p. 1 month to 1 year
 - q. 1 year or longer
 - r. Other (please specify) (text field)
 - s. I did not experience impairment
12. Consider the various experiences you have had through meditation, including any challenging, difficult, or distressing experiences. How much do you agree with the following statement: I am glad I have practiced meditation. (1 = strongly disagree, 6 = strongly agree)

MEDITATION-RELATED ADVERSE EFFECTS

Supplemental Materials Table 6. Adverse effects by lifetime meditation practice hours

Lifetime meditation hours category	Adverse effect	n	Mean	SD
0-10	Any AE	82	19.51	39.87
0-10	1+ MRAES-MBP	82	37.8	48.79
0-10	Any impair	82	6.1	24.08
0-10	Impair >1 day	82	1.22	11.04
0-10	Impair ≥1 month	82	0	0
11-100	Any AE	179	35.75	48.06
11-100	1+ MRAES-MBP	179	49.16	50.13
11-100	Any impair	179	12.85	33.56
11-100	Impair >1 day	179	6.15	24.08
11-100	Impair ≥1 month	179	0	0
101-500	Any AE	71	40.85	49.5
101-500	1+ MRAES-MBP	71	54.93	50.11
101-500	Any impair	71	15.49	36.44
101-500	Impair >1 day	71	9.86	30.02
101-500	Impair ≥1 month	71	5.63	23.22
501-1000	Any AE	39	35.9	48.6
501-1000	1+ MRAES-MBP	39	51.28	50.64
501-1000	Any impair	39	7.69	27
501-1000	Impair >1 day	39	5.13	22.35
501-1000	Impair ≥1 month	39	0	0
1001-5000	Any AE	31	25.81	44.48
1001-5000	1+ MRAES-MBP	31	70.97	46.14
1001-5000	Any impair	31	6.45	24.97
1001-5000	Impair >1 day	31	3.23	17.96
1001-5000	Impair ≥1 month	31	0	0
5001+	Any AE	32	28.12	45.68
5001+	1+ MRAES-MBP	32	53.12	50.7
5001+	Any impair	32	6.25	24.59
5001+	Impair >1 day	32	12.5	33.6
5001+	Impair ≥1 month	32	3.12	17.68

Note: Frequency of meditation-related adverse effects by amount of lifetime meditation practice. AE = adverse effects; MRAES-MBP = Meditation-Related Adverse Effects Scale – Mindfulness-Based Program (Britton et al., 2018); Impair = impairment; n = number of respondents with given lifetime meditation hours; mean = percentage endorsing AE item.

MEDITATION-RELATED ADVERSE EFFECTS

Supplemental Materials Table 7. Single item adverse effects and impairment severity and duration responses

Adverse effects item	Response category	%	n
Any adverse effect	Never	67.74	294
Any adverse effect	Rarely	19.82	86
Any adverse effect	Occasionally	8.76	38
Any adverse effect	Regularly	1.84	8
Any adverse effect	Frequently	0.69	3
Any adverse effect	Other (please specify)	1.15	5
Impairment severity	Not at all	89.40	388
Impairment severity	Somewhat	7.14	31
Impairment severity	Moderately	2.30	10
Impairment severity	Severely	0.23	1
Impairment severity	Other (please specify)	0.92	4
Impairment duration	None	86.87	377
Impairment duration	1 day or less	7.14	31
Impairment duration	For a few days to 1 week	2.53	11
Impairment duration	1 week to 1 month	1.84	8
Impairment duration	1 month to 1 year	0.69	3
Impairment duration	1 year or longer	0.46	2
Impairment duration	Other (please specify)	0.46	2

MEDITATION-RELATED ADVERSE EFFECTS

Supplemental Materials Table 8. Partial correlations between adverse effects with demographic, meditation practice, and psychological variables

Variable	<u>Any adverse effect</u>		<u>MRAES-MBP total</u>		<u>Any impairment</u>		<u>Impairment >1 day</u>	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
Age	-.11	.020*	-.17	<.001***	-.07	.135	.01	.856
Male	-.04	.381	.02	.723	-.03	.497	-.07	.158
non-Hispanic White	.05	.352	-.13	.005**	.01	.801	-.06	.191
Bachelor's degree	-.03	.544	-.03	.592	-.08	.120	-.03	.508
Low income	.06	.227	.03	.518	.13	.006**	.08	.106
Years since first exposure	.09	.076	.10	.040*	.06	.180	.08	.102
App first exposure	.07	.170	.04	.370	.18	<.001***	.21	<.001***
App ever exposure	.06	.185	-.02	.679	-.01	.758	.00	.919
Any meditation in the past 30 days	.12	.011*	.14	.003**	.06	.247	.12	.012*
Lifetime meditation hours category	.14	.004**	.21	<.001***	.09	.077	.11	.019*
Concentration practice	.04	.467	.01	.822	.04	.456	.00	.970
Insight practice	.08	.120	.02	.668	.08	.094	-.01	.849
Residential retreat	.03	.514	.10	.030*	.16	.001**	.10	.043*
PROMIS Depression	.11	.026*	.12	.015*	.09	.054	.08	.098
PROMIS Anxiety	.10	.045*	.07	.147	.04	.401	.07	.172
NIH Toolbox Loneliness	.15	.002**	.12	.012*	.05	.339	.05	.340
Adverse Childhood Experiences	.17	<.001***	.19	<.001***	.12	.016*	.03	.473
Socially Desirable Response Set	.02	.658	-.04	.362	.01	.778	-.01	.883
Glad to have practiced meditation	-.03	.487	-.01	.813	-.04	.360	.03	.502

Note: Partial correlations computed controlling for age, gender, race/ethnicity, education, and income. MRAES-MBP = Meditation-Related Adverse Effects Scale – Mindfulness-Based Program; App first exposure = first exposure to meditation through a smartphone app; App ever exposure = ever having been exposed to meditation through a smartphone app; Weekly days of meditation = average days of meditation per week in the past 30 days; Lifetime meditation hours categories = 0 to 10 (1), 11-100 (2), 101 and more (3); Lifetime meditation times category = 1-10 (1), 11-100 (2), 101+ (3); PROMIS = Patient-Reported Outcome Measurement Information System; NIH = National Institutes of Health.