

Using Wearable Technology to Examine the Relationship between Sleep and Mental Health in Underserved Perinatal Women

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Background

Growing studies have found that perinatal distress (i.e., stress, depression and anxiety) is associated with adverse maternal and infant outcomes such as preeclampsia, gestational diabetes, preterm and low birth weight neonates, and postpartum depression (Cherak et al., 2019; Coburn et al., 2016; Hosler et al., 2011; Rabiepour et al., 2019). Additionally, perinatal distress has been linked to children' and adolescents' psychological challenges such as poor executive function, greater impulsivity and internalizing problems (Buss et al., 2011; Szelely et al., 2020; Van den Bergh et al., 2005).

Perinatal distress levels have been documented to be particularly high in low-socioeconomic (LSE) perinatal women in the U.S. Risk factors identified for LSE women include low educational attainment, past history of medical complications (e.g., diabetes, preterm births, mental health disorders), unplanned pregnancy, lack of social support, and absence of the baby's father (Chang & Schaffir, 2019; Dunkel Schetter et al., 2016; Garfield et al., 2015; Okonkwo, 2019).

Recent studies show that the levels of stress, anxiety, and depression of pregnant women significantly increased during the pandemic (e.g., Ayaz et al., 2020). Liu et al. (2021) assessed mental health symptoms in 1,123 U.S. pregnant and postpartum women May-August, 2020. Approximately 36% reported clinically significant levels of depression, 23% for generalized anxiety, and 10% for PTSD. However, the majority of the participants of this study were White (89.9%) and obtained either a bachelor's degree (30.7%) or a graduate degree (41.6% Masters; 19.8% Doctorate). Little is known about mental health needs in vulnerable pregnant and postpartum women in underserved communities in the U.S.

One significant aspect of the perinatal period is changes in sleep patterns. High nocturnal rumination and insomnia in the perinatal period have been linked with symptoms of anxiety, depression, and suicide ideation (Kalmbach et al., 2020; Okun et al., 2018). Poor maternal sleep quality has also been associated with increased risk of preterm birth and fetal growth restriction, especially in Black women (Christian et al., 2021). Many healthcare providers often assume that

a decrease in sleep quality is normative for perinatal women, leading to under-treatment of the perinatal sleep disorders that often exacerbate negative perinatal mental health outcomes (Menke et al., 2019).

A novel method of the current study is to use the Oura ring to continuously monitor perinatal physiological data during the sleep, including biological metrics: time spent in each sleep stage (light, deep, REM), heart rate, heart rate variability, breathing rate, and skin temperature. The Oura ring has been tested against a variety of other sleep monitoring technologies and has been found to be sufficiently accurate (de Zambotti et al, 2019).

Objective and Significance

The objectives of this proposed study are 1) to examine perinatal mental health needs of underserved Black American, Hispanic American, and Asian-American ; and 2) to use a wearable device to study the associations between physiological indicators of sleep and emotional distress (i.e., stress, depression and anxiety) throughout their pregnancy. The results will be used to develop a community-based intervention to mitigate and prevent postpartum depression and anxiety among perinatal women.

Methods

The community-participatory research design will be used in this proposed study. The eligible participants will include women over the age of 18, in their second or third trimester of pregnancy, without medical/pregnancy conditions that require hospitalization, and no substance use. The study procedures involve four steps: First, we will identify and build rapport with community organizations in terms of meetings with stakeholders of the community partners, understanding the needs of the communities and making a plan together, as well as recruit our participant pool through these partnerships. Second, we will administer REDCap baseline surveys measuring perinatal distress including demographic information (e.g., maternal education, age, marital status, medical and mental health history, health insurance, perinatal care access), perceived stress (Perceived Stress Scale-10: Cohen, et al., 1993), depression (Personal Health Questionnaire: Kroenke & Spitzer, 2002), and anxiety (General Anxiety Disorder-7: Spitzer et al., 2006). Third, we will distribute the wearable device to a subgroup of participants who are interested in wearing the smart ring and hold teaching sessions to instruct participants on

how to use the device. Over the following months we will monitor the data with weekly data check-ins as well as communicate with participants via texts or brief phone calls to make sure subjects will be able to adhere to the study procedure appropriately and safely. Finally, we will clean the data and conduct analyses using SPSS, Stata, and R. We will report the prevalence rates of mental health symptoms in perinatal women, and connect these rates with sleep physiological data in perinatal women. The results will inform the team to develop a community-based intervention to improve sleep and mental health among underserved pregnant women. .

Students’ Responsibilities

[Redacted] will be conducting literature review, submit IRB, establishing and maintaining community-campus collaborations, setting up study website, using social media to recruit subjects, developing REDCap recruitment and exit surveys, referring eligible at-risk participants to appropriate community mental health resources, cleaning and analyzing data, and presenting findings in professional conferences such as the UROP Symposium.

[Redacted] responsibilities will include setting up biological monitoring technology, including the Oura ring, and delivering this technology to community partners in person. They will also command the role of monitoring the Oura ring data weekly through the Oura ring dashboard, as well as checking in with participants to ensure compliance, data quality, and to manage technical difficulties and discrepancies.

Itemized Budget

Item	Budget
Incentive for mental health survey: \$10 x 150	\$1,500
OURA Ring (\$250 x 10)	\$2,500
Incentive for participation in using the ring to collect sleep physiology: \$100 x 10	\$1,000
Total	\$5,000

Requested budget: \$2,500

Timeline

Time	Outcomes
May – June 2022	Establish community-campus partnerships, assess needs of perinatal women, and involve these women in the decision-making process of creating a sleep-based intervention IRB: submit IRB
June - July 2022	Recruit 150 participants through community based partners Conduct baseline mental health and demographic surveys
August – September 2022	Deliver wearable technology to participants Teach participants how to use the wearable technology
October, 2022- February, 2023	Monitor data using weekly summarizations and check-in with participants
March - May, 2023	Clean data and conduct analysis Present the results during the UROP symposium and other professional conferences

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