Study Protocol and Statistical Analysis Plan

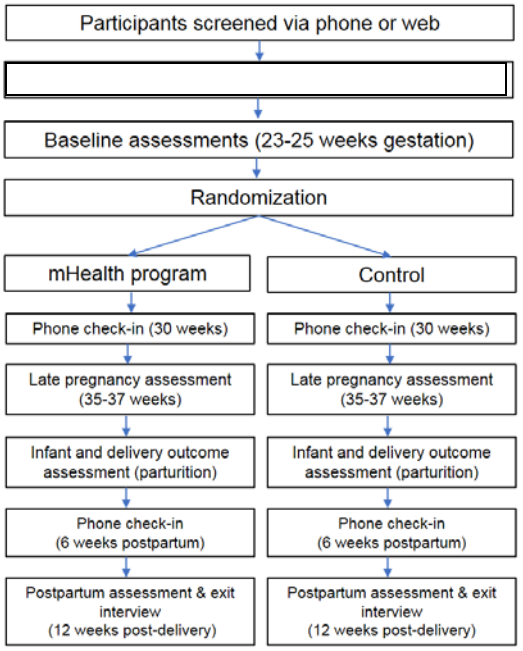
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STUDY PROTOCOL

Participants: The majority of participants (N=30) will be recruited from a rural healthcare clinic ~20 weeks gestation (See letter of support, Graves Gilbert Clinic). Additional recruitment will occur through word-of-mouth, an annual expectant parent fair though the Medical Center, Bowling Green, KY, and local advertising in an attempt to recruit a diverse and representative group of women. *Inclusion criteria include:* 1) Age 18-44; 2) Confirmed singleton viable pregnancy; 3) English-Speaking (the app is currently only available in English); 4) Physician release to participate in exercise; 5) Ownership of a smart phone; and 6) Plans to deliver at The Medical Center in Bowling Green, KY. *Exclusion criteria include:* 1) Multiple gestation pregnancy; 2) Inability to provide voluntary informed consent; 3) Any medical condition (pregnancy-related or not) that would preclude exercise.

Figure 1. Study Design



Study Design: An overview of the study design is provided in Figure 3. After contact is established and eligibility confirmed, Participants (N=30), data will be collected electronically at multiple timepoints. The first will be baseline (~23-25 weeks pregnant), late pregnancy (35-37 weeks pregnant), and ~12 weeks postpartum. There will also be two check-ins via telephone (one during pregnancy and one during postpartum upon medical clearance at ~6 weeks) to aid with retention, as well as allow participants to ask any questions about the app or the educational brochure. At each time point, the study procedures will be identical and follow the assessment procedures outlined below. Time points were chosen as women tend to become the least active during late pregnancy; and transitioning back into activity during the early postpartum days is important for long-term sustained activity. After the baseline assessment (~23-25 weeks gestation), the women will be randomized to the intervention or control group. The control group will receive an evidence-based educational brochure about physical activity during pregnancy. The intervention group will receive free access to the mobile app developed by our team (*BumptUp*). *BumptUp* users will watch an introductory video on the app's features and the goal of the app (i.e. to reach the recommended 150 minutes per week of physical activity). The app contains evidence-based workout information and education as well as a number of resources aimed at increasing physical activity for women during and after pregnancy (key features of the app are located in Table 1). Adherence will be assessed via how many weeks they used the app and met the 150min/week activity goal (PI will have access these data).

When a participant completes all study procedures, a final satisfaction survey and exit interview will take place to determine acceptability of the protocol and participant burden. App satisfaction will be assessed in the intervention group only via a survey adapted by our team. If a participant drops out before completing the study, all attempts will be made to conduct the exit interview and to determine the reason for drop out. Exit interviews will be recorded, transcribed, and coded for themes via standard qualitative analyses.

Assessment Procedures:

Data Collected at each timepoint: To assess the primary outcome of physical activity, participants will wear an Actigraph wGT3X-BT Accelerometer (ActiGraph LLC,) on their wrist for seven consecutive days at each time point. Monitoring physical activity for one week at multiple time points is standard in exercise research. Wrist-worn tri-axel accelerometers are a valid measure of physical activity in pregnant women. Data will be collected at 30Hz. The accelerometer output will be sampled by a 12-bit analog-to-digital converter. Categories of activity will be determined using the following cut points: Sedentary (0-99 counts/minute), light (100-1951 counts/min), moderate (1952-5724 counts/minute), and vigorous (≥5725 counts/min. The percentage of time spent sedentary, as well as the amount of time spent participating in different categories of physical activity, will be calculated. Physical activity will also be assessed subjectively using the Exercise Vital Sign survey—a survey designed to determine whether someone meets 150 minutes of physical activity per week (i.e. meets the recommendations from the ACOG). Self-efficacy for exercise is an important step towards eliciting changes in behavior[68], and this is especially true among pregnant women. Therefore, the Self-Efficacy for Physical Activity Survey will also be given.

In addition to physical activity, a number of other secondary outcomes will be examined, as physical activity is known to have a wide array of health benefits on the mother[4]. Medical data will be collected on weight status, glucose tolerance, and blood pressure, as all of these are affected by physical activity during pregnancy. In addition, obstetric outcomes, such as mode of delivery, will be collected. Team members (Dr. Maire Blankenship and Dr. Leigh Lindsey) will review all relevant medical data directly from the Graves Gilbert Clinic and Women's Health Specialist's electronic medical record systems.

In addition to medical outcomes, it is important to assess mental health status among new and expectant mothers, as depression and anxiety play a significant role in maternal morbidity and mortality, and physical activity improves symptoms of both during and after pregnancy. We expect BumptUp® users to have better mental health outcomes than control participants. To assess mental health, electronic surveys will be distributed at each time point. These include the Edinberg Postpartum Depression Questionnaire, the Center for Epidemiological Studies Depression Scale, and the State-Trait Anxiety Inventory.

To better understand the holistic impact of the intervention, social support, pregnancy symptoms, and barriers to being active will also be assessed at each timepoint via the Social Support and Exercise Survey, the CDC Barriers to being Active Quiz, and the Pregnancy Symptoms Inventory. Because the intervention has potential to improve more than just physical activity and obstetric outcomes (e.g. the social feature could improve social support, the resources provided within the intervention may remove barriers to activity that previously existed, and use of the exercise features and education could help women better manage/alleviate pregnancy symptoms), it is important to assess all of these factors. At each time point, surveys will be administered via Research Electronic Data Capture (REDCap).

Infant and Delivery Outcome Assessment: Before being discharged from the hospital after parturition, the study team will coordinate with the mothers and their nursing team a time to assess the infant as well as collect delivery outcome data from the mother (mode of delivery, length of labor, complications, mother's end pregnancy weight). Infant measurements will include skinfolds at four sites (hip, thigh, arm, and back), length, head circumference, and abdominal circumference. In addition, infant body composition will be via measured air displacement plethysmography system (PeaPod, COSMED). Dr. Tinius has a history of successful infant data collections at the Labor and Delivery Unit at The Medical Center.

Statistical Analyses Plan:

Sample Size Determination: Sample size for this pilot study was determined based on previously performed physical activity interventions among pregnant women. The effect size (0.91) for the main outcome of physical activity was determined from looking at post-intervention physical activity data from Asci et al.[83]. With this effect size, Dr. Stromberg, Director of the Applied Statistics Lab in the Department of Statistics at the University of Kentucky (see letter of support) determined using SAS software with a type I error rate of 0.05 that a sample size of 20 per group could detect this difference with 80% power, thus our sample size of 15 per group is justified for a pilot project.

Data Analysis: Aim 1: To estimate the success and feasibility of recruitment methods, the number of people who will hear about the study via various methods (e.g. health care providers, health fairs, word-of-mouth) will be estimated. Then, the number of women who completed initial screening, the number of women who meet the eligibility criteria, the number of women who complete each of the assessments, the number of women randomized, and the number of women who adhere to the intervention will be determined. The exit interview data will be analyzed via standard content analyses for qualitative studies as previously described[84] (and recently performed by our group). *Aim 2:* Although we may not detect all between group differences because we are proposing a pilot project, appropriate statistical tests will be performed in order to examine trends, and thus, promise for effect in the larger future trial. Normality of the distribution for each variable will be tested using Kolmogorov-Smirnov tests, and non-normally distributed data will be transformed as needed. The baseline characteristics of the two groups will be compared using *t*-tests or Chi square tests. The potential effect of the intervention on study outcomes will be explored using repeated measures ANOVAs (group x time). Specifically, physical activity data between groups will be compared from pre-post intervention. All data will be entered in Redcap data management system[85]. All data analyses will be discussed with a statistician to ensure statistical rigor. Analyses will be conducted using SAS or other statistical software.