Maternal Stress and Fetal Growth: Newborn Birthweight Related to Maternal Attachment and Heart Rate Variability

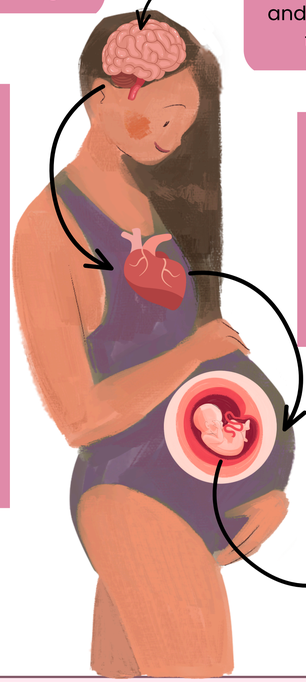
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External Factors:
Social Determinants of Health
Current Mental Health Status
Parity/Gravida
Participant Characteristics: BMI, Age

Antenatal Attachment:
A measurement of the strength and quality of attachment from the mother to the fetus[2].

Heart Rate Variability:
Heart rate measured in Root Mean Square of Successive Differences (RMSSD) which is commonly used as a metric of stress and nervous system activity. Higher HRV reflects the influence of the parasympathetic nervous system on heart rate[22,23].



Placental Transport:
Maternal stress has been linked to restricted nutrient availability due to decreased perfusion to the placenta[14,16]. This can result in reduced placental size[15] and vascularity[19].

Fetal Growth:
Placental growth restriction has been linked through histology to small for gestational age newborns[20].

01. Introduction

Maternal Antenatal Attachment (MAA), broadly defined as emotional attachment from the mother to the fetus before birth[1] and lower MAA has been linked to higher maternal stress[1,9]. Maternal stress has been associated with restricted placental development and smaller newborn birth weights[4–8,10,11]. Few studies have studied MAA as a predictor of lower infant birthweight directly, or investigated physiological biomarkers like heart rate variability (HRV), a commonly used metric of autonomic nervous system balance and stress[2,3].

02. Objective

The present study leverages data from the Biological Rhythms Before & After Your Birth Study (BioBAYB)[12]. cohort to examine whether stronger antenatal attachment is associated with a change in heart rate variability throughout pregnancy, and whether this relationship is associated with birth weight.

03. Methods

Table 1:

Design: Prospective Observational Study
Participants: Recruited throughout the United States through social media.
Measures: Antenatal Attachment Scale (collected monthly)
Smart Ring - Participants in the BioBAYB study[12] wore a smart ring (Oura Inc.), equipped with several infrared photoplethysmography (PPG) sensors to track over 30 features, including HRV, steps, sleep, temperature, and more. Due to the waterproof nature and long battery life of the ring, participants wore the ring for nearly 24 hours a day, allowing for continuous monitoring. This is a novel approach in respect to current literature.
Heart Rate Variability (z-score RMSSD) (continuous through device)

- Baseline for RMSSD was drawn from the 30-34 weeks of gestation range

Outcome: Percentile birth weight (manually calculated using Olson or Nicolades scales from self-reported birth weights)

- We operationalized the 20th percentile of birth weight as the smallest percentile to compare to larger birthweight babies.

04. Results

- Across the analytic sample (n= 85) RMSSD rose with increasing gestation. Mixed effects models, controlling for parity, demonstrated that for every additional week of gestation, women with newborns in the <20th percentile of birthweight had a 0.1 lower RMSSD z-score (95% CI -0.15 - -0.2, p=0.01). (Fig. 1)
- Controlling for age and economics, we additionally found that for every point increase in MAA, the change in RMSSD z-score from the 30-34 week gestational age period was 0.211 standard deviations higher (p=0.16).
- A final linear regression model controlling for parity and self-reported income revealed that higher birthweight was related to both being multiparous and having higher income, but also higher MAA. With every 1 point increase in attachment, the newborn had a 0.83 higher percentile birthweight (95% CI 0.14-1.52, p=0.02). (Fig. 2)

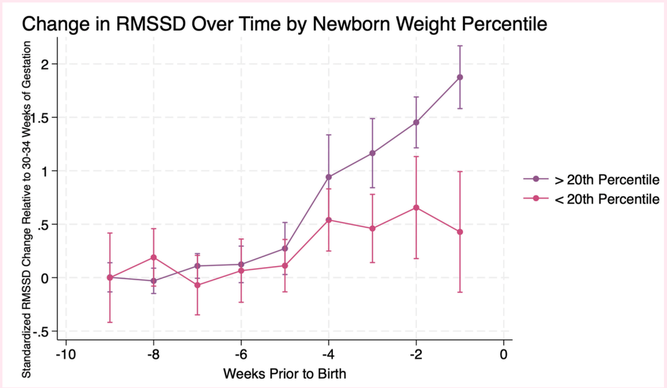


Figure 1: Participants heart rate variability across gestation increased more for those whose infants weighed greater than the 20th percentile at birth.

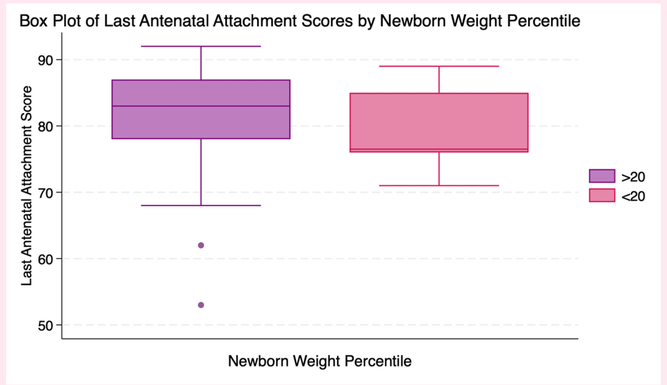


Figure 2: Participants whose infants weighed over the 20th weight percentile had a higher median last anenatal attachment score.

05. Conclusion

- RMSSD tends to increase across gestation, especially in the final weeks of pregnancy. However, in the group of women carrying a smaller-sized fetus, we observed the opposite trend with decreasing RMSSD over time and an overall relationship between MAA and newborn weight.
- These preliminary findings suggest that a lower newborn birthweight is associated with a decrease in RMSSD over gestation, and lower MAA.
- We did not observe significant changes in RMSSD related to attachment, though this may be limited by sample size.

Further investigation should include a larger and more diverse sample, physiological monitoring earlier in gestation to better view trends in RMSSD over time and consider other factors such as diet and exercise.

BioBayb 2 Study

References