Mindfulness
https://doi.org/10.1007/s12671-022-02061-9

ORIGINAL PAPER

Who Sticks with Meditation? Rates and Predictors of Persistence in a Population-based Sample in the USA

Sin U Lam[1,2] · Kevin M. Riordan[1,2] · Otto Simonsson[2,3,4] · Richard J. Davidson[2,5,6] · Simon B. Goldberg[1,2]

Accepted: 21 December 2022

Abstract

Objectives Despite the well-documented psychological benefits of meditation practice, limited research has examined factors associated with meditation practice persistence. Like other health behaviors (e.g., exercise), non-persistence may undermine the effectiveness of meditation.

Method We examined rates and correlates of meditation persistence using a population-based sample ($n = 953$) in the USA. Persistence was operationalized in two ways: number of lifetime practice sessions (i.e., lifetime persistence) and current practice frequency (i.e., current persistence). Consistent with the National Health Interview Survey, we defined meditation as mindfulness meditation, mantra meditation, and spiritual meditation. We examined factors related to the Reasoned Action Approach (RAA), a theory that has been used to explain adherence to health behaviors.

Results Almost half of the sample (49.3%) indicated lifetime exposure to meditation and a third (35.0%) indicated practice in the past year. Factors positively associated with persistence (lifetime and/or current) included having spoken with a meditation teacher, higher perceived effectiveness of meditation, higher meditation-positive subjective norms, lower perceived barriers, higher conscientiousness, higher well-being growth mindset, and retreat experience. Factors negatively associated with persistence included first exposure through various forms of technology and having a mental health motivation for practice. First exposure through a smartphone app and first exposure through friends and family were not associated with lifetime or current persistence. Findings were unchanged after controlling for demographics and applying a false discovery rate *p*-value adjustment.

Conclusions These findings provide insights into factors that may promote persistence with meditation, which can guide the delivery of meditation training.

Preregistration This study was preregistered at the Open Science Framework (https://osf.io/4h86s).

Keywords Meditation practice patterns · Health behavior · Persistence · Attrition · Population-based sampling

✉ Simon B. Goldberg
sbgoldberg@wisc.edu

[1] Department of Counseling Psychology, University of Wisconsin–Madison, 335 Education Building, 1000 Bascom Mall, Madison, WI 53706, USA

[2] Center for Healthy Minds, University of Wisconsin–Madison, Madison, USA

[3] Department of Sociology, University of Oxford, Oxford, England

[4] Department of Clinical Neuroscience, Karolinska Institute, Stockholm, Sweden

[5] Department of Psychology, University of Wisconsin–Madison, Madison, USA

[6] Department of Psychiatry, University of Wisconsin–Madison, Madison, USA

In the past several decades, meditation practice has gained popularity in clinical and non-clinical settings. It is now employed widely within psychiatry (Gaiswinkler et al., 2019), within education (Crescentini et al., 2016; Wisner et al., 2010), in the workplace (Bazarko et al., 2013), and in the military (Davis et al., 2019). This rise in popularity has been driven, in part, by increasing empirical evidence supporting the efficacy of meditation in both clinical (Goldberg et al., 2018) and non-clinical populations (Galante et al., 2021). Documented potential benefits include improved attention (MacLean et al., 2010), academic performance (Tang, 2014), and emotion regulation (Schonert-Reichl and Lawlor, 2010), as well as general physical (Edwards & Loprinzi, 2017) and mental well-being (Galante et al., 2021;

Published online: 06 January 2023

Goldberg et al., 2018, 2021; Goyal et al., 2014; Hofmann et al., 2010).

Epidemiological data have documented the growing popularity of meditation in the general public. Results from the National Health Interview Survey (NHIS), a nationally representative interview survey conducted by the Centers for Disease Control and Prevention (2022), found in 2012 that meditation was among the fifth most commonly used complementary health approaches in the USA (Centers for Disease Control & Prevention, 2022; Clarke et al., 2015). Between 2012 and 2017, the prevalence of meditation use increased more than threefold (i.e., from 4.1% in 2012 to 14.2% in 2017; Clarke et al., 2018). Meditation is by far the most widely accessed content within mental health and wellness apps (Coulon et al., 2016; Gál et al., 2021; Wasil et al., 2020).

Epidemiological studies have also begun to clarify demographic and clinical factors associated with meditation practice. Studies using the 2012 NHIS data found that past-year meditation use was positively associated with the following characteristics: non-Hispanic White, female, single, age 40 to 64 years, at least college-educated, residing in the western states of the USA, and with one or more chronic health conditions (Cramer et al., 2016; Upchurch et al., 2019).

Despite prior studies clarifying prevalence and predictors of current meditation practice (e.g., Burke et al., 2017; Cramer et al., 2016; Upchurch et al., 2019), one important unanswered question is what factors are associated with *persistence* of meditation practice among those with lifetime exposure to meditation. We define *meditation persistence* as the total amount of practice an individual has accumulated in their life (i.e., lifetime meditation practice persistence) as well as whether they are currently practicing (i.e., current meditation practice persistence). We conceptualize these aspects of meditation practice as persistence when examined among those with lifetime exposure to meditation as they characterize the degree to which an individual has persisted in their practice over time. We operationalize lifetime persistence as total lifetime sessions of meditation practice (ranging from 1 to 2 sessions to 5001 + sessions) and current persistence as the frequency of practice over the past year (ranging from never to daily).

From the vantage point of persistence, meditation can be viewed as a health behavior that, similar to diet and exercise, not only may be linked to beneficial health outcomes but also requires effort (Russ et al., 2017). Like other health behaviors (e.g., exercise), it is possible that many individuals do not persist in their meditation practice. Given evidence drawn from research on meditation-based interventions (MBIs) indicating a greater amount of practice is associated with greater benefits (Levi et al., 2021; Parsons et al., 2017), discontinuation may limit benefits one might receive from meditation. There is also evidence from MBIs that participants frequently discontinue treatment (Lam et al., 2022; Nam & Toneatto, 2016). Therefore, understanding barriers and facilitators of persistence may be crucial for maximizing the public health potential of meditation.

Drawing from the rich behavioral health literature, there are many candidate factors that may be associated with meditation persistence. Among prominent health behavior change theories, the Reasoned Action Approach (RAA; Fishbein & Ajzen, 2010) is one model that has previously been applied to conceptualize health engagement and adherence behavior in meditation (Erbe et al., 2019; Lederer & Middlestadt, 2014). According to this model, behaviors are driven by intentions, and intentions are primarily influenced by three factors: *attitudes*, *perceived norms*, and *perceived behavioral control* (Fishbein & Ajzen, 2010). Attitudes are defined as positive or negative evaluations of the consequences of behavioral engagement (Hagger, 2019). Applied to meditation, this might include one's reasons to use meditation and perceived psychosocial costs or benefits of meditation. Consistent with the possibility that more positive attitudes are linked to meditation practice, using meditation for mental health reasons and perceiving meditation as more effective and beneficial have both been linked with increased intentions for meditation practice (Pepping et al., 2016; Rizer et al., 2016).

Perceived or subjective norms are based on the perceived level of approval or enaction of certain behaviors by salient social referents (Lederer & Middlestadt, 2014; McEachan et al., 2016). Consistent with the possibility that more supportive perceived norms are linked to meditation practice, studies have revealed that meditation-positive subjective norms (e.g., approval of practice) are associated with a greater time practicing meditation among undergraduates (Crandall et al., 2019; Lederer & Middlestadt, 2014). Various factors might influence meditation-related subjective norms. For example, exposure to meditation through social interactions, such as speaking with a meditation teacher or attending a meditation retreat, or learning about meditation through friends or family members might positively influence persistence with meditation (Canby et al., 2021; Goldberg, 2022; Mintz, 2020). In contrast, exposure to meditation through a smartphone app, website, or other electronic media may be associated with decreased practice persistence, given the high attrition and often modest amount of social interaction embedded in these technologies (Linardon & Fuller-Tyszkiewicz, 2020).

Perceived behavioral control refers to the degree of control an individual perceives themselves to have over a given behavior, and/or their self-efficacy in performing that behavior (Fishbein & Ajzen, 2010). Consistent with the possibility that higher perceived behavioral control is linked to greater meditation practice, having lower perceived barriers (e.g., lower pragmatic barriers, greater

knowledge about meditation) may be associated with increased meditation practice (Hunt et al., 2020). Similarly, the degree to which an individual believes well-being can be intentionally cultivated (i.e., well-being growth mindset; Mrazek et al., 2018) is a form of perceived behavioral control that may be associated with increased persistence with meditation.

Outside of the RAA model, conscientiousness is one of the Big Five personality traits that has been consistently associated with persistence across a variety of health behaviors. For instance, greater conscientiousness is negatively associated with smoking and positively related to having a healthier diet and wearing seat belts (Bogg & Roberts, 2004, Lodi-Smith et al., 2010, Sutin & Terracciano, 2017). Lower conscientiousness also predicts poorer sleep hygiene (Duggan et al., 2014) and greater emergency department use (Friedman and Kern, 2014). With regard to MBIs, greater conscientiousness is associated with increased out-of-class meditation practice during and after (e.g., at the 3-month follow-up) an 8-week MBI (Canby et al., 2021; Friedman & Kern, 2014).

The current study had three main objectives. First, given the rapid uptake of meditation in the general population, we sought to provide updated estimates on the prevalence of meditation use in a demographically representative sample. Second, we aimed to report the prevalence of meditation persistence among those with lifetime exposure to meditation. Importantly, this extends prior work that has primarily focused on predictors of current practice within the general population (e.g., Cramer et al., 2016), rather than restricting analyses to those with lifetime exposure (i.e., to explore predictors related to meditation persistence). Third, we sought to investigate factors correlated with meditation persistence by exploring associations with the aspects of the RAA model. To examine these questions, we conducted an online survey ($n = 953$) using the Prolific platform, which recruited participants based on age, sex, and race to provide a proportionally representative sample of the US population (Peer et al., 2017).

We made three a priori hypotheses which were preregistered through the Open Science Framework (https://osf.io/4h86s). First, we hypothesized that the most common first exposure to meditation would occur through a smartphone app, and that this would be most pronounced for participants under age 30. Second, we hypothesized that the majority of participants will never have spoken with a meditation teacher. Third, we hypothesized that the following factors would be positively correlated with meditation persistence (i.e., greater lifetime and current meditation practice): (a) first exposure *not* through smartphone app, (b) having spoken with a meditation teacher, (c) first trying meditation for mental or emotional health reasons, (d) perceiving meditation practice as effective, (e) meditation-positive subjective norms, (f) lower perceived barriers of meditation, (g) higher conscientiousness, (h) higher well-being growth mindset, and (i) meditation retreat experience.

Method

Participants

A total of 993 participants consented to the study and were screened for lifetime exposure to meditation practice (see "Measures"). Of this sample, 953 passed the attention check and were included in the study. Compared to the US population (US Census Bureau, 2019), the overall sample was more educated (50.6% with a bachelor's degree or higher vs. 32.1% in the 2015–2019 US Census), older (median age = 44 vs. 38 years), and had a higher income (median income = $40,000 vs. $34,103). Although the sample had similar rates of some racial/ethnic groups (Asian, Black, multiracial), relative to the US population, non-Hispanic White participants were overrepresented (70.6% vs. 60.7%) while Hispanic participants were underrepresented (6.0% vs. 18.0%). Lower representation of Hispanic participants was likely caused by Prolific matching on race but not ethnicity (Supplementary Table S1).

Of the participants who underwent screening, almost half ($n = 470$; 49.3%) indicated having exposure to meditation (i.e., mindfulness, mantra, spiritual) in their lifetime. Participants with lifetime exposure were then invited to complete a follow-up survey regarding their experience with meditation. Most ($n = 434$; 92.3%) of the invited participants completed and passed the attention check item in the follow-up survey (Supplementary Table S2). Data showed that non-Hispanic White participants were more likely to complete follow-up ($r = 0.15$, $p < 0.01$), though no significant difference was found in other demographic characteristics (age, gender, education, income; $r = -0.05$ to 0.05, $p > 0.05$).

Procedure

This study was approved by the University of Wisconsin–Madison Institutional Review Board (IRB #2020–1368). Participants were recruited in November and December 2020 through Prolific (www.Prolific.co), an online behavioral research platform that has been shown to be higher in quality than other recruitment platforms (e.g., Amazon Mechanical Turk; Peer et al., 2017). Prolific participants have been shown to be more diverse, less dishonest, and more naïve (i.e., less familiar with commonly used research materials) than other established online recruitment platforms (Palan & Schitter, 2018; Peer et al., 2017). We used Prolific's representative sampling procedure which recruits

participants based on age, sex, and race, in proportion to US census data.

Measures

Demographics

Participants were asked to provide their age, gender identity, race/ethnicity, highest degree of education, and annual income. The following demographic variables were dichotomized for their use as covariates in our models: gender (not male as reference group), race/ethnicity (racial/ethnic minority as reference group), education (not college graduate as reference group), and annual income (income below US population per capita median [$34,103] as reference group; US Census Bureau, 2019).

Meditation Practice Background

Lifetime exposure to meditation, meditation frequency, and other practice-related variables were assessed. For lifetime exposure to meditation, participants were asked if they have ever tried any meditation practice as defined by NHIS (i.e., mindfulness, mantra, spiritual; Supplementary Table S3).

For those who indicated lifetime exposure to meditation, additional questions regarding their practice background were assessed in a follow-up survey (Supplementary Table S4). These questions assessed when participants were first introduced to meditation and how the first exposure occurred (e.g., through smartphone app, structured meditation course, health care provider). To assess their meditation practice background, participants were asked about their lifetime sessions of practice and their current practice frequency (*never* to *daily*; Supplementary Table S4). Lifetime persistence was operationalized as lifetime practice sessions and current persistence was operationalized as current practice frequency. To examine the associations between meditation persistence and factors hypothesized to be associated with persistence, we treated lifetime and current meditation practice persistence as continuous variables. Lifetime persistence was coded as 1–2 (1); 3–10 (2); 11–100 (3); 101–500 (4); 501–1000 (5); 1001–5000 (6); 5001 + (7) sessions. Current persistence was coded as *never* (1), *several times per year* (2), *monthly* (3), *weekly* (4), *daily* (5). Participants were also asked whether they had attended a day-long or multi-day meditation retreat and whether they had ever spoken with a meditation teacher.

Meditation Motivation

Items were adapted from Pepping et al. (2016) to assess participants' motivations for first trying meditation. Participants were asked to indicate their motivations by selecting all relevant factors from a list of options which included physical health, emotional health or stress reduction, sociocultural reasons, and/or "other" which allowed participants to specify reasons not listed (Supplementary Table S4). Consistent with our preregistration, we focused on whether individuals had an initial mental health motivation for practicing meditation.

Perceived Effectiveness of Practice

Participants were asked to rate how effective they believed meditation practice to be (1 = *not at all effective* to 7 = *very effective*), with higher scores representing greater perceived effectiveness. This item was included based on previous findings indicating that perceived effectiveness was associated with meditation persistence (Pepping et al., 2016).

Subjective Norms

Participants completed four items used by Crandall et al. (2019) to assess their perceptions of meditation-related social norms. The included items were as follows: "Most people who are important to me think that I should practice meditation" (*1 = strongly disagree, 5 = strongly agree*); "The people in my life whose opinions I value would approve of me practicing meditation" (*1 = strongly disagree, 5 = strongly agree*); "Most people who are important to me practice meditation often" (*1 = completely false, 5 = completely true*); and "The people in my life whose opinions I value practice meditation often" (*1 = completely false, 5 = completely true*). Higher scores indicate more meditation-positive subjective norms. Internal consistency reliability for the current study was high (Cronbach's $\alpha = 0.84$, McDonald's $\omega = 0.84$).

Ways of Exposure

Participants were indicated how they were first exposed to meditation by selecting among several options: smartphone app, technological platforms (website, YouTube, video/DVD, or podcast), book, friend, family member, religious teacher or religious organization, yoga class, exercise class, at school, at work, structured meditation course, and health care provider (Supplementary Table S4). For some analyses, we collapsed exposure through friends and family into a social influence category and collapsed exposure through smartphone app and technological platforms into a general technology category.

Perceived Barriers to Practice

To assess participants' perceived barriers to meditation, we used the 12-item Determinants of Meditation Practice Inventory-Revised (DMPI-R; Hunt et al., 2020). Given that the

DMPI-R is not a unidimensional scale, we used the three subscales that had acceptable internal consistencies (Cronbach's $\alpha \geq 0.70$) in the present sample. These subscales were *low perceived benefit* (e.g., "I don't believe meditation can help me"; four items, Cronbach's $\alpha = 0.75$, McDonald's $\omega = 0.76$), *perceived inadequate knowledge* (e.g., "I don't know much about meditation"; two items, Cronbach's $\alpha = 0.72$, McDonald's $\omega = 0.72$), and *perceived pragmatic barriers* (e.g., "There is no quiet space where I can meditate"; three items, Cronbach's $\alpha = 0.71$, McDonald's $\omega = 0.75$). Internal consistency for the cultural barriers subscale was low (Cronbach's $\alpha = 0.35$, McDonald's $\omega = 0.46$) and therefore not used. Participants responded to each item using a 5-point Likert-type scale (*1 = strongly disagree, 5 = strongly agree*). Higher total scores reflect higher levels of perceived barriers to meditation.

Conscientiousness

Conscientiousness was assessed using the Ten-Item Personality Inventory (TIPI; Gosling et al., 2003). The TIPI is a psychometrically valid, brief measure of the Big Five personality dimensions. The two items assessing conscientiousness included "I see myself as dependable, self-disciplined," and "I see myself as disorganized, careless" (reverse-scored). Participants rated each item on a 7-point Likert scale (1 = *Disagree strongly*, 7 = *Agree strongly*), with higher scores indicating greater conscientiousness. Internal consistency reliability was adequate (Cronbach's $\alpha = 0.73$, McDonald's $\omega = 0.75$).

Well-being Growth Mindset

Well-being growth mindset was assessed using three items adapted from the Growth Mindset Scale of intelligence (e.g., "You have a certain amount of wellbeing, and you can't really do much to change it," "Your wellbeing is something about you that you can't change very much"; Dweck, 2006). Participants rated the items on a 6-point Likert-type scale (1 = *strongly disagree*, 6 = *strongly agree*), with higher total scores indicating greater well-being growth mindset. Internal consistency reliability was high (Cronbach's $\alpha = 0.91$, McDonald's $\omega = 0.91$).

Data Analyses

Data used in this study are part of a project assessing utilization and adverse effects of meditation practice in a population-based sample. Data related to adverse effects were reported elsewhere (Goldberg et al., 2022).

Hypotheses were specified in our preregistration. However, we made six deviations. First, to aid in interpretation of effect sizes we used correlations and partial correlations (controlling for demographics), rather than regression models, to examine associations with meditation persistence. Second, given the low rates of first exposure through a smartphone app, we also examined whether exposure through various forms of technology (smartphone app, website, podcast, YouTube, etc.) was associated with meditation persistence. Third, we examined whether exposure through friends or family was associated with meditation persistence. Fourth, we conducted McNemar's test for paired data and a point-biserial correlation instead of one-sample *t*-tests to evaluate whether exposure through smartphone app was the most common form of first exposure and whether this effect was most pronounced for respondents under age 30. Fifth, we conducted sensitivity analyses examining partial associations controlling for demographic variables. Sixth, given the large number of correlations conducted, we controlled for false discovery rate (FDR) using the Benjamini and Hochberg's (1995) method.

For the first of our three a priori hypotheses, we examined whether exposure through a smartphone app was significantly more common than exposure through other means (i.e., *not* through smartphone app) using McNemar's test. A point-biserial correlation (e.g., simplified case of Pearson's correlation for dichotomous variables; Cohen et al., 2014) was computed to examine if first exposure through a smartphone app was most pronounced for participants under the age of 30 years. For our second hypothesis, we used a one-sample test of equal proportions to assess whether the proportion of participants who have spoken with a meditation teacher was greater than 50%.

For the third hypothesis, correlations were computed to investigate whether persistence with meditation was associated with first exposure through a smartphone app, first exposure through any technology, first exposure through friends or family, having spoken with meditation teacher, having a mental health motivation for practice, perceived effectiveness of meditation, subjective norms, perceived barriers, conscientiousness, well-being growth mindset, and meditation retreat experience. We conducted two sets of sensitivity analyses, one removing outliers (i.e., values three standard deviations from the mean) and one controlling for demographics. Partial correlations were used to examine associations controlling for demographic factors (i.e., age, gender identity, race/ethnicity, highest degree of education, and annual income). Instances where results changed in sensitivity analyses are noted. Given we examined ten potential correlates of meditation practice, we controlled for FDR using Benjamini and Hochberg's (1995) method. The *p*-values reported in the text are FDR adjusted.

Results

Prevalence of Meditation Use

Sample descriptive statistics are shown in Supplementary Table S2. No continuous variables were found to deviate

from normality outside of recommended ranges (skewness < 2.00, kurtosis < 7.00; Curran et al., 1996): skewness (range = −0.84 to 0.87) and kurtosis (range = −0.45 to 0.49). In terms of demographic characteristics among those with lifetime exposure to meditation, female participants accounted for 53.9% of the sample, male participants accounted for 42.9%, and non-binary or transgender-identifying participants accounted for 3.2%. Most participants (72.6%) identified as non-Hispanic White, 12.0% as African American, 6.7% as Asian American, 5.30% as Latin American, 0.46% as Native American, and 2.3% as multiracial. The average age of participants was 43.77 ($SD = 15.53$).

Almost half of the survey participants (49.3%) indicated lifetime exposure of meditation using the NHIS definition. Within the full sample, mindfulness meditation was the most popular type of meditation practice (34.8% of full sample), followed by spiritual meditation (26.2%) and mantra meditation (14.5%). A third of the sample (35.0%) indicated use of meditation in the past year. The average number of years since first exposure to meditation was 14.28 ($SD = 13.77$). More than a fourth of survey participants (25.5%) were exposed to meditation in the last 3 years. Lifetime persistence among those who were exposed to meditation indicated 1.6% practiced 1 to 2 meditation sessions, 18.7% practiced 3 to 10 sessions, 41.2% practiced 11 to 100 sessions, and 17.3% practiced 101 to 500 sessions, while the rest of the sample (21.2%) had practiced over 500 sessions. Current persistence among those who were exposed to meditation indicated 22.1% of the participants practiced daily, 25.4% practiced weekly, 14.8% practiced monthly, 16.1% practiced several times per year, and 21.7% reported no meditation practice in the past year. Descriptive data for lifetime and current persistence and types of meditation practiced across racial/ethnic groups is reported in Supplementary Tables S5–S7.

Characteristics of First Exposure

The most common first exposure to meditation was through a form of social influence (23.7%; 15.7% from friends and 8.1% from family) or technological platforms (15.7%; e.g., website, video/DVD). Contrary to our hypothesis, first exposure through smartphone app (3.9%) was not the most common way in which participants were exposed to meditation (McNemar's χ^2 [1, $n = 434$] = 366.82, $p < 0.01$ for comparison between first exposure through smartphone app vs. first exposure through another means). In addition, contrary to our hypothesis, respondents under 30 were not more likely to experience first exposure of meditation through smartphone app ($r = 0.01$, $p = 0.20$). The same result was found after controlling for demographic factors ($r = 0.04$, $p = 0.41$). Other less common ways of exposure were through books (9.7%), health care providers (9.2%), yoga class (7.1%), religious teacher or organization (7.8%), and school or work (8.5%).

Less than half of those with lifetime exposure to meditation (39.2%) had ever spoken with a meditation teacher. As hypothesized, a one-sample test of equal proportions showed that the proportion of participants who had spoken with a meditation teacher was significantly fewer than 50% (χ^2 [1, $n = 434$] = 19.93, $p < 0.01$).

Correlates of Persistence with Meditation

Correlations and partial correlations of factors hypothesized to be associated with meditation persistence are presented in Table 1, Fig. 1, and Supplementary Table S8, respectively.

No correlations were found between first exposure through smartphone app and lifetime meditation practice or current meditation practice. Interestingly, first exposure through any technology (smartphone apps, websites, YouTube, video/DVD, podcast) was negatively associated with lifetime persistence but not current persistence. First exposure through friends or family was not found to be associated with lifetime nor current persistence. As hypothesized, having spoken with a meditation teacher was positively associated with lifetime persistence and current persistence. Contrary to our hypothesis, first trying meditation for mental or emotional health reasons (e.g., stress reduction) was negatively associated with lifetime persistence and was not associated with current persistence. As hypothesized, perceiving meditation practice as effective was strongly associated with greater lifetime and current persistence. Similarly, meditation-positive subjective norms were moderately associated with greater lifetime and current persistence.

As hypothesized, perceived barriers to meditation were negatively associated with lifetime and current persistence. Specifically, lower perceived knowledge and lower perceived benefits of meditation were found to be moderately associated with reduced lifetime and current persistence. A small but significant negative correlation was also found between perceived pragmatic barriers to meditation and both lifetime and current persistence.

As hypothesized, higher conscientiousness was also associated with greater lifetime and current persistence, albeit with a small effect size. Higher well-being growth mindset was correlated with greater lifetime persistence and was not correlated with current persistence. As hypothesized, having attended a meditation retreat was moderately associated with greater lifetime persistence and weakly associated with current persistence. Significance tests were unchanged for all the above analyses when controlling for demographic covariates, after removing outliers, and with or without applying FDR p-value adjustment.

Table 1 Correlations between demographic variables and hypothesized predictors of meditation practice persistence with lifetime and current meditation practice persistence

Variable	Lifetime persistence			Current persistence		
	r	*p*	p_{FDR}	*r*	*p*	p_{FDR}
Age	0.24	< 0.01***	< 0.01***	0.03	0.54	0.69
Male	− 0.07	0.13	0.15	− 0.13	0.01**	0.01*
Non-Hispanic White	0.13	0.01**	0.01*	0.08	0.09	0.17
Bachelor's degree	0.01	0.81	0.81	− 0.03	0.50	0.69
Low income	0.05	0.29	0.32	− 0.07	0.17	0.29
First exposure via app	− 0.08	0.09	0.12	0.00	0.96	0.96
First exposure via any technology	− 0.18	< 0.01***	< 0.01***	− 0.01	0.830	0.93
First exposure via friends or family	− 0.03	0.48	0.50	− 0.03	0.52	0.69
Spoken with meditation teacher	0.31	< 0.01***	< 0.01***	0.13	0.01**	0.01*
Mental health motivation	− 0.27	< 0.01***	< 0.01***	− 0.01	0.79	0.93
Perceived effectiveness	0.51	< 0.01***	< 0.01***	0.63	< 0.01***	< 0.01***
Subjective norms	0.28	< 0.01***	< 0.01***	0.36	< 0.01***	< 0.01***
Low perceived benefits	− 0.37	< 0.01***	< 0.01***	− 0.43	< 0.01***	< 0.01***
Perceived inadequate knowledge	− 0.41	< 0.01***	< 0.01***	− 0.38	< 0.01***	< 0.01***
Perceived pragmatic barriers	− 0.20	< 0.01***	< 0.01***	− 0.18	< 0.01***	< 0.01***
Conscientiousness	0.17	< 0.01***	< 0.01***	0.15	< 0.01**	0.01**
Well-being growth mindset	0.11	0.02*	0.03*	0.04	0.40	0.62
Retreat experience	0.28	< 0.01***	< 0.01***	0.18	< 0.01***	< 0.01***

Lifetime persistence, number of lifetime meditation sessions; *Current persistence*, frequency of past year meditation practice; *First exposure* via *app*, first exposure to meditation through a smartphone app; *first exposure* via *any technology*, first exposure through various forms of technology (smartphone app, website, YouTube, video/DVD, podcast); *mental health motivation*, initial motivation for mediation due to mental/emotional health or stress reduction

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Discussion

To provide insights regarding meditation practice patterns, we investigated several health behavior-related correlates of meditation persistence within a large, population-based sample ($n = 953$). We examined several factors based on the RAA model which has been used previously to conceptualize adherence to health behaviors (Crandall et al., 2019; Erbe et al., 2019; Lederer & Middlestadt, 2014). Meditation practice was common within the full sample, with 49.3% reporting lifetime exposure to meditation. Among those who were exposed, most (78.3%) indicated use of meditation in the past year. First exposure in the past 3 years was fairly common (25.5%), reflecting the rising popularity of meditation in the USA (Clarke et al., 2018). Of note, the 12-month prevalence rate found here (i.e., 35.0%) is considerably higher than that of the 2017 NHIS survey (14.2%; Clarke et al., 2018). While this may be due to the current sample being less representative than a larger-scale national survey, it also may be that meditation has indeed become even more popular in the USA since 2017.

Contrary to our a priori hypothesis, first exposure to meditation through a smartphone app was rare (3.9%). Moreover, younger participants (< 30 years old) were no more likely to have been exposed in this way. However, most participants (58.8%) reported using a meditation app at some point in their life. Thus, while meditation apps may not be the entry point, they do appear to be a central part of the landscape of meditation practice for many individuals. Our findings indicated that the most common ways individuals are first exposed to meditation were through friends or family (23.7%), other technological platforms (15.7%; e.g., websites, YouTube), books (9.7%), and health care providers (9.2%). As such, an individual might be exposed to the concept and content of meditation practice from their surrounding environment prior to deciding to download a meditation app for practice. This possibility would align with the RAA model (Crandall et al., 2019; Fishbein & Ajzen, 2010), as engagement behaviors are theorized to be driven by intention which can be influenced by attitudes and perceived norms.

We also examined several candidate correlates of meditation persistence that align with the factors highlighted in the RAA model. The RAA model emphasizes the influence of attitudes, perceived norms, and perceived behavioral control in driving behaviors (Fishbein & Ajzen, 2010). Contrary to our hypothesis, first exposure through a smartphone app was not associated with persistence, although first exposure through various forms of technology (smartphone app, website, etc.) was negatively associated with lifetime persistence (i.e., number of lifetime meditation sessions). One possible

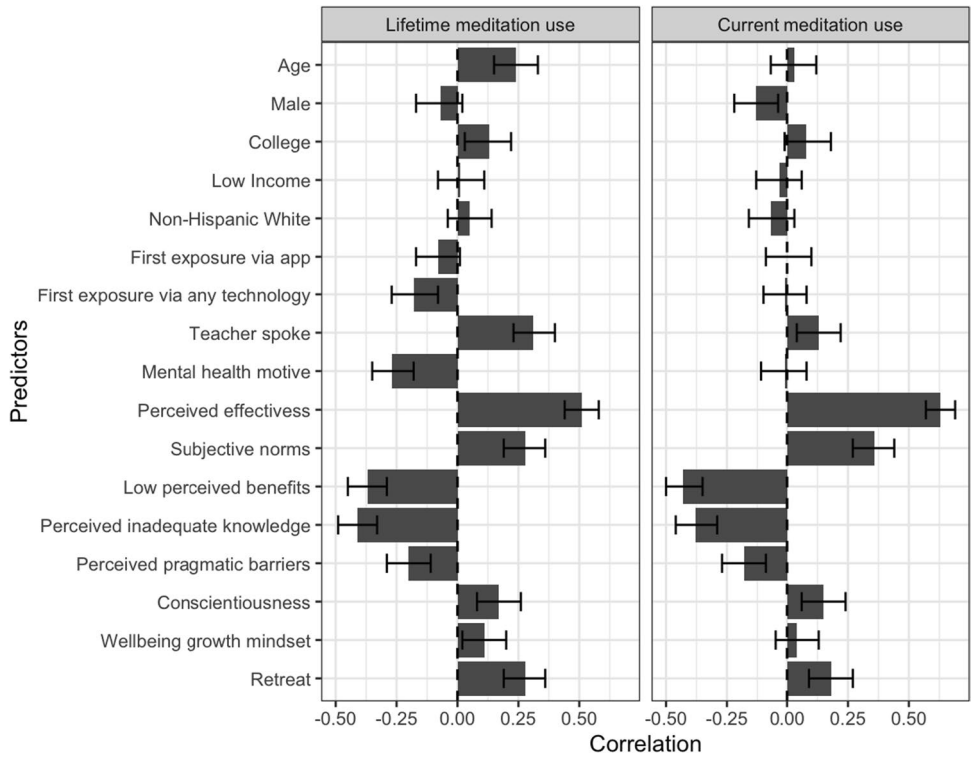

Fig. 1 Correlations between demographic variables and hypothesized predictors of meditation practice persistence with lifetime (left panel) and current meditation practice persistence (right panel). Bars indicate correlation coefficient with 95% confidence intervals. See Table 1 for these data in tabular format. First exposure via app = first exposure to meditation through a smartphone app; first exposure via any technology = first exposure through various forms of technology (smartphone app, website, YouTube, video/DVD, podcast); teacher spoke = ever spoken with a meditation teacher; mental health motive = initial motivation for mediation due to mental/emotional health or stress reduction; subjective norms = meditation-supportive subjective norms; well-being growth mindset = well-being related growth mindset; retreat = ever attended residential or daylong retreat programs

explanation for this is that these technologically mediated exposure pathways may involve less social influence, making them less potent for supporting meditation persistence. Social influence can play a central role in maintenance of health behaviors (Fishbein, 2008), including through impacting perceived norms. Of course, some technological platforms can be highly social (e.g., social media), which theoretically could support rather than inhibit engagement. It would be valuable for a future study to closely examine the influence of technology on persistence with meditation, perhaps by investigating the specific types of technology (e.g., YouTube vs. social media) and types of engagement (e.g., primarily consumer, primarily producer of content on social media). Interestingly, we did not find an association between exposure through friends or family and persistence in the current sample, despite other social-related variables (speaking with a meditation teacher, subjective norms) being associated with persistence. Here again, a future study could productively investigate precisely how social influence may impact the ways in which participants are exposed to and persist with meditation.

As hypothesized, having spoken with a meditation teacher and having attended a meditation retreat were both associated with greater persistence. This finding aligns with the RAA model that cultivation of a positive attitude regarding meditation (which could occur through these experiences) and perceived behavioral control may increase behavioral intention and engagement. Prior work has indicated that interacting with a meditation teacher and/or attending retreats are identified to be helpful for participants to normalize their challenging experiences with meditation and gain deeper insights during practice (Lepore., 2010). Having spoken with a meditation teacher and/or attending a retreat might therefore lead to a more positive attitude towards meditation that in turn motivates continued practice. Importantly, it is also entirely possible that speaking with a meditation teacher and/or attending a retreat is the *result* of persistence, rather than a *cause* of persistence. Furthermore, both persistence and these behaviors could be caused by a third variable (e.g., benefitting from practice). The cross-sectional nature of our data makes it impossible to determine the causal direction.

Contrary to our hypothesis, first trying meditation for mental or emotional health reasons (e.g., stress reduction) was found to be negatively associated with lifetime persistence and was not associated with current persistence (i.e., frequency of practice in the past year). One possible explanation for this is that individuals who are primarily practicing for mental health reasons may discontinue their meditation practice once they feel better. This possibility is consistent with the good-enough-level phenomenon observed in psychotherapy, where patients discontinue treatment when their symptoms have remitted, regardless of the length of treatment (Barkham et al., 2006). It may also be that individuals motivated primarily for mental health reasons are more distressed generally and find meditation practice more aversive (Goldberg et al., 2022), leading them to discontinue their practice.

As hypothesized and consistent with prior work (e.g., Pepping et al., 2016), perceiving meditation practice as effective was also associated with greater persistence. Within RAA, this might be considered an element of a positive attitude that can influence behavioral intentions and actions. Meditation-positive subjective norms and greater conscientiousness were also linked with greater persistence, consistent with previous findings (Canby et al., 2021; Crandall et al., 2019; Friedman et al., 2013; Lederer & Middlestadt, 2014). Finally, lower perceived barriers to meditation (i.e., perceived benefits, perceived adequate knowledge, perceived pragmatic barriers; Hunt et al., 2020) were associated with greater lifetime and current persistence. This might be explained by perceived barriers decreasing perceived behavioral control which can have a direct influence on behavioral engagement (Conner et al., 2017; Fishbein & Ajzen, 2010).

Finally, higher well-being growth mindset was positively associated with lifetime persistence but not current persistence. One possible explanation for the link with lifetime but not current persistence is that well-being growth mindset may be an outcome rather than a predictor of persistence with practice. It may be that individuals who have practiced for longer periods of time have experienced firsthand that their well-being is malleable and not fixed. In contrast, whether one is currently practicing may be the result of a variety of more proximal contextual factors (e.g., demands on one's time and other barriers; Hunt et al., 2020). Simply practicing more recently would not necessarily demonstrate experientially that well-being is malleable, as this may require repeated practice over time.

There are several implications of this study. At a broad level, our results add to the literature documenting rapid increases in the popularity of meditation in recent years and suggest that previous estimates (e.g., 14.2% past-year utilization rate in 2017; NHIS) may be lower than the current (e.g., past year) utilization rates. In addition, we identified several factors associated with meditation persistence that can inform efforts to increase the public health impact of these practices. To maximize persistence with meditation practice, it may be helpful to provide initial exposure through a non-technological pathway, provide opportunities to speak with a meditation teacher and/or attend a meditation retreat, reduce pragmatic barriers, increase knowledge about meditation and its potential benefits, encourage the view that well-being is modifiable (i.e., well-being growth mindset), and support opportunities to connect with other practitioners who share the subjective norm of meditation practice being beneficial. Moreover, having mental health reasons for initiating a meditation practice may decrease persistence. These potential facilitators and barriers may be helpful for guiding efforts to introduce and support meditation practice in the general population. Health care providers, meditation teachers, and others involved in sharing meditation may be encouraged to attend to these factors. Efforts to address these factors may also occur at the public health level (e.g., sharing scientific data on the potential benefits and risks of meditation practice through pamphlets in health care provider offices).

Limitations and Future Directions

There are several important limitations for the current study. First, the current sample's demographic characteristics did not align perfectly with the demographics of the general US populations, which raises questions regarding generalizability. For instance, the current sample was more educated and with higher income compared to the general US population (US Census Bureau, 2019). This may have upwardly biased our estimates of meditation practice with the sample potentially having greater access and resources (e.g., time, health care, social capital) supporting exposure to meditation. Generalizability may also have been influenced by restricting our sample to Internet users. Second, our conceptualization of meditation persistence is not without limitations. In the hopes of obtaining a large and relatively representative sample, we restricted our data collection to a cross-sectional survey that assessed patterns of meditation practice at a fairly gross level. This necessarily omitted nuances of persistence that may indeed be important (e.g., the distribution of meditation practice sessions over time, the specific styles of practice engaging with). These nuances may be important to examine in a future study. Third, the cross-sectional nature of the current study makes it impossible to infer causality linking candidate predictors and persistence with meditation. Fourth, the fact that multiple constructs were assessed using the same self-report method may contribute to the common methods bias which can produce spurious correlations among constructs (Podsakoff et al., 2012). There is a possibility that the observed correlations are spurious and result from biases such as response styles or social desirability (Baumgartner & Steenkamp, 2001; Podsakoff et al., 2012).

Fifth, the current study adopted the definition of meditation practice from the NHIS. While valuable for comparisons with NHIS, not all forms of contemporary meditation practice were represented (e.g., loving-kindness and compassion practice). Lastly, the modest ($r < 0.30$) magnitude for most of the associations suggests that much of the variance in persistence with meditation remains unexplained.

For future studies, it is crucial to examine the current factors that are associated with meditation persistence and other candidate barriers and facilitators longitudinally. This could occur through cross-sectional surveys that involve retrospection (e.g., assessing motivations for attending a meditation retreat, assessing perception of whether speaking with a meditation teacher was the result of or cause of persistence), although these methods are at risk of bias (Shiffman et al., 2008). It would be ideal to examine predictors of persistence using observational longitudinal designs or field-based experiments. Longitudinal studies could identify which baseline characteristics are associated with persistence while field-based experiments could randomly assign participants to receive a particular manipulation (e.g., opportunity to speak with a meditation teacher or interact with others who practice meditation). For instance, it would be valuable to clarify the potential causal link between motivation for meditation practice and meditation persistence in a future longitudinal study. Future studies could also investigate whether well-being growth mindset changes as a result of practice as well as whether baseline well-being growth mindset predicts engagement (e.g., in the context of an MBI).

Furthermore, future studies could examine whether variables associated with meditation practice itself (e.g., dosage, practice quality, type of practice; Goldberg et al., 2020; Manigault et al., 2021; Strohmaier et al., 2020) are associated with persistence. It could be valuable to investigate additional factors borrowed from the health behavior literature, such as whether practicing meditation within the same context (i.e., context-dependent repetition; Lally et al., 2010) with a fixed practice schedule or dedicated practice space increases persistence (Gardner & Rebar, 2019). Experience sampling methodologies may be helpful for investigating many of the above factors in the real world (i.e., in situ). Furthermore, given engagement with meditation varies across demographic groups (e.g., race/ethnicity; Cramer et al., 2016; Upchurch and Johnson, 2019), future studies should examine the presence of culture-specific predictors of persistence which may be helpful for the development of culturally congruent and more accessible meditation practices and MBIs (Biggers et al., 2020). For example, it would be valuable for future research to examine how factors investigated in the present study (e.g., perceived effectiveness of meditation, meditation-positive subjective norms) may help promote meditation persistence for individuals experiencing actual pragmatic barriers to practice which may be associated with sociodemographic variables.

Supplementary Information The online version contains Supplementary Material available at https://doi.org/10.1007/s12671-022-02061-9.

Author Contribution Sin U Lam: conceptualization, methodology, software, formal analysis, data curation, writing–original draft, visualization. Kevin Riordan: conceptualization, writing–reviewing and editing. Otto Simonsson: writing–reviewing and editing. Richard Davidson: writing–reviewing and editing, funding acquisition. Simon Goldberg: conceptualization, methodology, software, formal analysis, investigation, data curation, writing–reviewing and editing, visualization, supervision, project administration, funding acquisition.

Funding This research was supported by the National Center for Complementary and Integrative Health Grant K23AT010879 (Simon B. Goldberg) and U24AT011289 (Richard J. Davidson), the National Institute of Mental Health Grant R01MH43454 (Richard J. Davidson), the Sweden-America Foundation (Otto Simonsson), by the University of Wisconsin—Madison Office of the Vice Chancellor for Research and Graduate Education with funding from the Wisconsin Alumni Research Foundation (Simon B. Goldberg), with funding from the Wisconsin Center for Education Research (Simon B. Goldberg), and by generous donors to the School of Education of the University of Wisconsin-Madison, and by the Graduate School through support from the Wisconsin Alumni Research Foundation (Kevin M. Riordan). Richard J. Davidson is the founder, president, and serves on the board of directors for the nonprofit organization, Healthy Minds Innovations, Inc.

Data Availability Data are available by request.

Declarations

Conflict of Interest Richard J. Davidson is the founder and president, and serves on the board of directors for the nonprofit organization, Healthy Minds Innovations, Inc. The remaining authors declare no conflicts of interest with respect to the research, authorship, or publication of this article.

Ethics Approval and Consent to Participate This study was approved by the Institutional Review Board (IRB) office at University of Wisconsin–Madison (IRB #2020–1368). Written informed consent was obtained for participation of the current study.

References

Barkham, M., Connell, J., Stiles, W. B., Miles, J. N. V., Margison, F., Evans, C., & Mellor-Clark, J. (2006). Dose-effect relations and responsive regulation of treatment duration: The good enough level. *Journal of Consulting and Clinical Psychology, 74*(1), 160–167. https://doi.org/10.1037/0022-006x.74.1.160

Baumgartner, H., & Steenkamp, J.-B.E.M. (2001). Response styles in marketing research: A cross-national investigation. *Journal of Marketing Research, 38*(2), 143–156. https://doi.org/10.1509/jmkr.38.2.143.18840

Bazarko, D., Cate, R. A., Azocar, F., & Kreitzer, M. J. (2013). The impact of an innovative mindfulness-based stress reduction program on the health and well-being of nurses employed in a corporate setting. *Journal of Workplace Behavioral Health, 28*(2), 107–133. https://doi.org/10.1080/15555240.2013.779518

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing.

Journal of the Royal Statistical Society: Series B (Methodological), 57(1), 289–300. https://doi.org/10.1111/j.2517-6161.1995.tb02031.x

Biggers, A., Spears, C. A., Sanders, K., Ong, J., Sharp, L. K., & Gerber, B. S. (2020). Promoting mindfulness in African American communities. *Mindfulness, 11*(10), 2274–2282. https://doi.org/10.1007/s12671-020-01480-w

Bogg, T., & Roberts, B. W. (2004). Conscientiousness and health-related behaviors: A meta-analysis of the leading behavioral contributors to mortality. *Psychological Bulletin, 130*(6), 887–919. https://doi.org/10.1037/0033-2909.130.6.887

Burke, A., Lam, C. N., Stussman, B., & Yang, H. (2017). Prevalence and patterns of use of mantra, mindfulness and spiritual meditation among adults in the United States. *BMC Complementary and Alternative Medicine, 17*, 316. https://doi.org/10.1186/s12906-017-1827-8

Canby, N. K., Eichel, K., Peters, S. I., Rahrig, H., & Britton, W. B. (2021). Predictors of out-of-class mindfulness practice adherence during and after a mindfulness-based intervention. *Psychosomatic Medicine, 83*(6), 655–664. https://doi.org/10.1097/psy.0000000000000873

Centers for Disease Control and Prevention. (2022, March 3). *National health interview survey*. https://www.cdc.gov/nchs/nhis/index.htm

Clarke, T. C., Black, L. I., Stussman, B. J., Barnes, P. M., & Nahin, R. L. (2015). Trends in the use of complementary health approaches among adults: United States, 2002–2012. *National Health Statistics Reports, 79*, 1–16.

Clarke, T. C., Barnes, P. M., Black, L. I., Stussman, B. J., & Nahin, R. L. (2018). Use of yoga, meditation, and chiropractors among U.S. adults aged 18 and over. *NCHS Data Brief, 325*, 1–8.

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2014). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Lawrence Erlbaum Associates. https://doi.org/10.4324/9781410606266

Conner, M., McEachan, R., Lawton, R., & Gardner, P. (2017). Applying the reasoned action approach to understanding health protection and health risk behaviors. *Social Science & Medicine, 195*, 140–148. https://doi.org/10.1016/j.socscimed.2017.10.022

Coulon, S. M., Monroe, C. M., & West, D. S. (2016). A systematic, multi-domain review of mobile smartphone apps for evidence-based stress management. *American Journal of Preventive Medicine, 51*(1), 95–105. https://doi.org/10.1016/j.amepre.2016.01.026

Cramer, H., Hall, H., Leach, M., Frawley, J., Zhang, Y., Leung, B., Adams, J., & Lauche, R. (2016). Prevalence, patterns, and predictors of meditation use among US adults: A nationally representative survey. *Scientific Reports, 6*, 36760. https://doi.org/10.1038/srep36760

Crandall, A., Cheung, A., Young, A., & Hooper, A. P. (2019). Theory-based predictors of mindfulness meditation mobile app usage: A survey and cohort study. *JMIR MHealth and UHealth, 7*(3), e10794. https://doi.org/10.2196/10794

Crescentini, C., Capurso, V., Furlan, S., & Fabbro, F. (2016). Mindfulness-oriented meditation for primary school children: Effects on attention and psychological well-being. *Frontiers in Psychology, 7*, 805. https://doi.org/10.3389/fpsyg.2016.00805

Curran, P. J., West, S. G., & Finch, J. F. (1996). The robustness of test statistics to nonnormality and specification error in confirmatory factor analysis. *Psychological Methods, 1*(1), 16–29. https://doi.org/10.1037/1082-989x.1.1.16

Davis, L. L., Whetsell, C., Hamner, M. B., Carmody, J., Rothbaum, B. O., Allen, R. S., Bartolucci, A., Southwick, S. M., & Bremner, J. D. (2019). A multisite randomized controlled trial of mindfulness-based stress reduction in the treatment of posttraumatic stress disorder. *Psychiatric Research and Clinical Practice, 1*(2), 39–48. https://doi.org/10.1176/appi.prcp.20180002

Duggan, K. A., Friedman, H. S., McDevitt, E. A., & Mednick, S. C. (2014). personality and healthy sleep: The importance of conscientiousness and neuroticism. *PLoS ONE, 9*(3), e90628. https://doi.org/10.1371/journal.pone.0090628

Dweck, C. S. (2006). *Mindset: The new psychology of success*. Random House Publications.

Edwards, M. K., & Loprinzi, P. D. (2017). Comparative effects of meditation and exercise on physical and psychosocial health outcomes: A review of randomized controlled trials. *Postgraduate Medicine, 130*(2), 222–228. https://doi.org/10.1080/00325481.2018.1409049

Erbe, R. G., Beckmeyer, J. J., Lohrmann, D. K., & Middlestadt, S. E. (2019). Examining determinants of adolescents' intention to meditate. *American Journal of Health Studies*, *34*(1). https://doi.org/10.47779/ajhs.2019.27

Fishbein, M. (2008). A reasoned action approach to health promotion. *Medical Decision Making, 28*(6), 834–844. https://doi.org/10.1177/0272989x08326092

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach* (1st ed.). Psychology Press.

Friedman, H. S., & Kern, M. L. (2014). Personality, well-being, and health. *Annual Review of Psychology, 65*(1), 719–742. https://doi.org/10.1146/annurev-psych-010213-115123

Friedman, B., Veazie, P. J., Chapman, B. P., Manning, W. G., & Duberstein, P. R. (2013). Is personality associated with health care use by older adults? *Milbank Quarterly, 91*(3), 491–527. https://doi.org/10.1111/1468-0009.12024

Gaiswinkler, L., Kaufmann, P., Pollheimer, E., Ackermann, A., Holasek, S., Kapfhammer, H. P., & Unterrainer, H. F. (2019). Mindfulness and self-compassion in clinical psychiatric rehabilitation: A clinical trial. *Mindfulness, 11*(2), 374–383. https://doi.org/10.1007/s12671-019-01171-1

Gál, V., & ȘTefan, S., & Cristea, I. A. (2021). The efficacy of mindfulness meditation apps in enhancing users' well-being and mental health related outcomes: A meta-analysis of randomized controlled trials. *Journal of Affective Disorders, 279*, 131–142. https://doi.org/10.1016/j.jad.2020.09.134

Galante, J., Friedrich, C., Dawson, A. F., Modrego-Alarcón, M., Gebbing, P., Delgado-Suárez, I., Gupta, R., Dean, L., Dalgleish, T., White, I. R., & Jones, P. B. (2021). Mindfulness-based programmes for mental health promotion in adults in nonclinical settings: A systematic review and meta-analysis of randomised controlled trials. *PLOS Medicine, 18*(1), e1003481. https://doi.org/10.1371/journal.pmed.1003481

Gardner, B., & Rebar, A. L. (2019). Habit formation and behavior change. *Oxford Research Encyclopedia of Psychology*. https://doi.org/10.1093/acrefore/9780190236557.013.129

Goldberg, S. B. (2022). A common factors perspective on mindfulness-based interventions. *Nature Reviews Psychology, 1*(10), 605–619. https://doi.org/10.1038/s44159-022-00090-8

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

Goldberg, S. B., Knoeppel, C., Davidson, R. J., & Flook, L. (2020). Does practice quality mediate the relationship between practice time and outcome in mindfulness-based stress reduction? *Journal of Counseling Psychology, 67*(1), 115–122. https://doi.org/10.1037/cou0000369

Goldberg, S. B., Riordan, K. M., Sun, S., & Davidson, R. J. (2021). The empirical status of mindfulness-based interventions: A systematic review of 44 meta-analyses of randomized controlled trials. *Perspectives on Psychological Science, 17*(1), 108–130. https://doi.org/10.1177/1745691620968771

Goldberg, S. B., Lam, S. U., Britton, W. B., & Davidson, R. J. (2022). Prevalence of meditation-related adverse effects in a population-based sample in the United States. *Psychotherapy Research*, *32*(3), 291–305. https://doi.org/10.1080/10503307.2021a.1933646

Gosling, S. D., Rentfrow, P. J., & Swann, W. B. (2003). A very brief measure of the Big-Five personality domains. *Journal of Research in Personality, 37*(6), 504–528. https://doi.org/10.1016/s0092-6566(03)00046-1

Goyal, M., Singh, S., Sibinga, E. M. S., Gould, N. F., Rowland-Seymour, A., Sharma, R., Berger, Z., Sleicher, D., Maron, D. D., Shihab, H. M., Ranasinghe, P. D., Linn, S., Saha, S., Bass, E. B., & Haythornthwaite, J. A. (2014). Meditation programs for psychological stress and well-being. *JAMA Internal Medicine, 174*(3), 357–368. https://doi.org/10.1001/jamainternmed.2013.13018

Hagger, M. S. (2019). The reasoned action approach and the theories ofreasoned action and planned behavior. In D. S. Dunn (Ed.), *Oxford bibliographies in psychology*. Oxford University Press. https://doi.org/10.1093/obo/9780199828340-0240

Hofmann, S. G., Sawyer, A. T., Witt, A. A., & Oh, D. (2010). The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *Journal of Consulting and Clinical Psychology, 78*(2), 169–183. https://doi.org/10.1037/a0018555

Hunt, C. A., Hoffman, M. A., Mohr, J. J., & Williams, A. L. (2020). Assessing perceived barriers to meditation: The determinants of meditation practice inventory-revised (DMPI-R). *Mindfulness, 11*(5), 1139–1149. https://doi.org/10.1007/s12671-020-01308-7

Lally, P., Van Jaarsveld, C. H., Potts, H. W., & Wardle, J. (2010). How are habits formed: Modelling habit formation in the real world. *European Journal of Social Psychology, 40*(6), 998–1009. https://doi.org/10.1002/ejsp.674

Lam, S., Kirvin-Quamme, A., & Goldberg, S. B. (2022). Overall and differential attrition in mindfulness-based interventions: A meta-analysis. *Mindfulness, 13*(11), 2676–2690. https://doi.org/10.1007/s12671-022-01970-z

Lederer, A. M., & Middlestadt, S. E. (2014). Beliefs about meditating among university students, faculty, and staff: A theory-based salient belief elicitation. *Journal of American College Health, 62*(6), 360–369. https://doi.org/10.1080/07448481.2014.907296

Lepore, J. D. (2010). *Exploring the training of Buddhist teachers: Implications for mindfulness-based practitioners* [Doctoral dissertation, Alliant International University, San Francisco Bay].

Levi, K., Shoham, A., Amir, I., & Bernstein, A. (2021). The daily dose-response hypothesis of mindfulness meditation practice: An experience sampling study. *Psychosomatic Medicine, 83*(6), 624–630. https://doi.org/10.1097/psy.0000000000000912

Linardon, J., & Fuller-Tyszkiewicz, M. (2020). Attrition and adherence in smartphone-delivered interventions for mental health problems: A systematic and meta-analytic review. *Journal of Consulting and Clinical Psychology, 88*(1), 1–13. https://doi.org/10.1037/ccp0000459

Lodi-Smith, J., Jackson, J., Bogg, T., Walton, K., Wood, D., Harms, P., & Roberts, B. W. (2010). Mechanisms of health: Education and health-related behaviours partially mediate the relationship between conscientiousness and self-reported physical health. *Psychology & Health, 25*(3), 305–319. https://doi.org/10.1080/08870440902736964

MacLean, K. A., Ferrer, E., Aichele, S. R., Bridwell, D. A., Zanesco, A. P., Jacobs, T. L., King, B. G., Rosenberg, E. L., Sahdra, B. K., Shaver, P. R., Wallace, B. A., Mangun, G. R., & Saron, C. D. (2010). Intensive meditation training improves perceptual discrimination and sustained attention. *Psychological Science, 21*(6), 829–839. https://doi.org/10.1177/0956797610371339

Manigault, A. W., Slutsky, J., Raye, J., & Creswell, J. D. (2021). Examining practice effects in a randomized controlled trial: Daily life mindfulness practice predicts stress buffering effects of mindfulness meditation training. *Mindfulness, 12*(10), 2487–2497. https://doi.org/10.1007/s12671-021-01718-1

McEachan, R., Taylor, N., Harrison, R., Lawton, R., Gardner, P., & Conner, M. (2016). Meta-analysis of the reasoned action approach (RAA) to understanding health behaviors. *Annals of Behavioral Medicine, 50*(4), 592–612. https://doi.org/10.1007/s12160-016-9798-4

Mintz, S. (2020). *Impact the meditation instructor has on the student* [Doctoral dissertation, California Southern University].

Mrazek, A. J., Ihm, E. D., Molden, D. C., Mrazek, M. D., Zedelius, C. M., & Schooler, J. W. (2018). Expanding minds: Growth mindsets of self-regulation and the influences on effort and perseverance. *Journal of Experimental Social Psychology, 79*, 164–180. https://doi.org/10.1016/j.jesp.2018.07.003

Nam, S., & Toneatto, T. (2016). The influence of attrition in evaluating the efficacy and effectiveness of mindfulness-based interventions. *International Journal of Mental Health and Addiction, 14*(6), 969–981. https://doi.org/10.1007/s11469-016-9667-1

Palan, S., & Schitter, C. (2018). Prolific.ac—a subject pool for online experiments. *Journal of Behavioral and Experimental Finance, 17*, 22–27. https://doi.org/10.1016/j.jbef.2017.12.004

Parsons, C. E., Crane, C., Parsons, L. J., Fjorback, L. O., & Kuyken, W. (2017). Home practice in mindfulness-based cognitive therapy and mindfulness-based stress reduction: A systematic review and meta-analysis of participants' mindfulness practice and its association with outcomes. *Behaviour Research and Therapy, 95*, 29–41. https://doi.org/10.1016/j.brat.2017.05.004

Peer, E., Brandimarte, L., Samat, S., & Acquisti, A. (2017). Beyond the Turk: Alternative platforms for crowdsourcing behavioral research. *Journal of Experimental Social Psychology, 70*, 153–163. https://doi.org/10.1016/j.jesp.2017.01.006

Pepping, C. A., Walters, B., Davis, P. J., & O'Donovan, A. (2016). Why do people practice mindfulness? An investigation into reasons for practicing mindfulness meditation. *Mindfulness, 7*(2), 542–547. https://doi.org/10.1007/s12671-016-0490-3

Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology, 63*(1), 539–569. https://doi.org/10.1146/annurev-psych-120710-100452

Rizer, C. A., Fagan, M. H., Kilmon, C., & Rath, L. (2016). The role of perceived stress and health beliefs on college students' intentions to practice mindfulness meditation. *American Journal of Health Education, 47*(1), 24–31. https://doi.org/10.1080/19325037.2015.1111176

Russ, S. L., Maruyama, G., Sease, T. B., & Jellema, S. (2017). Do early experiences matter? Development of an Early Meditation Hindrances Scale linked to novice meditators' intention to persist. *Psychology of Consciousness: Theory, Research, and Practice, 4*(3), 274–287. https://doi.org/10.1037/cns0000129

Schonert-Reichl, K. A., & Lawlor, M. S. (2010). The effects of a mindfulness-based education program on pre- and early adolescents' well-being and social and emotional competence. *Mindfulness, 1*(3), 137–151. https://doi.org/10.1007/s12671-010-0011-8

Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annual Review of Clinical Psychology, 4*(1), 1–32. https://doi.org/10.1146/annurev.clinpsy.3.022806.091415

Strohmaier, S., Jones, F. W., & Cane, J. E. (2020). Effects of length of mindfulness practice on mindfulness, depression, anxiety, and stress: A randomized controlled experiment. *Mindfulness, 12*(1), 198–214. https://doi.org/10.1007/s12671-020-01512-5

Sutin, A., & Terracciano, A. (2017). Personality and arterial health: Conscientiousness promotes better cardiovascular health. *Innovation in Aging, 1*(suppl_1), 1373–1374. https://doi.org/10.1093/geroni/igx004.5053

Tang, Y. Y. (2014). Short-term meditation intervention improves self-regulation and academic performance. *Journal of Child and Adolescent Behaviour*, *2*(4). https://doi.org/10.4172/2375-4494.1000154

Upchurch, D. M., & Johnson, P. J. (2019). Gender differences in prevalence, patterns, purposes, and perceived benefits of meditation practices in the United States. *Journal of Women's Health, 28*(2), 135–142. https://doi.org/10.1089/jwh.2018.7178

United States Census Quick Facts, (2019). United States Census Bureau, https://www.census.gov/quickfacts/fact/table/US/PST045219

Wasil, A. R., Gillespie, S., Patel, R., Petre, A., Venturo-Conerly, K. E., Shingleton, R. M., ... & DeRubeis, R. J. (2020). Reassessing evidence-based content in popular smartphone apps for depression and anxiety: Developing and applying user-adjusted analyses. *Journal of Consulting and Clinical Psychology, 88*(11), 983-993. https://doi.org/10.1037/ccp0000604

Wisner, B. L., Jones, B., & Gwin, D. (2010). School-based meditation practices for adolescents: A resource for strengthening self-regulation, emotional coping, and self-esteem. *Children & Schools, 32*(3), 150–159. https://doi.org/10.1093/cs/32.3.150