

# Pregnant women's use of a consumer-based meditation mobile app: A descriptive study

Digital Health  
Volume 8: 1–9  
© The Author(s) 2022  
Article reuse guidelines:  
sagepub.com/journals-permissions  
DOI: 10.1177/20552076221089098  
journals.sagepub.com/home/dhj



Jeni Green<sup>1</sup>, Taylor Neher<sup>2</sup>, Megan Puzia<sup>3</sup>, Breanne Laird<sup>1</sup> and Jennifer Huberty<sup>1</sup> 

## Abstract

**Objective:** The objectives of this study were to explore the satisfaction of pregnant or recently pregnant women with the existing Calm app content (i.e. non-pregnancy) and preferences and recommendations for the types of pregnancy-specific content that would be helpful to pregnant women.

**Methods:** This study was a national cross-sectional survey of subscribers to a meditation mobile app (i.e. Calm). Eligible participants were currently pregnant or recently pregnant (within the past 12 months) and used Calm during their pregnancy. Participants were asked about their Calm usage and perceived benefits of Calm during pregnancy, and interest in pregnancy-specific content. Descriptive statistics were used to characterize the sample.

**Results:** Participants ( $N = 111$ ) were on average 34 years old ( $SD = 5.4$ ) and half of the sample was currently pregnant ( $N = 55$ ). The most common reasons for using the Calm app during pregnancy was for sleep problems (29%;  $n = 31$ ) or anxiety (27%;  $n = 29$ ). Women reported Calm was most helpful for improving sleep (32%;  $n = 32$ ), anxiety (25%;  $n = 25$ ), and stress (21%;  $n = 21$ ). Nearly all women wanted pregnancy-specific meditation content within the app (98%;  $n = 98$ ) and expressed interest in topics including pregnancy-related anxiety (68%;  $n = 67$ ), postpartum (50%;  $n = 49$ ), pregnancy-related sleep problems (41%;  $n = 40$ ), and labor and delivery (38%;  $n = 37$ ).

**Conclusion:** Women who used the Calm app during pregnancy found it helpful for improving sleep, anxiety, and stress but desire pregnancy-specific content. Future meditation mobile app studies should utilize pregnancy-specific content and test the feasibility and efficacy of sleep and mental health in pregnant women.

## Keywords

Mindfulness, pregnancy, medicine, meditation, mHealth, psychology, apps

Submission date: 3 January 2022; Acceptance date: 6 January 2022

## Introduction

In the last decade, there has been an increased interest in prenatal mindfulness-based interventions to improve mental health or pregnancy outcomes.<sup>1,2</sup> Mindfulness has been defined as observing the present moment, without judgment and can be cultivated through practices such as meditation.<sup>1</sup> Mindfulness-based interventions have been consistently associated with reductions in stress, symptoms of anxiety and depression, and related prenatal mental health outcomes.<sup>2–5</sup> Pregnant women also report improvements in sleep, reductions in pain and preeclampsia risk, an ability to manage weight gain, and improved recovery following a

pregnancy loss.<sup>1</sup> Mindfulness training is recommended for all pregnant women regardless of preexisting concerns.<sup>1</sup> While mindfulness-based interventions show promise, many studies lack methodological rigor and have high

<sup>1</sup>College of Health Solutions, Arizona State University, Phoenix, AZ, USA

<sup>2</sup>Independent Research Consultant, Little Rock, AR, USA

<sup>3</sup>Behavioral Research and Analytics, LLC, Salt Lake City, UT, USA

### Corresponding author:

Jeni Green, Arizona State University, College of Health Solutions, 500 North 3rd Street, Phoenix, AZ 85004, USA.

Email: jeni.green@asu.edu



attrition, no control groups, and are underpowered.<sup>1</sup> There is a need for more research to explore the utility of mindfulness-based interventions during pregnancy that overcomes previous limitations.

Mobile applications (i.e. apps) have been considered a feasible, effective strategy to deliver mindfulness-based interventions such as meditation.<sup>6</sup> Using mobile apps to meditate has no known risks or side effects,<sup>1</sup> may reduce stigma, is cost-effective, and may increase the accessibility for pregnant women.<sup>7</sup> Over 260 mindfulness meditation apps have been identified in published literature, but many commercially available apps have a low evidence base for their efficacy, particularly among pregnant users.<sup>7</sup> Few meditation apps exist that are designed specifically for pregnancy and only a few general meditation apps (i.e. not specifically developed with content for pregnant women) have included meditation content for pregnancy.<sup>1</sup> Although, general meditation apps could also be beneficial to improving mental health during pregnancy, the efficacy of these apps is unknown and there is a poor understanding of how women use these apps or their perceptions/experiences of these apps.

Calm is a popular, subscription-based, meditation app accessible across web-based and smartphone platforms (iOS and Android) with over 100 million downloads and four million subscribers. The app offers a range of content rooted in mindfulness principles to help users incorporate mindfulness into their lives and generally promote well-being (e.g. a large library of guided meditations including the 10-min Daily Calm, Sleep Stories, educational courses, mindful movement, music, and nature scenes and sounds).<sup>8,9</sup> Calm also teaches users the basics of mindfulness, includes components to remind users to meditate, track user activity, and allow users to share their status with others. The feasibility of the app and its efficacy for improving mental health outcomes (i.e. stress, anxiety, and depressive symptoms), mindfulness, and sleep have been previously tested in various populations providing evidence that using Calm may improve well-being.<sup>6,10,11</sup> Currently, Calm has no content specific to pregnancy, has a limited understanding of how its pregnant users are using the app, and only a small study has studied its efficacy in pregnant women.<sup>12</sup>

The purpose of this study was to conduct a cross-sectional survey of Calm subscribers who are pregnant or were recently pregnant. We explored satisfaction in pregnant or recently pregnant women with the existing Calm content (i.e. non-pregnancy), and preferences and recommendations for the types of pregnancy-specific content that would be helpful to pregnant women. Findings from this study will inform pregnancy-specific content for meditation mobile apps and the design of future research using mobile apps in pregnant women.

## Methods

### Study design and recruitment

This was a national cross-sectional study. Participants were paying subscribers to Calm who were currently using the app during pregnancy or who had used the app during a recent pregnancy. Participants were recruited via email and on social media platforms (e.g. Calm's Instagram account and Calm's Daily Calm Community group on Facebook) in July 2021. Participants were eligible if they (1) were at least 18 years old, (2) US residents, (3) were able to read and answer questions in English, and (4) were either currently pregnant and using the Calm app or within 12 months of pregnancy and used the Calm app during pregnancy.

### Survey

The investigator-developed survey included a total of 37 questions and took participants ~10.3 min to complete (median = 6.7, SD = 14.4). The survey asked questions about demographics, pregnancy-related questions (e.g. weeks' gestation and months since last pregnancy), and mental and physical health during pregnancy. Additionally, the survey asked about their Calm usage during pregnancy, perceived benefits of Calm during pregnancy, and interest in pregnancy-specific content or communities. The survey was administered using an online data capturing software (Qualtrics, Provo, UT, USA) and those who were interested in participating accessed the survey through a link or QR code provided in recruitment materials. Participants were able to skip questions or stop taking the survey at any time.

### Statistical analysis

Data were analyzed using SPSS Statistics version 26.0 (IBM Corp.). Descriptive statistics were used to characterize the sample regarding demographics, pregnancy-related characteristics, Calm usage during pregnancy and perceived benefits, motivation to use Calm, and proposed content areas to incorporate for pregnancy.

## Results

### Demographic and health characteristics

In total, 440 individuals completed the eligibility questions, 155 were eligible, and 151 consented to the study. Of those who were eligible, 111 completed the survey. Most participants were ineligible because they did not reside in the US. All participants identified as female. The sample was mostly White (79%;  $n = 86$ ) and non-Hispanic (87%;  $n = 95$ ), and the average age was 34 years (SD = 5.4;

**Table 1.** Demographic characteristics of the sample ( $N = 111$ ).

Variable	<i>n/M</i>	Percentage/ SD
Age ( $N = 105$ )	34.0	5.4
Race ( $N = 109$ )		
White, European American, or Caucasian	86	78.9
Black, African American, or Native African	9	8.3
Asian or Asian American	7	6.4
American Indian or Alaskan Native	2	1.8
Arab or Non-Arab North African/ Middle-Eastern	2	1.8
Native Caribbean or Afro-Caribbean Islander	2	1.8
Bi-racial or Multi-racial	5	4.6
Other	3	2.8
Hispanic or Latinx ( $N = 109$ )	14	12.8
Highest level of education		
High school	1	0.9
Some college	13	11.9
Associate degree	9	8.3
Bachelor's degree	41	37.6
Graduate degree	45	41.3
Employment status during pregnancy ( $N = 109$ )		
Employed and working	80	73.4
Employed but not working, related to pregnancy	3	2.8
Employed but not working, not related to pregnancy	2	1.8
Unemployed	5	4.6
Unable to work for reasons related to pregnancy	2	1.8

(continued)

**Table 1.** Continued.

Variable	<i>n/M</i>	Percentage/ SD
Homemaker	11	10.1
Student	6	5.5
Annual household income during pregnancy ( $N = 95$ )		
\$1 to \$9999	1	1.1
\$10,000 to \$24,999	4	4.2
\$25,000 to 49,999	4	4.2
\$50,000 to 74,999	12	12.6
\$75,000 to 99,999	15	15.8
\$100,000 to 149,999	26	27.4
\$150,000 or more	33	34.7

Table 1). Most participants had completed college (87%;  $n = 95$ ), and the majority had been employed and working during their pregnancies (73%;  $n = 80$ ) with an average household income of over \$100,000 (62%;  $n = 59$ ).

Approximately half of the sample were currently pregnant and using Calm (Table 2). About 74% ( $n = 80$ ) of participants reported that during their pregnancies, their physical health was *Good* or *Very good* and 78% ( $n = 84$ ) reported their mental health was *Moderate* or *Good*. Slightly over half reported having a health diagnosis during pregnancy (55%;  $n = 45$ ), and 42% ( $n = 45$ ) reported that they experienced adverse events, pregnancy complications, or otherwise had a “high-risk” pregnancy.

### *Calm usage during pregnancy*

Approximately half of the participants had regularly used Calm before their pregnancy (Table 3). Of those, 46% ( $n = 26$ ) reported that becoming pregnant changed the way that they used Calm. Most participants reported that they used Calm at least three times per week (52%;  $n = 53$ ) and continued to use Calm throughout their pregnancy until delivery (80%), with almost half continuing use post-delivery (45%;  $n = 44$ ). The most popular components were meditations (38%;  $n = 39$ ) and sleep stories (28%;  $n = 29$ ).

### *Motivation for use and perceived benefits*

Almost 90% of participants (88%;  $n = 93$ ) reported that they used Calm for reasons specific to their pregnancy,

**Table 2.** Pregnancy-related characteristics of the sample.

Variable	<i>n</i>	Percentage
Pregnancy status ( <i>N</i> = 111)		
Currently pregnant	55	49.5
Pregnant in the last year	56	50.5
Self-rated physical health during pregnancy ( <i>N</i> = 107)		
Very bad	3	2.8
Bad	3	2.8
Moderate	21	19.6
Good	54	50.5
Very good	26	24.3
Self-rated mental health during pregnancy ( <i>N</i> = 107)		
Very bad	4	3.7
Bad	9	8.4
Moderate	42	39.3
Good	42	39.3
Very good	10	9.3
Experienced adverse events, pregnancy complications, or had a “high-risk” pregnancy ( <i>N</i> = 109)	45	41.7
Health diagnoses during pregnancy ( <i>N</i> = 99)		
Anxiety	28	28.3
Depression	16	16.2
Hypertension	13	13.1
Pain	7	7.1
Insomnia	7	7.1
Diabetes	7	7.1
PTSD	6	6.1
Asthma	5	5.1

(continued)

**Table 2.** Continued.

Variable	<i>n</i>	Percentage
High cholesterol	2	2.0
Emphysema, COPD, and other lung diseases	2	2.0
Heart disease	1	1.0
Arthritis or other rheumatic diseases	2	2.0
Cancer	1	1.0
Other health condition	4	4.0
No health diagnoses during pregnancy	54	54.5

PTSD: post-traumatic stress disorder; COPD: chronic obstructive pulmonary disease;

with the most common reasons being to improve pregnancy-related sleep problems (29%; *n* = 31) or reduce pregnancy-related anxiety (27%; *n* = 29; Table 4). Participants reported that Calm was most helpful for improving sleep (32%; *n* = 32), anxiety (25%; *n* = 25), and stress (21%; *n* = 21) with ~10% (*n* = 10) reporting Calm not being helpful for pregnancy (Table 5).

Overwhelmingly, participants felt that there was a need for pregnancy-specific meditation content within the app (98%; *n* = 98), such as meditations for pregnancy-related anxiety (68%; *n* = 67), postpartum (50%; *n* = 49), pregnancy-related sleep problems (41%; *n* = 40), and preparation for labor and delivery (38%; *n* = 37; Table 6). Additionally, 90% of participants believed that they would benefit from trimester-specific meditations. Beyond meditation, 43% (*n* = 41) of participants felt that other pregnancy-related features could be included in the app. Slightly over half reported that they would be interested in connecting with other pregnant or recently pregnant users or becoming a member of a Calm pregnancy community (58%; *n* = 58). Of those, participants were specifically interested in connecting through group meditations with other pregnant or recently pregnant users (69% *n* = 40) and discussion boards within the app (57% *n* = 33).

## Discussion

We conducted a cross-sectional survey of Calm subscribers who are pregnant or were recently pregnant. We explored satisfaction in pregnant or recently pregnant women (within 12 months postpartum) with the existing Calm content (i.e. non-pregnancy), and preferences and recommendations for the types of pregnancy-specific content

**Table 3.** Calm usage characteristics during pregnancy.

Variable	<i>n</i>	Percentage
Time when started to use Calm ( <i>N</i> = 105)		
Regularly used prior to pregnancy	56	53.3
Previously used, but not immediately prior to pregnancy	30	28.6
Began using it during pregnancy	17	16.2
Began using after finding out they were pregnant	2	1.9
Of regular users, the way they used Calm changed during pregnancy ( <i>N</i> = 56)	26	46.4
Of new users, trimester started using Calm ( <i>N</i> = 17)		
First trimester	5	29.4
Second trimester	8	47.1
Third trimester	4	23.5
Trimester with most usage ( <i>N</i> = 101)		
First	18	17.8
Second	14	13.9
Third	24	23.8
Equally across all trimesters	45	44.6
Length of time using Calm during pregnancy ( <i>N</i> = 97)		
Less than a week	3	3.1
More than one week, but less than a month	7	7.2
More than a month, but not the through entire pregnancy	9	9.3
Throughout the rest of my pregnancy, until delivery	34	35.1
Continued using after delivery	44	45.4
Frequency of use ( <i>N</i> = 103)		
Less than 1 time per week	17	16.5
1 to 2 times per week	33	32

(continued)

**Table 3.** Continued.

Variable	<i>n</i>	Percentage
3 to 4 times per week	24	23.3
5 or more times per week	29	28.2
Component used the most ( <i>N</i> = 102)		
Meditations (not sleep-specific)	39	38.2
Sleep stories	29	28.4
Sleep meditations	12	11.8
Soundscapes	8	7.8
Music	7	6.9
Breathing exercises	2	2.0
Mood check-ins	2	2.0
Gratitude check-ins	1	1.0
Walking meditations	1	1.0
Calm body	1	1.0

that would be helpful to pregnant women. Our findings demonstrated that the most common reasons for using the Calm app during pregnancy were to improve pregnancy-related sleep problems and anxiety. Women also reported that the app was most helpful during pregnancy for specifically improving sleep, anxiety, and stress. Despite that Calm was perceived as helpful for women, most felt there was a need for pregnancy-specific meditation particularly related to anxiety, postpartum, sleep problems, and preparation for labor and delivery. Many women also wanted other pregnancy-related features, besides meditations, to be included in the app. Finally, most women also expressed interest in connecting with other pregnant women via a pregnancy community, group meditations, or discussion boards.

Women in our study reported using the Calm app during pregnancy for sleep problems and anxiety and report the app being most helpful for improving sleep, anxiety, and stress. It is not surprising that pregnant women seek resources to improve sleep during pregnancy as many report alternations in sleep duration, quality, and pattern of sleep across their pregnancy.<sup>13</sup> Data from a sleep survey from the National Sleep Foundation reported up to 78% of pregnant women complain about sleep disturbance during their third trimester.<sup>13,14</sup> Cognitive behavioral therapy-insomnia (CBT-I) is often the first-line treatment for insomnia and while CBT-I

**Table 4.** Motivations for using Calm during pregnancy.

Variable	<i>n</i>	Percentage
Reasons for using Calm during pregnancy ( <i>N</i> = 106)		
Improve pregnancy-related sleep problems	31	29.2
Reduce pregnancy-related worries/anxiety	29	27.4
Lower pregnancy-related stress	10	9.4
Manage a pregnancy-related health condition	5	4.7
Become a more mindful parent	5	4.7
Manage physical discomfort or pain related to pregnancy	4	3.8
Prepare for labor/delivery	4	3.8
Other reasons related to pregnancy	5	4.7
Reasons not specifically related to pregnancy	13	12.3
Primary sources of pregnancy-related stress ( <i>N</i> = 58)		
The possibility of something being wrong with the baby	13	22.4
The possibility of miscarriage	9	15.5
Your own health	7	12.1
Relationship with husband/partner	6	10.3
Coping with the new baby	5	8.6
Giving birth	4	6.9
Employment problems related to pregnancy	2	3.4
Relationships with friends/family	1	1.7
Going to the hospital	1	1.7
Internal examinations	1	1.7
Your housing	1	1.7
Money problems	1	1.7
Other sources	7	12.1

**Table 5.** Perceived benefits of Calm during pregnancy.

Variable	<i>n</i>	Percentage
What the app was most helpful for ( <i>N</i> = 101)		
Improving pregnancy-related sleep problems	32	31.7
Reducing pregnancy-related worry/anxiety	25	24.8
Lowering pregnancy-related stress	21	20.8
Becoming a more mindful parent	6	5.9
Managing a pregnancy-related health condition	2	2.0
Managing pain or physical discomfort related to pregnancy	2	2.0
Preparing for labor/delivery	2	2.0
Other things related to pregnancy	1	1.0
Calm was not specifically helpful for pregnancy	10	9.9

has been shown to be effective in improving sleep outcomes in pregnant women, these programs can be burdensome and costly.<sup>15,16</sup> While mindfulness-based interventions may be a good alternative or adjunctive approach, studies testing their efficacy on sleep outcomes in pregnant women are lacking. In fact, one review on mindfulness studies during pregnancy reported that none of the randomized controlled trials reviewed (*N* = 13) included sleep outcomes and none were app based.<sup>17</sup> Other mindfulness-based interventions such as yoga have been shown to be efficacious for sleep in pregnant women.<sup>18</sup> One study testing a mindfulness-based program (not app based) to reduce excessive gestational weight gain, stress, and depression in overweight and obese pregnant women reported that mindfulness training attenuated the influence of poor sleep on perceived stress.<sup>19</sup> In non-pregnant populations, findings consistently show that mindfulness-based interventions may help with sleep problems but, there is a need for more rigorous trials to conclude on their efficacy.<sup>20–22</sup> Additionally, several reviews specifically suggest delivering mindfulness meditation interventions via mobile apps to encourage adherence and overcome other treatment barriers such as cost and transportation.<sup>22–24</sup> To our knowledge, only one study testing a mindfulness meditation app in pregnant women assessed sleep.<sup>25</sup> Findings from a recent pilot feasibility study testing a mindfulness meditation app in pregnant women with moderate to moderately severe depressive symptoms (*N* = 27) reported significant

**Table 6.** Proposed pregnancy-specific content to incorporate.

Variable	<i>n</i>	Percentage
Reported the need for pregnancy-specific content ( <i>N</i> = 100)	98	98.0
Desired topics in pregnancy-related content ( <i>N</i> = 98)		
Managing pregnancy-related worry/anxiety	67	68.4
Life after delivery/postpartum	49	50.0
Pregnancy-related sleep problems	40	40.8
Preparing for labor/delivery	37	37.8
Being a parent to other children while pregnant	31	31.6
Managing pregnancy-related stress	26	26.5
Managing physical discomfort/pain related to pregnancy	15	15.3
Managing pregnancy-related depression	8	8.2
Managing health conditions diagnosed during pregnancy	6	6.1
Other pregnancy content	1	1.0
Reported that they would benefit from trimester-specific meditations ( <i>N</i> = 98)	90	91.8
Reported that non-meditation features/components related to pregnancy could be incorporated into the app ( <i>N</i> = 95)	41	43.2
Interested in connecting with other pregnant users or joining a pregnancy community with other users ( <i>N</i> = 100)	58	58.0
Desired type of community ( <i>N</i> = 58)		
Group meditations with other pregnant users	40	69.0
Discussion boards within the app	33	56.9
Social media communities with other pregnant users	24	41.4
Direct messaging through the app	8	13.8
Other type of community	2	3.4

improvements in sleep disturbance.<sup>25</sup> Women also indicated, in interviews, appreciating the convenience of the intervention. Considering the high rates of sleep problems during pregnancy and the potential of mindfulness interventions (i.e. meditation mobile apps) to improve sleep, research in this area is highly warranted. Additionally, mobile app developers and future studies should consider incorporating multi-component (e.g. mindfulness and CBT-I strategies) as well as hybrid approaches (e.g. in-clinic and/or remote) and testing these strategies to improve the experience of pregnancy and postpartum.

Women in our study also reported using the Calm app during pregnancy for anxiety and found it most helpful for anxiety and stress (in addition to sleep). Interestingly poor sleep has been implicated in the development of prenatal mood disorders including anxiety and has been linked to increased stress in pregnant women.<sup>26–28</sup> It is likely that pregnant women with sleep problems experience mental health problems (or vice versa) and are seeking out resources to help manage these issues. Several reviews on mindfulness-based interventions in pregnancy have reported significant reductions in anxiety and stress.<sup>1–5</sup> However, there is limited data on the effects of mindfulness-based apps on mental health in pregnant women. One recent study conducted during the COVID-19 pandemic in both obstetric (pregnant between 14 and 34 weeks) and gynecology (surgical procedures) patients (*N* = 50) reported significant reductions in stress, anxiety, and depression compared to a treatment as a usual control group (*N* = 51) after using a meditation mobile app for 30 days.<sup>12</sup> Women using the app also reported high satisfaction and that mindfulness meditation helped to improve their stress. In the aforementioned pilot feasibility study by Kubo,<sup>25</sup> the findings also showed significant improvements in stress (in addition to sleep disturbance) after using the app for six weeks. While meditation apps may show promise for improving sleep, anxiety, and stress, women express a desire for pregnancy-specific meditation content. It is unknown whether tailoring meditations for pregnant women would have a greater impact on sleep and/or prenatal mental health. However, research suggests tailoring interventions to increase engagement and efficacy in digital health interventions such as mobile apps.<sup>29</sup> Given the unique, temporal stressors that pregnancy confers, pregnant women may benefit and better optimize health outcomes from content that is specifically tailored to their needs during pregnancy.<sup>1,30,31</sup> Social support is also another strategy shown to increase engagement and efficacy in digital health interventions.<sup>29</sup> Not surprisingly women in our study expressed interest in a social support component (e.g. pregnancy community, group meditations, and discussion boards), which could easily be integrated into mobile apps. Tailored apps for pregnant women and digital social

support strategies should be tested for their impact, particularly on sleep and prenatal mental health.

### Limitations

Though the information provided here may help inform future studies, there are several limitations to this research. First, the data may be biased to participant self-selection and the sample is not representative of all pregnant women. There is a need to explore perceptions of meditation apps in those who do not already use them as well as across a range of demographic characteristics and in more diverse samples (e.g. racial/ethnic minorities and trans/non-binary individuals). Second, for participants completing the survey who were in the postpartum period may be subject to recall errors related to how they used Calm when they were pregnant. Future studies exploring the needs and preferences for mobile apps in the postpartum period would also be useful as well as incorporating objective usage data for more accurate reporting of app use. Third, we did not assess the reasons for discontinued app use during pregnancy. Future studies should investigate why pregnant women stop using meditation apps and strategies to encourage adherence. Finally, this survey did not evaluate mental health outcomes. Future studies testing the feasibility and efficacy of mobile apps both specific for and not specific for prenatal mental health and sleep are needed.

### Conclusion

Pregnant women using the Calm app find the app most helpful for improving sleep, anxiety, and stress but feel the app needs more tailoring related to pregnancy content. Mobile apps, even if not developed specifically for pregnancy, could benefit by adding pregnancy-specific content in their app including topics related to anxiety, postpartum, sleep problems, and preparation for labor and delivery. Strategies for social support between pregnant women are also a desired feature within the app. Future research testing the feasibility and efficacy of tailored meditation mobile apps for pregnant women to improve sleep and mental health are needed.

**Contributorship:** All authors contributed to the conception and design, acquisition of data, analysis, and interpretation of data, drafting the article or revising it critically for important intellectual content, and final approval of the version to be published.

**Declaration of Conflicting Interests:** The authors declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Dr Jennifer Huberty discloses that she receives an annual salary from Calm and holds stock within the company. However, her salary and equity are not dependent upon the results of her

research. Megan Puzia and Taylor Neher disclose that they are paid contractors (i.e. Research Coordinators) of Calm.

**Ethical approval:** The Institutional Review Board at Arizona State University approved this study (STUDY00014083). All participants provided electronic consent before participating in the survey.

**Funding:** The authors received no financial support for the research, authorship, and/or publication of this article.

**Guarantor:** JH.

**ORCID ID:** Jennifer Huberty  <https://orcid.org/0000-0002-0276-4640>

### References

1. Babbar S, Oyarzabal AJ and Oyarzabal EA. Meditation and mindfulness in pregnancy and postpartum: a review of the evidence. *Clin Obstet Gynecol* 2021; 64: 661–682.
2. Taylor BL, Cavanagh K and Strauss C. The effectiveness of mindfulness-based interventions in the perinatal period: a systematic review and meta-analysis. *PLoS One* 2016; 11: e0155720.
3. Dhillon A, Sparkes E and Duarte RV. Mindfulness-Based interventions during pregnancy: a systematic review and meta-analysis. *Mindfulness* 2017; 8(6): 1421–1437.
4. Hall HG, Beattie J, Lau R, et al. Mindfulness and perinatal mental health: A systematic review. *Women Birth* 2015; 29(1): 62–71.
5. Shi Z and MacBeth A. The effectiveness of mindfulness-based interventions on maternal perinatal mental health outcomes: a systematic review. *Mindfulness (N Y)* 2017; 8: 823–847.
6. Huberty J, Green J, Glissmann C, et al. Efficacy of the mindfulness meditation mobile app “calm” to reduce stress among college students: randomized controlled trial. *JMIR Mhealth Uhealth* 2019; 7(6): e14273.
7. Gál É, Ștefan S and Cristea IA. The efficacy of mindfulness meditation apps in enhancing users’ well-being and mental health related outcomes: a meta-analysis of randomized controlled trials. *J Affect Disord.* 279: 131–142.
8. Chiesa A and Serretti A. A systematic review of neurobiological and clinical features of mindfulness meditations. *Psychol Med* 2010; 40: 1239–1252.
9. Kabat-Zinn J. Mindfulness-based interventions in context: past, present, and future. *Clin Psychol Sci Pract* 2003; 10: 144–156.
10. Huberty J, Eckert R, Larkey L, et al. Smartphone-based meditation for myeloproliferative neoplasm patients: Feasibility study to inform future trials. *J Med Internet Res.* 2019; 3(2): e12662.
11. Huberty J, Green J, Puzia M, et al. Testing a mindfulness meditation mobile app for the treatment of sleep-related symptoms in adults with sleep disturbance: a randomized controlled trial. *PLoS ONE*, 2020; 16(1): e0244717.
12. Smith RB, Mahner ND, Foote J, et al. Mindfulness effects in obstetric and gynecology patients during the coronavirus



- disease 2019 (COVID-19) pandemic: a randomized controlled trial. *Obstet Gynecol (New York 1953)* 2021; 137: 1032–1040.
13. Bacaro V, Benz F, Pappaccogli A, et al. Interventions for sleep problems during pregnancy: A systematic review. *Sleep Med Rev* 2020; 50: 101234.
  14. Summary of findings of the 2007 Sleep in America Poll. National Sleep Foundation.
  15. Trauer JM, Qian MY, Doyle JS, et al. Cognitive behavioral therapy for chronic insomnia: a systematic review and meta-analysis. *Ann Intern Med* 2015;163(3): 191–204.
  16. Manber R, Bei B, Simpson N, et al. Cognitive Behavioral Therapy for Prenatal Insomnia. *Obstet Gynecol* 2019; 133(5). doi:10.1097/aog.0000000000003216
  17. Lucena L, Frange C, Pinto ACA, et al.. Mindfulness interventions during pregnancy: A narrative review. *J Integr Med* 2020; 18(6): 470–477.
  18. Narendran S, Nagarathna R, Narendran V, et al. Efficacy of yoga on pregnancy outcome. *J Altern Complement Med* 2005; 11: 237–244.
  19. Felder JN, Laraia B, Coleman-Phox K, et al. Poor sleep quality, psychological distress, and the buffering effect of mindfulness training during pregnancy. *Behav Sleep Med* 2018; 16(6): 611–624.
  20. Shallcross AJ, Visvanathan PD, Sperber SH, et al. Waking up to the problem of sleep: can mindfulness help? A Review of Theory and Evidence for the Effects of Mindfulness for Sleep. *Curr Opin Psychol* 2019; 28: 37–41.
  21. Winbush NY, Gross CR and Kreitzer MJ. The effects of mindfulness-based stress reduction on sleep disturbance: a systematic review. *Explore* 2007; 3(6): 585–591.explore.2007.08.003
  22. Rusch HL, Rosario M, Levison LM, et al. The effect of mindfulness meditation on sleep quality: a systematic review and meta-analysis of randomized controlled trials. *Ann N Y Acad Sci* 2019; 1445(1): 5–16.
  23. Garland SN, Zhou ES, Gonzalez BD, et al. The quest for mindful sleep: a critical synthesis of the impact of mindfulness-based interventions for insomnia. *Curr Sleep Med Rep* 2016; 2(3): 142–151.
  24. Ong JC and Moore C. What do we really know about mindfulness and sleep health? *Curr Opin Psychol* 2020. doi:10.1016/j.copsyc.2019.08.020
  25. Kubo A, Aghaee S, Kurtovich EM, et al. Mhealth mindfulness intervention for women with moderate-to-moderately-severe antenatal depressive symptoms: a pilot study within an integrated health care system. *Mindfulness (N Y)* 2021; 12: 1387–1397.
  26. Ross LE, Murray BJ and Steiner M. Sleep and perinatal mood disorders : a critical review. *J Psychiatry Neurosci* 2005; 30: 247–256.
  27. Gao M, Hu J, Yang L, et al. Association of sleep quality during pregnancy with stress and depression: a prospective birth cohort study in China. *BMC Pregnancy Childbirth* 2019; 19: 44.
  28. Palagini L, Gemignani A, Banti S, et al. Chronic sleep loss during pregnancy as a determinant of stress: impact on pregnancy outcome. *Sleep Med* 2014; 15: 853–859.
  29. Yardley L, Spring BJ, Riper H, et al. Understanding and promoting effective engagement with digital behavior change interventions. *Am J Prev Med* 2016; 51: 833–842.
  30. Kalmbach DA, Cheng P, O'Brien LM, et al. A randomized controlled trial of digital cognitive behavioral therapy for insomnia in pregnant women. *Sleep Med* 2020; 72: 82–92.
  31. Duncan LG, Cohn MA, Chao MT, et al. Benefits of preparing for childbirth with mindfulness training: a randomized controlled trial with active comparison. *BMC Pregnancy Childbirth* 2017; 17: 40.
-