Women's Perinatal and Postpartum Depression Predict Sympathetic Dominance in Infant ANS Response to Stressors over the First 6 Months of Life

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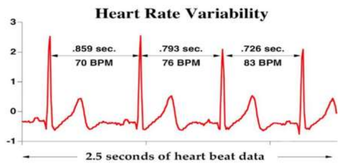
Background

Objectives

Depression affects up to 20% of all pregnant and postpartum women.[1] Children born to depressed mothers are at higher risk for socioemotional and cognitive problems. Yet, the underlying biological mechanisms that mediate the associations between maternal depression and childhood behavioral and mental health outcomes remain unclear. One potential mechanism may be dysregulation of the developing autonomic nervous system (ANS), impairing the child's ability to adapt to environmental stressors and challenges with resilient responses that maintain a healthy state of arousal. One salient measurement of ANS activity is heart rate variability (HRV) – the variation in time between each heart beat. It provides a dynamic index of parasympathetic and sympathetic activation in response to stressors. HRV measures cardiac vagal tone and is an index of self-regulation.[2]



Although the relationship between depression and HRV has been examined extensively in adults, there are few studies of the association between maternal depression and infant HRV. Of those, findings are inconclusive. Many report that maternal depression is associated with lower infant HRV, indicative of poor emotional regulation and sensitivity to stress, while others report null associations.[3-9] Furthermore, these studies included fetuses and infants from a wide age range (from 37 weeks gestation to 6 months of age), measured different HRV parameters making comparisons difficult, and did not adjust for the same confounders and covariates.

Studies utilizing HRV as a measurement often only include resting HRV (basal rate) and report only a general measure, where higher HRV is considered indicative of better ability to dynamically respond to stressors and changes in the environment. Fewer studies examine HRV frequency bands that provide more in-depth assessment of sympathetic and parasympathetic mechanisms that drive HRV or evaluate HRV in response to stressors rather than basal HRV only. To our knowledge, this study is the first to examine the effects of maternal depression during pregnancy on infant HRV at two time points (1 month and 6 months of age) as well as measure effects of prenatal and postpartum depression in our models.

Aims

This study aimed to determine how maternal depression during pregnancy and the postpartum would predict infant ANS activation both at rest and in response to a stressor at 1 month and 6 months of age.

Methods

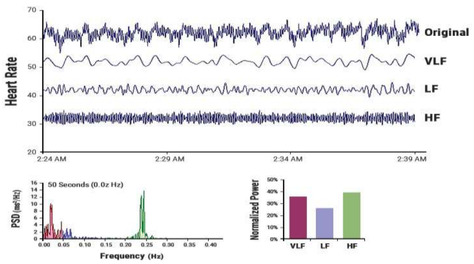
Recruitment and Participants

Mothers who were 18 years of age or older were recruited from Obstetrics and Gynecology (OBGYN) clinics in San Francisco Exclusion criteria for mothers included ongoing steroid use, history of adrenal or endocrine problems, smoking, genetic abnormalities, and cognitive impairment. Exclusion criteria for infants included postnatal steroids, genetic disorders, congenital infections, chronic lung disease, or other major neonatal illness. UCSF Institutional Review Board approved this study.

Data Collection Procedures

Mothers completed a baseline sociodemographic questionnaire and Patient Health Questionnaire-9 (PHQ-9) after consenting to participate. Home visits were made at 1 and 6 months infant age. At these times, mothers completed the Patient Health Questionnaire-9 (PHQ-9), and an ECG of the infant was acquired.

- Stressor protocols were used to elicit stress reactivity. These included developmentally appropriate, validated stressors: a 'handling' protocol at 1 month of age and the 'still-face paradigm' at 6 months of age. An electrocardiogram (ECG) was acquired continuously during the baseline, stressor, and recovery periods of the protocols using Mindware's mobile technology system.
- Mindware's HRV software was employed for Fast Fourier Transformation to separate HRV into various frequency bands for analysis, including very low frequency (VLF), low frequency (LF), high frequency (HF), and the LF/HF ratio. These are established measures of HRV that have been linked to different branches of ANS activity.



Data Analysis

- Latent growth models were computed to examine effects of maternal depression during pregnancy and the postpartum on infant HRV frequency bands at 1 and 6 months of age.

Results

202 mother-infant pairs participated in this study. 29% of women were Hispanic/Latina, 20% were African-American and 16% were Asian-American, with the remainder of European-American or mixed race. Mean age was 33.7, with a range from 19 to 47. 25% of the women had a high school education or less while 50% were college graduates. 59% were receiving some form of government assistance, with 39% requiring multiple forms of assistance. Infants were 47% boys and 53% girls. Their gestational age ranged from 27 to 43 weeks, with an average of 36.73 (2.87). During pregnancy, 19% of the women met the threshold for clinical depression, with 8% having severe symptoms. At 6 months postpartum, 14% of the women remained above the threshold for depression, with 6% reporting severe symptoms. Table 1 shows the characteristics for infants in this study.

Pregnancy depression predicted lower baseline or tonic HRV in the VLF bandwidth (-0.269, p=0.047) as well as a higher LF/HF ratio in reactivity to the stressor (0.442, p=0.039) (Table 1). Maternal depression at 6 months was associated with lower HF HRV in infant reactivity to the stressor (-0.076, p=0.036) (Table 2). There were no effects of maternal depression at either time point on the LF HRV frequency band.

Table 1. Results of Growth Models for Effects of Pregnancy Depression on Different Infant HRV Measures at 1 and 6 Months of Age

Measure	Estimate	Standard Error	p-value
Basal/Resting			
VLF	**-.269**	**.135**	**.047***
LF	-.181	.171	290
HF	.039	.251	.877
LF/HF Ratio	-1.633	.892	.067
Reactivity 1 Month			
VLF	1.799	1.846	.330
LF	-.182	1.784	.919
HF	-.403	2.822	.886
LF/HF Ratio	1.822	10.793	.970
Reactivity 6 Months			
VLF	-.001	.039	.970
LF	-.035	.045	.432
HF	-.077	.053	.152
LF/HF Ratio	**.442**	**.214**	**.039***

Table 2. Results of Growth Models for Effects of Pregnancy Depression on Different Infant HRV Measures 6 Months of Age

Measure	Estimate	Standard Error	p-value
Reactivity 6 Months			
VLF	.032	.023	.171
LF	.048	.027	.074
HF	**-.076**	**.036**	**.036***
LF/HF Ratio	-.133	.145	.358

Conclusions & Implications

Findings suggest that infants exposed to maternal depression during pregnancy had a less regulated ANS at rest, evidenced by lower power in the VLF band. Lower VLF has been associated in a number of studies with high levels of inflammation and is strongly linked to all cause morbidity and mortality in adults.[10] Lower levels of HF HRV during reactivity to a stressor indicate vagal withdrawal and greater sympathetic nervous system arousal in response to stress among infants exposed to postpartum maternal depression. In previous research with adults, lower HF power in response to stressors has been correlated with depression as well.[11] Lastly, the higher 6 month LF/HF ratio associated with pregnancy depression suggests a sustained effect of exposure to depression in utero on greater sympathetic arousal of infants when reacting to a stressor at 6 months of age. Taken together, results indicate a pattern of sympathetic dominance among infants exposed to maternal depression, not only in their basal or resting state ANS activity but in their reactivity to stressors. Findings could ultimately inform early interventions with mothers and infants to modulate effects of maternal depression on the infant and develop therapies to enhance infant ANS regulation.

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