



THE UNIVERSITY  
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# Testing the Associations between Prenatal Stress, Prenatal Diet Quality, and Infant Temperament at 6 Months of Age

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## Introduction

- Infant temperament:** individual differences in reactivity and self-regulation that act as early indicators of long-term behavior (Rothbart & Bates, 1998; Rothbart & Derryberry, 1981; Rothbart & Putnam, 2002; Rueda, Posner et al., 2004).
  - Negativity:** tendency to react with negative emotions to a given stimuli; used in our study
- Prenatal stress and diet during pregnancy program fetal development to influence neurological, cognitive, and behavioral outcomes in offspring (Talge et al., 2007; Lindsay et al., 2019).
- Cortisol:** the body's primary stress hormone
  - Influences the developing fetus via the placenta
  - High levels can lead to long-term health risk and/or neurological delays (Talge et al., 2007; Cardwell, 2013).
- Low-nutrient diets during pregnancy have been associated:
  - Low birth weight
  - Irregular development
  - Delayed or reduced cognitive abilities (Kennedy et al., 2019; Lindsay et al., 2019).
- The current study examined the relationships between maternal prenatal stress (measured subjectively and objectively), maternal diet quality during pregnancy, and infant temperament at six months of age.

## Participants

- Data came from the Brain and Early Experience (BEE) Study, a longitudinal study following mother-infant dyads from mid-pregnancy through childhood (N = 203) (Mills-Koonce et al., 2022).

Table 1. Descriptive Statistics of BEE Study Sample

	Mean	SD
Maternal years of education	15.42	2.48
Maternal pre-pregnancy BMI	27.35	7.16
Gestational age at prenatal visit (weeks)	29.15	4.02
Gestational weeks total (weeks)	39.25	1.11
Incomes to needs ratio	3.60	2.72
Child weight at birth (lbs)	7.55	1.03
Prenatal hair cortisol levels (pg/mg)	8.71	16.57
Maternal perceived stress	1.53	0.66
Infant age at 6-month visit (months)	7.17	1.39
Child negativity at 6-month timepoint	3.93	1.00
Healthy Eating Index	55.92	13.24

	% Black	% White
Maternal Race	35.12	64.88
	% Male	% Female
Infant Sex	49.55	50.45

Note. Maternal education is based on the United States educational system, where 1 = completed first grade and 18 = completed a master's degree.

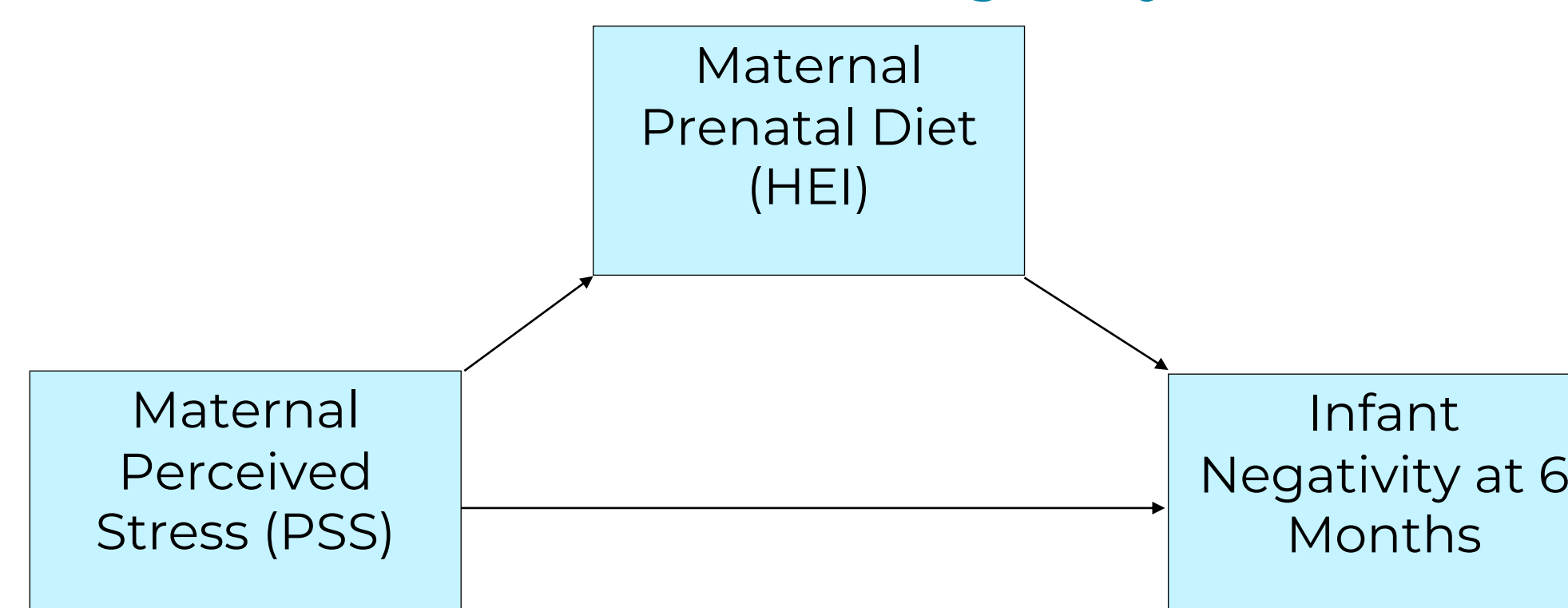
## Measures

- Subjective prenatal stress:** measured via Perceived Stress Scale (PSS; Cohen et al., 1983)
  - 10-item questionnaire assessing perceptions of general stress
  - Collected at the prenatal timepoint
- Objective prenatal stress:** measured via Hair Cortisol Concentration (HCC) in pg/mg
  - Hair samples collected from mothers at the prenatal timepoint
- Prenatal diet quality:** measured via Healthy Eating Index (HEI)
  - 24-h dietary recalls using the Nutrition Data System for Research (NDSR)
  - Collected following the prenatal timepoint
- Infant negative temperament:** measured via the negativity subscale of the Infant Behavior Questionnaire-Very Short Form (IBQ-VSF; Putnam & Rothbart, 2006)
  - 37-item questionnaire assessing infant behavior and reactivity qualities
  - Collected at 6-month timepoint

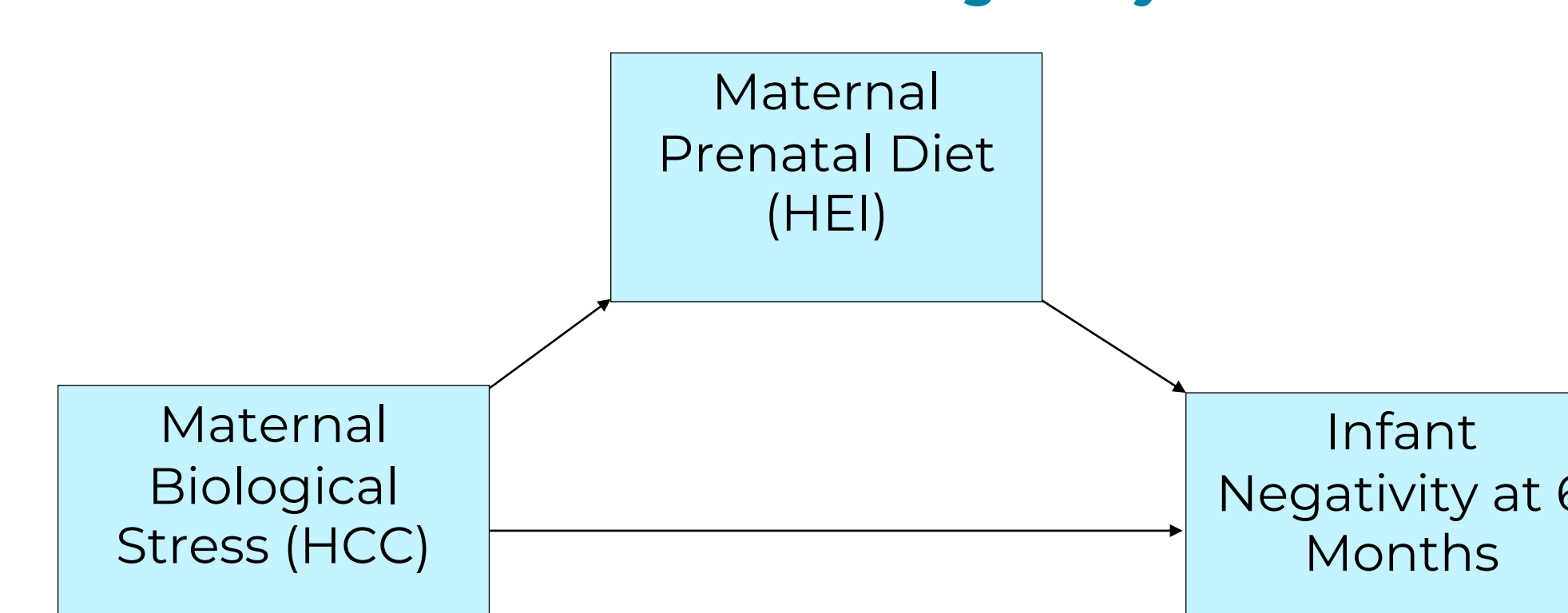
## Statistical Analyses

- Statistical analyses were run in SPSS version 27
- Bivariate correlations were used to examine the association between subjective and objective measures of prenatal stress
- Linear regressions were used to examine the direct associations between prenatal stress measures, prenatal diet quality, and infant negativity at the 6-month timepoint

### Model 1: Mediation Effects of HEI on the Relationship of PSS and Infant Negativity



### Model 2: Mediation Effects of HEI on the Relationship of HCC and Infant Negativity



## Results

- PSS and HCC were not significantly correlated ( $r = .02, p = .10$ )
- PSS and HEI were negatively correlated ( $r = -.17, p < .05$ ).

Table 2

Associations between all study variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. GA weeks	-												
2. Race	.04	-											
3. I2N Ratio	-.04	-.33***	-										
4. PC Ed	.01	-.39***	.60***	-									
5. PC BMI	-.08	.26***	-.21**	-.21**	-								
6. PC HCC	-.02	.09	-.06	-.13	.13	-							
7. PSS	.07	.10	-.15*	-.22**	.02	.02	-						
8. GA weeks birth	-.09	-.05	.11	.04	.03	.03	-.13*	-					
9. Child sex	.09	.08	-.01	-.04	-.03	-.11	-.04	-.08	-				
10. Birth weight	-.10	-.12*	-.08	-.15*	-.16*	.11	.01	.39***	-.19**	-			
11. TC age 6mo	.15*	.17*	.01	-.15*	-.04	.21*	.12	.03	-.14*	.02	-		
12. Negativity	.07	.11	-.04	-.15	.07	.10	-.05	-.10	-.13	-.08	.28**	-	
13. HEI	.07	-.26**	.31***	.39***	-.16*	-.01	-.17*	.01	-.03	-.03	.12	-.05	-

Note. \* $p < .10$ , \*\* $p < .05$ , \*\*\* $p < .01$ , \*\*\*\* $p < .001$

Ns range from 123 to 195

GA weeks = gestational weeks at prenatal timepoint; I2N Ratio = incomes-to-needs ratio, as provided by the questionnaire of the same name; PC Ed = parental education in years; PC BMI = maternal body mass index prior to pregnancy; PC HCC = maternal hair cortisol concentration, in pg/mg; PSS = maternal perceived stress as given by the perceived stress scale; GA weeks birth = gestational weeks at child birth; TC age 6mo = age of child at 6-month timepoint; HEI = healthy eating index score

- Direct effect of prenatal stress on infant negativity**
  - Prenatal perceived stress was not significantly associated with infant negativity at 6-months ( $\beta = -.17, p = .333$ ).
  - Prenatal HCC was not significantly associated with infant negativity at 6-months ( $\beta = .00, p = .868$ ).
- Direct effect of prenatal diet quality on infant negativity**
  - Prenatal diet quality was not significantly associated with infant negativity at 6-months ( $\beta = -.00, p = .657$ ).
- Diet effect of prenatal stress on prenatal diet quality.**
  - Prenatal perceived stress was not significantly associated with prenatal diet quality ( $\beta = -1.00, p = .597$ ).
  - Prenatal HCC was not significantly associated with prenatal diet quality ( $\beta = .00, p = .800$ ).

## Limitations

- Study is largely white, educated, earning above the poverty line, generally low-risk
- Results of HCC may be skewed due to low participation among Black, Indigenous, People of Color (BIPOC) individuals
  - Low participation as a result of hair types and hair styles being difficult to cut
- Measure of infant negativity may be biased because it is based on maternal reports
  - Implicit biases associated with child sex
    - Males tend to be labeled as more difficult (Parade & Leerkes, 2008)
  - Parents perception of their child's behavior

## Discussion and Future Directions

- Subjective and objective measures of prenatal stress not correlated**
  - Pregnancy changes the body's reactivity to stress by lowering cortisol levels
  - HCC may be more indicative of long-term rather than short-term stress
  - PSS has been shown to have potential flaws in that it is unidimensional
- Effects of prenatal stress on infant negativity**
  - There may be trimester-specific effects of prenatal stress
    - Our sample ranged from 21.57-39.00 gestation weeks at prenatal timepoint
  - Parenting styles/types may influence infant negativity
- Effect of prenatal diet quality on infant negativity**
  - Use of self-reported diet methods may introduce bias
  - Postnatal factors, such as breastfeeding or other parenting decisions, may have unexamined effects
- Effect of prenatal stress on prenatal diet quality**
  - Generally low-risk sample was used
- Future studies should...**
  - Incorporate wider diversity of race, education levels, and SES
  - Aim to investigate higher risk samples to determine potential effects
  - Ensure use of most accurate, inclusive measures
  - Consider for external factors and bias

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