HHS Public Access

Author manuscript

J Midwifery Womens Health. Author manuscript; available in PMC 2022 September 12.

Published in final edited form as:

J Midwifery Womens Health. 2021 September ; 66(5): 664–670. doi:10.1111/jmwh.13251.

Feasibility and Acceptability of Guided Imagery to Sequentially Address Multiple Health Behaviors During Pregnancy

Peter Giacobbi Jr., Ph.D.,
Department of Sport Sciences, Joint Appointment in Department of Social and Behavioral Sciences, West Virginia University College of Physical Activity and Sport Sciences, School of Public Health, Morgantown, West Virginia

Danielle Symons-Downs, Ph.D.,
Department of Kinesiology, Joint Appointment in Department of Obstetrics and Gynecology, Penn State University College of Health and Human Development, College Station, Pennsylvania

Treah Haggerty, M.D., M.S.,
Department of Family Medicine, West Virginia University School of Medicine, Morgantown, West Virginia

Stanislav Pidhorskyi, Ph.D.,
Lane Department of Computer Science and Electrical Engineering, West Virginia University Benjamin M. Statler College of Engineering and Mineral Sciences, Morgantown, West Virginia

D. Leann Long, Ph.D.,
Department of Biostatistics, University of Alabama Birmingham School of Public Health, Birmingham, Alabama

Melanie Clemmer, Ph.D.,
Department of Obstetrics and Gynecology, Center for Reproductive Medicine, West Virginia University School of Medicine, Morgantown, West Virginia

Shari Steinman, Ph.D.,
Department of Psychology, West Virginia University College of Liberal Arts and Sciences, Morgantown, West Virginia

Melissa D. Olfert, DrPH, MS, RDN, LD,
Department of Nutritional Sciences, West Virginia University Davis College of Agriculture, Natural Resources and Design, Morgantown, West Virginia

Kelsey Kinnamon, B.S.,
Department of Sport Sciences, West Virginia University, College of Physical Activity and Sport Sciences, Morgantown, West Virginia

Neel Rao, B.S.,
Department of Sport Sciences, West Virginia University, College of Physical Activity and Sport Sciences, Morgantown, West Virginia

Correspondence should be directed to: Peter R. Giacobbi, Jr., Health & Education Building, CPASS 208, West Virginia University, P. O. Box 6116, 375 Burch Street, Morgantown, West Virginia, 25606-6116.

Conflict of Interest: The authors have no conflicts of interest to disclose.

Hannah Staggs, B.S.,
Department of Sport Sciences, West Virginia University, College of Physical Activity and Sport Sciences, Morgantown, West Virginia

Donald Adjeroh, Ph.D.
Lane Department of Computer Science and Electrical Engineering, West Virginia University, Benjamin M. Statler College of Engineering and Mineral Sciences, Morgantown, West Virginia

Abstract

Introduction: Pregnancy presents health challenges related to well-being, physical activity, dietary regulation, and body image. There is evidence to support the use of guided imagery to address these concerns during pregnancy. The purpose of this study was to analyze the use and short-term outcomes of a multi-behavior guided imagery intervention delivered through a mobile health (mHealth) application for pregnant women.

Methods: A single-arm, five-week feasibility trial was conducted and participants were instructed to listen to an audio file every day for 35 days on a mHealth application. Measurements included ongoing assessments of the participants' use of the guided imagery audio files, pre- and post-test measures of depression, anxiety, stress, physical activity, food cravings, and body image. Post-intervention qualitative interviews were conducted to assess whether participants would continue to use guided imagery.

Results: 58 participants (Mean age, 28.5 years) were enrolled from January to June of 2018. Cloud analytics data showed an average of 4.96 audio downloads per week with the Sleep and Relaxation file being the most widely used (Mean weekly usage, 5.67) and reported favorite during follow-up interviews. Paired t-tests from pre- to post-test showed significant reductions in depression, anxiety, and stress, increased physical activity, and sedentary behavior along with some changes in body image.

Discussion: Future scalable guided imagery interventions are justified to test for efficacy. Guided imagery may also be delivered in person by health care providers or by using widely available technologies.

Précis

Guided imagery audio files are feasible for use during pregnancy and had a positive impact on mental health, physical activity, and body image.

Keywords

guided imagery; pregnancy; perinatal depression; pregnancy related anxiety; physical exercise

Introduction

Pregnant women experience physical and psychological challenges, some of which may be associated with increased risks for adverse perinatal outcomes.[1,2] Psychological stress can lead to shorter gestation periods, preterm birth, low birth weight, and several birth complications.[2–6] For some women, the physiologic changes of pregnancy exacerbate body

image disturbances associated with other co-occurring conditions (e.g., eating disorders, reduced self-esteem, and obesity).[7] These findings from observational studies support the need to develop and test self-management strategies to address physical and mental health during pregnancy.

Physical activity may reduce some of the health risks associated with pregnancy such as gestational diabetes, hypertension, excessive weight gain, and depression.[8–11] Professional associations recommend that most women without obstetric or medical complications can initiate or continue physical activity during pregnancy.[12] However, many pregnant women reduce or eliminate physical activity.[13] It is also known that women experience unique food cravings.[14] Self-management strategies that address physical activity and food cravings are particularly important for women who are overweight or obese during pregnancy.

One self-management tool with evidence to support its use to address physical activity, food cravings, and mental health challenges is guided imagery.[15–17] Guided imagery is a quasi-perceptual, multi-sensory, conscious experience that resembles the actual perception of some object, scene, in the absence of external stimuli.[18] Like mindful meditation, guided imagery can create awareness about one's thoughts, feelings, and behaviors. Guided imagery is used to increase an individual's preparation and motivation towards a task, behavior, or health goal.[15] This cognitive technique has been used widely [17] but has not been tested with pregnant women as part of a multi-health behavior change intervention.

The purpose of this study was to test the use, feasibility, acceptability, and short-term outcomes of a guided imagery intervention designed for pregnant women which was delivered through a mobile health (mHealth) application. The guided imagery intervention consisted of audio files located on a mHealth application developed for this study called PregPal. The intervention was intended to address sleep/relaxation, body awareness, physical activity, food cravings, and body image. Primary outcomes were recruitment, retention rates and usage of the audio files. Other outcomes included changes in physical activity, sedentary behavior, and mental health. Post-intervention interviews were conducted to understand participant's experiences during the trial. It was hypothesized the participants would use the audio files on 50% or more of the days during a 5 week study period.[19]

Method

All study procedures were approved by the West Virginia University institutional review board (IRB #170267365R002). Participants were recruited through paid advertisements on Facebook and university departments of Family Medicine and Obstetrics and Gynecology. Recruitment materials sought pregnant women to test a mobile health (mHealth) application to promote healthy lifestyles related to stress, physical activity, and diet.

A community-engaged approach was used to help develop guided imagery content by interviewing 12 pregnant women (mean age, 31.36 years). Content analysis of these interviews revealed 5 central themes: 1) concerns related to body function (e.g., "Am I ever going to get my muscle tone back?"), 2) images of the baby, 3) physical activity behavior, 4) the pregnancy experience, and 5) app use. Adjectives and descriptions of pregnancy from

these interviews were then integrated into the guided imagery scripts over 10 iterations. The written scripts were audio recorded on a Surface Pro Six and (www.microsoft.com) and uploaded into an Amazon Cloud portal. The PregPal app was made available in the App Store after approval was gained from iOS.

The development of the guided imagery scripts was also informed by a cognitive-motivational framework.[20] From this perspective, imagery is viewed to have cognitive and motivational functions. Each have general and specific characteristics. General images for the cognitive function consist of planning, scheduling, and self-management strategies while specific images are associated with increased skill and imagery vividness using all senses and emotions. General images for the motivational function address stress reduction, positive emotions, increased confidence, and improved body image. Motivational specific images are related to goal related responses and outcomes. Table 1 describes the title and length of each script and examples of imagery content. Written copies of the guided imagery files are provided as supplementary material.

This study was a single-arm 5-week, within-subjects feasibility design with pre and post-test assessments, along with monitoring of participants' usage of the audio files from a Cloud server. Inclusion criteria were: 1) being an iOS user; 2) 18 to 39 years of age; 3) less than 33 weeks' gestation; 4) low-risk pregnancy and able to engage in exercise and day-to-day tasks; 5) Be able and willing to listen to audio files for 35 consecutive days; 6) English speaking; 7) Able to provide a name and date stamped image of their latest sonogram; and 8) Be willing to complete pre- and post-test surveys and interviews. Participants who completed the trial were given an iPad 6 as remuneration.

After downloading the app, participants were provided the option of consent to participate in the study and to complete pre-testing measures after which the introductory audio file would become available. Each audio file was only available for a 7-day time-period so the order of access was sequential. After listening to the introductory file, the sleep and relaxation file was opened with subsequent files being unlocked after each 7-day increment. At the end of 5 weeks, all audio files were unlocked for unlimited access. Participants were aware that usage of the audio files was being monitored.

Study Measures

Demographic measures included educational attainment, race/ethnicity, birthdate, date of conception or weeks pregnant, pre-pregnancy height and weight, and parity status.

The short-form of the Depression, Anxiety, and Stress Scale (DASS-21) was used to measure mental health.[21] Respondents answered 21 items to indicate how much each statement applied "over the past week" from 0 (Did not apply to me at all) to 3 (Applied to me very much or most of the time). The original DASS-21 includes 7 items each to measure (1) depression, (2) anxiety, and (3) stress. However, psychometric evidence supports the use of a combined measure of depression, anxiety and stress as a single score [22] which was applied in the present study. The DASS-21 scores were obtained by summing all the items with a possible range of 0 to 66. Higher scores on this measure are indicative of lower levels of mental health. The DASS-21 is a valid and reliable measure of mental health in adults.[20]

The Pregnancy Physical Activity Questionnaire (PPAQ) was used to measure physical activity.[23] The PPAQ measures 32 types of physical activity in the following categories: (1) household/caregiving (13 items); (2) occupational activity (5 items); (3) sport/exercise (8 items); (4) transportation (3 items); and (5) inactivity (3 items). Participants indicated how much time they spent engaging in each activity during a typical week. Each activity was assigned an intensity value in metabolic equivalent of task (MET, 1 MET = energy expended during rest) based on values in the compendium of physical activity.[24] The duration of each activity was multiplied by its intensity to calculate metabolic energy expenditure (MET-h·week^{-1}). Total physical activity was derived from summing all activities in the PPAQ. Higher scores represent a greater amount of energy expended from physical activity. Total scores on the PPAQ for MET-h·week^{-1} for low activity range from 0 to 19.7, moderate activity ranges from 22.2 to 25.2, while high activity would be 34.5 or higher.[23] An upper range limit of Met-h·week^{-1} is unknown. We also computed sedentary time from 3 items on the PPAQ that measure time, in minutes, spent sitting while using a computer or watching TV. Sedentary time could range from 0 to 10,800 minutes a week: higher scores represent a greater amount of sedentary behavior. The PPAQ was validated for pregnant women using accelerometry and is a valid and reliable measure of physical activity for this population.[23]

The Food Cravings Questionnaire – trait (FCQ-T) was used to measure food cravings.[25] The FCQ-T has 21 items and 4 subscales: (1) preoccupation with food (6 items), (2) loss of control once eating (6 items), (3) positive outcome expectancy from eating (5 items), and (4) emotional cravings (4 items). The FCQ-T uses a Likert scale from 1 (never or not applicable) to 6 (always) in the trait format. Scoring the FCQ-T consists of summing all items with total scores that can range from 21 to 126: higher scores indicate a higher level of trait food cravings. The FCQ-T has adequate reliability and validity for use as a trait measure of food cravings.[25]

The Body Image in Pregnancy Scale (BIPS) is a 36-item scale with 7-subscales: (1) preoccupation with physical appearance (6 items); (2) dissatisfaction with strength related aspect of one's body (7 items); (3) dissatisfaction with complexion (4 items); (4) sexual attractiveness (5 items); (5) prioritization of appearance over function (5 items); (6) appearance-related behavioral avoidance (3 items); and (7) dissatisfaction with body parts (6 items).[26] The preoccupation with physical appearance, sexual attractiveness, and prioritization of appearance over function scales are scored on Likert scale with 1 being 'If you strongly disagree with the statement' to select 5 'If you strongly agree with the statement.' The dissatisfaction with strength-related aspects of one's body, dissatisfaction with complexion, dissatisfaction with body parts, and preoccupation with physical appearance scales were scored as 1 being 'If you are strongly satisfied' to 5 being 'If you are strongly dissatisfied.' The appearance-related behavioral avoidance scale was scored as 1 ('If you rarely engaged in the behavior') to 5 ('If you constantly engage in the behavior'). BIPS scores were obtained by summing the responses on each item and dividing that number by the items in the scale. The range of scores for all subscales are from 1 to 5 with higher scores indicating greater body disturbance. The BIPS is a valid and reliable measure of body imagery in pregnancy.[26]

Two items from previous work assessed attitudes towards guided imagery.[27] Participants were asked how confident and logical they perceived their use of imagery was during pregnancy. Scores could range from 0 to 10 with higher scores indicating a more positive attitude in the use of guided imagery during pregnancy.

Qualitative interviews were conducted to assess the participants' experiences with guided imagery and whether they would continue using this skill. Specifically, we asked participants (1) Can you tell us what you thought of the guided imagery files, (2) What were your favorite and least favorite audio files, and (3) Do you think you will continue using guided imagery.

Data Analysis

App usage data, quantified by the number of audio file downloads, were descriptively analyzed. Estimates of internal consistency (alpha) were computed for all study measures except the PPAQ and the sedentary behavior subscale of this survey: alpha is not typically computed for these latter measures for reasons beyond the scope of this short report. Paired-samples *t*-tests and confidence intervals using pre- to post-intervention survey data were used to examine changes in DASS-21, PPAQ, FCQ-T, BIPS, and attitudes towards guided imagery. Interview data from the formative stages and post-intervention interviews were transcribed verbatim and content analyzed.[28]

RESULTS

For this study, 178 women contacted study staff and 61 were pre-screened. Of these, 58 women completed the pre-test and 46 completed the intervention for an adherence rate of 79%. The women in this study were predominantly white with various levels of educational attainment (Table 2). Estimates of internal consistency (alpha) were above .62 for all measures except the sexual attractiveness subscale of the BIPS based on conventional standards (Table 3).[29]

The participants uploaded the *Sleep and Relaxation* audio file the most with a drop off in usage for the remaining files (Figure 1). Our hypothesis that participants would use the app for 50% of the 35 days was supported.

Paired-sample t-tests revealed significant reductions in the composite score on the DASS-21. Both physical activity and sedentary behavior increased (Table 3). Trait food cravings did not significantly change from pre- to post-test. Significant changes in body image were observed that included reductions in dissatisfaction with complexion, sexual attractiveness, and increased prioritization of appearance over function, and dissatisfaction with body parts. Finally, a significant pre-post increase on the imagery attitude scale was also observed.

Post intervention interviews with 42 of 46 study completers revealed 37 (88%) reported positive experiences using guided imagery, 3 (7%) were not clear about their experiences or indicated ambivalence about this technique, while 1 interview was inaudible and the participant's response could not be discerned. Thirteen participants (31%) reported the

sleep/relaxation as their favorite while 14 (33%) stated the *Eat Healthy* file was the least preferred.

DISCUSSION

This 5-week study demonstrated feasibility, acceptability, adherence, and outcomes similar to other studies with non-pregnant women.[16,19] The Sleep/Relaxation audio file was the most widely downloaded file and also cited as the favorite during post-intervention interviews. The Eat Healthy file was the least used and least favorite and there were no changes in trait food cravings. Significant improvements were observed in physical activity, indices of mental health, and aspects of body image.

The participants increased their minutes of sedentary time in addition to their physical activity. This could have reflected compensation for their increased levels of activity or, more likely, the physiological changes associated with pregnancy. Since many pregnant women decrease their levels of physical activity during pregnancy,[30] it is possible that guided imagery may help women maintain or increase physical activity. Conversely, the guided imagery intervention may not have been robust enough to address sedentary time, food cravings, and aspects of body image related to physical strength and appearance. Studies using guided imagery to address food cravings were conducted with non-pregnant women [16] so it is possible that dietary challenges of pregnancy made this approach unlikely to yield changes.

Health-care workers and pregnant women may adopt or adapt the guided imagery scripts presented in Table 1 or the supplementary material for use during pregnancy. It is also possible to engage pregnant women in the development of guided imagery scripts by using these scripts as inspiration for more tailored versions. While the guided imagery scripts used here were theory-based,[20] health-care workers can peruse the internet with the terms “guided imagery” and make informed decisions about appropriate resources on this topic.

The present study was limited by the sample which was educated and racially and ethnically homogeneous. The reliance on self-report data and lack of a comparison condition were also shortcomings. Participants may have changed their behaviors because they were aware that audio file usage was being monitored. Future work using activity monitors with matched controls is justified. Finally, the sole use of PregPal on the iOS platform was another limitation.

CONCLUSION

Feasibility and acceptability of guided imagery by pregnant women was established with this sample. The participants were willing to engage in guided imagery to sequentially address multiple health behaviors. The short-term changes observed in this study warrant additional research with a larger sample and comparison group. Researchers should also report on the clinical significance of study results in future trials.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements:

This research was supported by the National Institute of General Medical Sciences of the National Institutes of Health (NIH) under Award Number 2U54GM104942-02. Additional support for this project was provided by the West Virginia Prevention Research Center supported by Cooperative Agreement Number 1-U48-DP-005004 from the Centers for Disease Control (CDC) and Prevention and the National Science Foundation (NSF-16-510). The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official positions of the NIH, CDC or NSF.

The authors would like to thank Thomas Hulsey for his thoughtful comments during the design phase of this study and feedback on an early draft of the manuscript.

References

1. Santos S, Voerman E, Amiano P, et al. Impact of maternal body mass index and gestational weight gain on pregnancy complications: an individual participant data meta-analysis of European, North American and Australian cohorts. Bjog. 2019;126(8):984–995. [PubMed: 30786138]
2. Staneva A, Bogossian F, Pritchard M, Wittkowski A. The effects of maternal depression, anxiety, and perceived stress during pregnancy on preterm birth: A systematic review. Women and Birth. 2015;28(3):179–193. [PubMed: 25765470]
3. Glover V Maternal depression, anxiety and stress during pregnancy and child outcome; what needs to be done. Best Practice & Research Clinical Obstetrics & Gynaecology. 2014;28(1):25–35. [PubMed: 24090740]
4. La Marca-Ghaemmaghami P, Ehlert U. Stress During Pregnancy. European Psychologist. 2015;20(2):102–119.
5. Lima SAM, El Dib RP, Rodrigues MRK, et al. Is the risk of low birth weight or preterm labor greater when maternal stress is experienced during pregnancy? A systematic review and meta-analysis of cohort studies. PloS one. 2018;13(7):e0200594. [PubMed: 30048456]
6. Staneva AA, Bogossian F, Wittkowski A. The experience of psychological distress, depression, and anxiety during pregnancy: A meta-synthesis of qualitative research. Midwifery. 2015;31(6):563–573. [PubMed: 25912511]
7. Fuller-Tyszkiewicz M, Skouteris H, Watson BE, Hill B. Body dissatisfaction during pregnancy: A systematic review of cross-sectional and prospective correlates. Journal of Health Psychology. 2012;18(11):1411–1421. [PubMed: 23188921]
8. Doi SAR, Furuya-Kanamori L, Toft E, et al. Physical activity in pregnancy prevents gestational diabetes: A meta-analysis. Diabetes Research and Clinical Practice. 2020;168:108371. [PubMed: 32827593]
9. Magro-Malosso ER, Saccone G, Di Tommaso M, Roman A, Berghella V. Exercise during pregnancy and risk of gestational hypertensive disorders: a systematic review and meta-analysis. Acta Obstetricia et Gynecologica Scandinavica. 2017;96(8):921–931. [PubMed: 28401531]
10. Downs DS, Evenson KR, Chasan-Taber L. Obesity and Physical Activity During Pregnancy and Postpartum: Evidence, Guidelines, and Recommendations. In. Obesity During Pregnancy in Clinical Practice: Springer London; 2013:183–227.
11. Davenport MH, McCurdy AP, Mottola MF, et al. Impact of prenatal exercise on both prenatal and postnatal anxiety and depressive symptoms: a systematic review and meta-analysis. British Journal of Sports Medicine. 2018;52(21):1376–1385. [PubMed: 30337464]
12. ACOG Committee Opinion No. 650: Physical Activity and Exercise During Pregnancy and the Postpartum Period. Obstet Gynecol. 2015;126(6):e135–142. [PubMed: 26595585]
13. Symons Downs D, Evenson KR, Chasan-Taber L. Obesity and physical activity during pregnancy and postpartum: Evidence, Guidelines, and Recommendations. In: Nicholson W, Baptitste-Roberts K, eds. Obesity During Pregnancy in Clinical Practice. London: Springer-Verlan; 2014:183–227.

14. Orloff NC, Hormes JM. Pickles and ice cream! Food cravings in pregnancy: hypotheses, preliminary evidence, and directions for future research. Frontiers in psychology. 2014;5:1076–1076. [PubMed: 25295023]
15. Conroy D, Hagger MS. Imagery interventions in health behavior: A meta-analysis. Health Psychology. 2018;37(7):668–679. [PubMed: 29809020]
16. Giacobbi P Jr., Long D, Nolan R, Shawley S, Johnson K, Misra R Guided imagery targeting exercise, food cravings, and stress: a multi-modal randomized feasibility trial. J Behav Med. 2018;41(1):87–98. [PubMed: 28766183]
17. Giacobbi PR Jr., Stewart J, Chaffee K, Jaeschke A-M, Stabler M, Kelley GA. A Scoping Review of Health Outcomes Examined in Randomized Controlled Trials Using Guided Imagery. Prog Prev Med (N Y). 2017;2(7):e0010–e0010. [PubMed: 29457147]
18. Imagery Mental. Metaphysics Research Lab, Center for the Study of Language and Information, Stanford University; 2014. http://plato.stanford.edu/archives/fall2014/entries/mental-imagery/.
19. Gordon JS, Armin J,D. Hingle M, et al. Development and evaluation of the See Me Smoke-Free multi-behavioral mHealth app for women smokers. Translational Behavioral Medicine. 2017:1–13. [PubMed: 28032316]
20. Paivio A. Cognitive and motivational functions of imagery in human performance. Can J Appl Sport Sci. 1985;10(4):22S–28S. [PubMed: 4085129]
21. Lovibond PF, Lovibond SH. The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. Behaviour Research and Therapy. 1995;33(3):335–343. [PubMed: 7726811]
22. Osman A, Wong JL, Bagge CL, Freedenthal S, Gutierrez PM, Lozano G. The Depression Anxiety Stress Scales—21 (DASS-21): Further Examination of Dimensions, Scale Reliability, and Correlates. 2012;68(12):1322–1338.
23. Chasan-Taber L, Schmidt MD, Roberts DE, Hosmer D, Markenson G, Freedson PS. Pregnancy Physical Activity Questionnaire. Medicine & Science In Sports & Exercise. 2004;36(10):1750–1760. [PubMed: 15595297]
24. Ainsworth BE, Haskell WL, Herrmann SD, et al. 2011 Compendium of Physical Activities: a second update of codes and MET values. Medicine and science in sports and exercise. 2011;43(8):1575–1581. [PubMed: 21681120]
25. Nijs IMT, Franken IHA, Muris P. The modified Trait and State Food-Cravings Questionnaires: Development and validation of a general index of food craving. Appetite. 2007;49(1):38–46. [PubMed: 17187897]
26. Watson B, Fuller-Tyszkiewicz M, Broadbent J, Skouteris H. Development and validation of a tailored measure of body image for pregnant women. Psychological Assessment. 2017;29(11):1363–1375. [PubMed: 28125247]
27. Borkovec TD, Nau SD. Credibility of analogue therapy rationales. Journal of Behavior Therapy and Experimental Psychiatry. 1972;3(4):257–260.
28. Hsieh HF, Shannon SE. Three approaches to qualitative content analysis. Qualitative Health Research. 2005;15:1277–1288. [PubMed: 16204405]
29. Nunnally JC, Bernstein IH. Psychometric Theory. 4th ed. New York: McGraw-Hill; 1994.
30. Huberty JL, Buman MP, Leiferman JA, Bushar J, Adams MA. Trajectories of objectively-measured physical activity and sedentary time over the course of pregnancy in women self-identified as inactive. Preventive Medicine Reports. 2016;3:353–360. [PubMed: 27419036]

Quick Points:

- The guided imagery intervention that sequentially addressed multiple health behaviors was acceptable to pregnant women and feasible to deliver on a mobile health application.
- The guided imagery intervention showed reductions in depression, anxiety and stress and increased physical activity.
- Sedentary behavior also increased which often occurs during pregnancy.
- An efficacy trial with a control group is warranted.

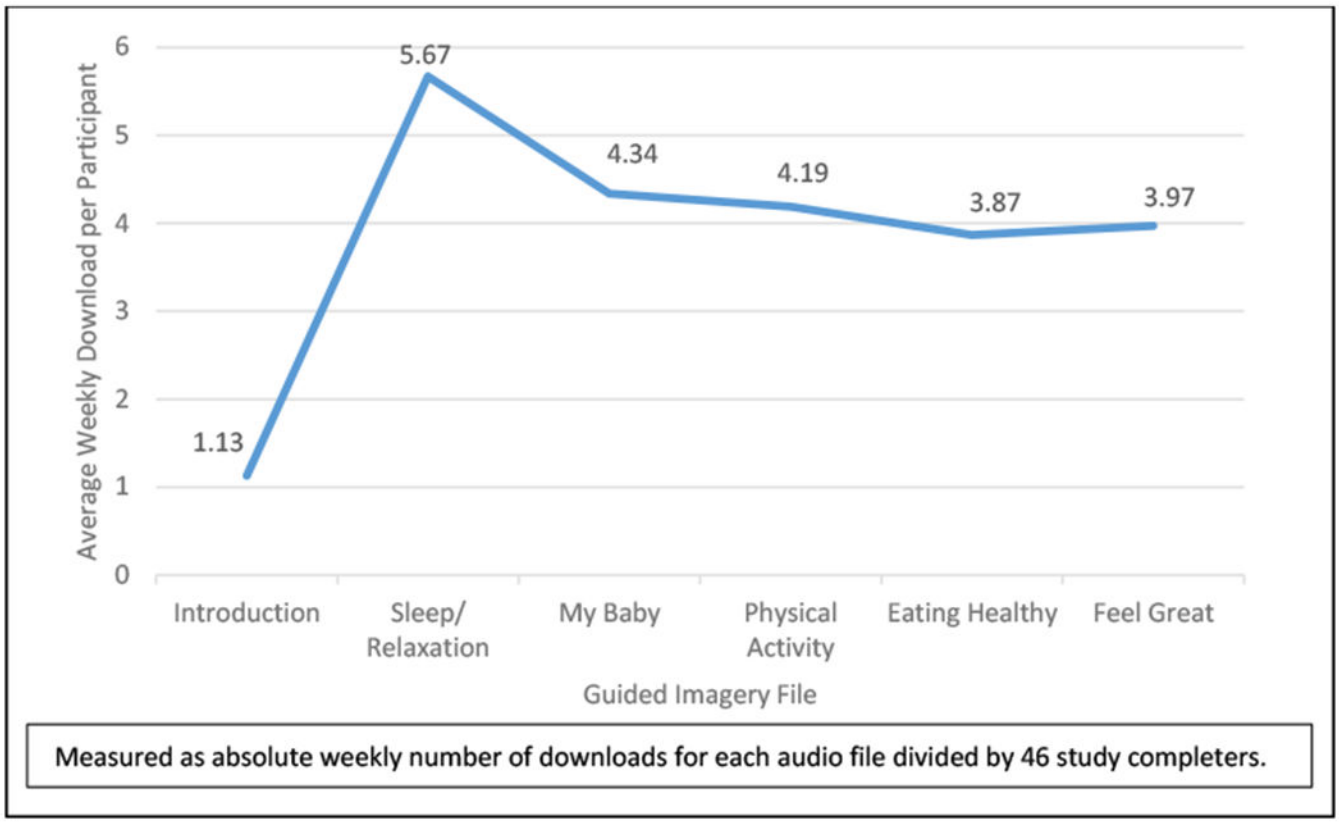

Figure 1.
Average weekly audio downloads by file for those who completed the study [n=46]

Table 1.

Guided Imagery Audio File Title, Descriptions, and Length

Week and Title	Description	Examples from Audio Files
Week 1: Introduction and basics of guided imagery (1 minute, 17 seconds)	Definition of guided imagery, instructions on how and when to listen to the audio files, and encouragement to use of all senses and emotions	"Guided imagery allows you to imagine pictures, emotions, sounds, tastes, smells, and other sensations associated with your pregnancy."
Week 1: Sleep and relaxation (2 minutes, 53 seconds)	Relaxation at bedtime, coping with stress and discomfort (e.g., labor)	"Combine your images with deep breathing by putting your hands on your belly and chest. As you breathe in, the hand on your belly should rise before the hand on your chest while you relax your shoulders… The same breathing activities and imagery that helps you fall asleep right now can also help you when you experience contractions, pain, or stress."
Week 2: My baby (4 minutes, 8 seconds)	Images of the baby, and body awareness	"Think about what it feels like knowing that your baby is growing inside of you. Imagine how connected you are with your baby. Think about the deep connection that you have with your baby, including how he or she may experience your excitement and energy."
Week 3: Physical activity (5 minutes, 11 seconds)	Feelings, sensations, and images of physical activity during pregnancy	"See yourself taking a long walk in a place that you are comfortable with. Imagine the details of this place such as the time of day and temperature…Feel your heart beat faster and your breathing increase. Notice your lungs filling deeply with clean, fresh air and all this air reaching your baby through the bloodstream."
Week 4: Eat healthy (4 minutes, 8 seconds)	Healthy eating, coping with nausea and food cravings	"Try to imagine a food that you crave. This could be any food that you may have the urge to eat frequently….As you eat more of this food, imagine yourself becoming full and deciding to stop eating. You may crave certain foods at different times and that is ok…When this happens, imagine yourself coping with these cravings by eating something healthy, going for a walk, or breathing."
Week 5: Feel great (4 minutes, 32 seconds)	Review of imagery skills from previous files with emphasis on body image	"Imagine something that makes you feel happy and excited. Feel the happiness flow through your body and being passed along to your baby… Realize that any changes you notice in your body are natural and are helping you create a healthy home for your baby. You might be getting bigger and feeling uncomfortable with your body but see yourself being confident as these changes occur."

Table 2.

Demographic Characteristics of Participants at Baseline (n=58)

Demographic Characteristics	**Value**
Age mean (SD), years	28.5 (4.4)
Educational attainment, n (%)	
High School or Less	12 (21)
Vocational/Some College	10 (17)
Associate Degree	7 (12)
College Degree (Bachelors)	14 (24)
Post-Grad (Professional School/MS/Doctor)	15 (26)
Race/ethnicity, n (%)	
White	54 (92)
Black	1 (2)
Biracial	3 (6)
Hispanic	0
Pre-pregnancy BMI, kg/m^2 mean (SD)	27.6 (7.3)
Gestational mean (SD), weeks	18.8 (6.3)
Parity, n (%)	
Nulliparous	19 (33)
Multiparous	39 (67)

Abbreviations: BMI, body mass index; kg/m^2 kilograms divided by meters squared.

Table 3.

Participants' Responses to the Questionnaires Pre- and Post-Test (n = 46)

Questionnaire	Pre-Test Mean (SD) and Alpha (α)	Post-Test Mean (SD) and Alpha (α)	Mean Difference Mean (95% CI)	Wilcoxon's Signed Rank *P* Values
Depression, Anxiety, Stress Scale (DASS-21) - Total Scores[a]	47.50 (11.1) α = .91	43.4 (9.0) α = .87	4.14 (1.43-6.84)	<.01
Pregnancy Physical Activity Questionnaire (PPAQ) – Total Activity (MET-h·wk^{-1})[b,c]	27.70 (10.29)	31.91 (11.84)	4.21 (1.65-6.76)	<.01
Sedentary Behavior subscale of PPAQ (Minutes)[d]	27.41 (19.51)	44.04 (13.98)	16.63 (12.58-21.66)	<.01
Food Cravings Questionnaire – Trait[e]	54.1 (18.6) α = .96	52.8 (16.6) α = .92	1.30 (3.23-5.83)	.48
Body Image in Pregnancy Subscales[f]				
Preoccupation with physical appearance	3.24 (0.83) α = .91	3.02 (0.91) α = .89	0.22 (0.09-0.53)	.16
Dissatisfaction with strength-related aspects of one's body	3.28 (0.67) α = .72	3.11 (0.61) α = .83	0.17 (−0.09-0.43)	.19
Dissatisfaction with complexion	2.82 (0.93) α = .83	2.50 (0.72) α = .77	0.32 (0.05-0.88)	<.05
Sexual attractiveness	3.38 (1.04) α = .15	2.98 (0.56) .48	0.40 (0.08-0.72)	<.01
Prioritization of appearance over function	3.13 (0.77) α = .83	3.74 (0.70) α = .83	−0.61 (−0.94-0.28)	<.01
Appearance related behavioral avoidance	1.42 (0.53) .84	1.40 (0.61) α = .79	0.02 (−0.19-0.23)	.82
Dissatisfaction with body parts	2.66 (0.67) α = .81	2.90 (0.57) α = .63	−0.24 (−0.41-.09)	<.01
Imagery logic[g]	7.42 (1.50)	8.16 (1.38)	−.73 (1.11-.36)	<.01

[a]Overall DASS-21 scores range from 0 to 66 with higher scores indicating poorer mental health.

[b]The range of PPAQ scores for MET-h·week^{-1} range from 0 to 19.7 as low activity, moderate activity would range from 22.2 to 25.2, while high activity would be 34.5 or greater.[20]

[c]Estimate of internal consistency (alpha) are not reported on the PPAQ for reasons beyond the scope of this short report.

[d]Sedentary behavior scores on PPAQ range from 0 to 10,800 minutes per week with greater minutes being higher levels of sedentary behavior.

[e]FCQ-T scores range from from 21 to 126 with higher scores indicating greater trait food cravings.

[f] Scores on all subscales of the BIPS range from 1 to 5. Higher scores on all measures, except sexual attractiveness, indicate greater body disturbance on that subscale. Higher scores on the sexual attractiveness scale indicate more positive feelings about the respondent's perceived sexual attractiveness.

[g] Imagery logic scores range from 1 to 10 with higher scores indicating more positive views about the use of imagery during pregnancy.