Infant developmental outcomes post Hurricane Harvey: prenatal maternal stress on childhood development at 6 months old

Emmanuel Oketunmbi Jr, Maiah Jackson, Oluwashina Ojo, Rebecca Lipschutz, Guillaume Elgbeili, Brian Biekman, David Laplante, Suzanne King, Johanna Bick

University of Houston, Houston, TX

Introduction

Research has shown that increased prenatal maternal stress levels can affect a wide range of infant health, cognitive, and neurodevelopmental outcomes. Previous research has found that higher prenatal maternal stress and negative appraisal of a stressful event was associated with poorer infant motor development at 6 months of age, especially when stress exposure occurred later in pregnancy (Simcock et al., 2016, 2017, in press). Additionally, maternal subjective stress had a differential impact on infant sex, such that at high levels of stress, boys scored higher than girls for problem-solving skills (Simcock et al., 2017). However, other results showed that young girls improved fine motor skills over time while that of boys did not change (Simcock et al., 2018). Overall, different aspects of prenatal stress and maternal experiences affect children's development, thus further research is needed to better understand these effects. Natural disasters such as the Queensland Floods (Simcock et al., 2016, 2017, 2018, in press) or Hurricane Harvey, provide unique opportunities to study the effects of prenatal stress as a "natural experiment" on infant outcomes.

Present Study

This study examines the effects of prenatal stress on infant developmental outcomes at 6 months. We hypothesized that exposure to prenatal stress would predict worse developmental outcomes for children. Based on prior studies, we also expect to see associations with timing of exposure, child sex, and cognitive appraisal.

Methods

This is a cohort study of mothers (N= 671) exposed to Hurricane Harvey prenatally or within one year of conception. Mothers completed questionnaires assessing demographic data, objective exposure to Hurricane Harvey, subjective at baseline and infant development at 6 months postpartum. Hierarchical multiple regression was used for analyses.

Measures

Infant neurodevelopment was assessed with the Ages and Stages Questionnaire – III, a parent completed the screening tool assessed at 6-months postpartum. Subscales include communication, gross motor, fine motor, personal-social and problem solving.

HOSS: Prenatal stress was assessed using the Harvey Objective Stress Scale (HOSS) to measure mother's exposure to Hurricane Harvey in terms of threat, loss, scope and change. This measure was adapted from a previously used scale, Iowa Flood 100 scale.

Subjective Stress: A Composite Scale of Mother's Subjective Stress (COSMOSS) was calculated using principal component analysis (PCA) on three traumatic stress measures, Impact of Event Scale- Revised (IES-R), Peritraumatic Distress Inventory (PDI) and Peritraumatic Dissociative Experiences Questionnaires (PDEQ) total scores. The COSMOSS variable was standardized to a mean of 0, so that a positive score indicates levels of subjective stress that is above the mean.

Cognitive Appraisal: Cognitive appraisal was measured with a single item: "If you think about all the consequences of Hurricane Harvey on you and your household, would you say the hurricane has been..?" Answers were scaled on a 5-point Likert scale from Very Negative (-2) to Very Positive (+2).

Timing of flood exposure: was calculated as the number of days between estimated conception date and the peak of the hurricane. Estimated conception date was calculated by subtracting 280 days (40 weeks) from each woman's due date (based on infant gestational age and date at delivery).

Maternal and infant covariates: Maternal education, income, ethnicity as well as infant sex and birthweight.

Table 1. Sample Demographics

| Variable	N (%) N = 671
Maternal Education	
Highschool/ GED	45 (6.7%)
Some college / Associates	182 (7.1)
Bachelors	59 (8.6)
Graduate Degree	82 (7.1)
Family Income	
Less than $25,000	88 (13.2)
25-50,000	114 (17)
50-75,000	115 (17.1)
75-100,000	118 (17.6)
100,000+	232 (34.5)
Maternal Age, M(SD)	31.25 (4.7)
Maternal Race	
White	513 (76.5)
Black	75 (11.2)
Other/Mixed	80 (11.9)
Hispanic	169 (25.2)
Trimester Exposed	
Pre-conception	17 (2.5)
1st	159 (23.7)
2nd	171 (25.5)
3rd	314 (46.8)
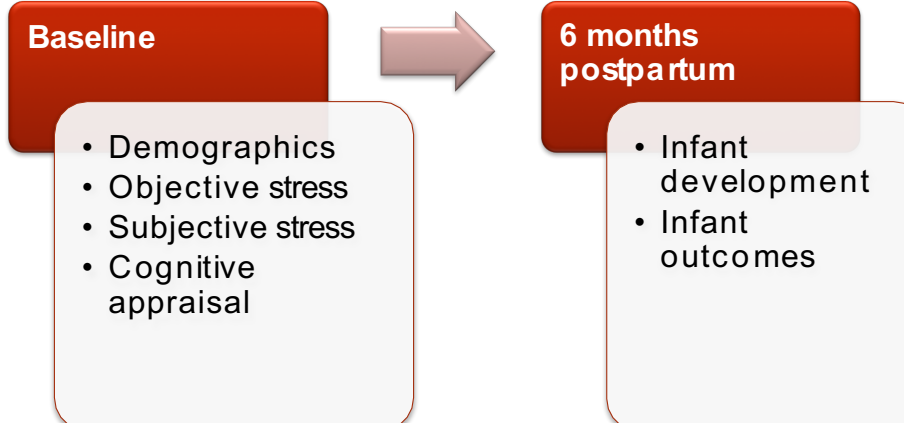
Figure 1. Timeline of assessment

Results

Table 2. Summary of Hierarchical Regression Analysis for Variables Predicting Infant Negative Affect.

Variable	Communication B	SE B	β	Gross Motor B	SE B	β	Fine Motor B	SE B	β	Personal Relationship B	SE B	β	Problem Solving B	SE B	β
Cog Appraisal	-0.04	0.47	0.00	0.81	0.57	0.06	0.64	0.61	0.04	0.30	0.55	0.01	1.11	0.52	0.09
Subj Stress	0.42	0.43	0.04	-0.24	0.53	-0.02	0.27	0.56	0.02	0.08	0.50	-0.01	0.21*	0.48	0.02
Obj Stress	0.13	0.19	0.03	0.04	0.23	0.01	0.10	0.25	0.02	-0.04	0.22	0.13	0.19	0.21	0.04
Infant sex	0.73	0.73	0.04	1.63	0.90	0.07	2.27**	0.95	0.09	2.82***	0.84	0.13	2.75***	0.81	0.13
Mat Education	-0.06	0.29	-0.01	-0.01	0.36	0.00	0.57	0.37	0.06	1.02***	0.33	0.02	0.72*	0.32	0.09
Exposure timing	0.00	0.00	0.05	0.00	0.01	-0.04	0.00	0.01	0.00	0.00	0.01	0.25	0.00	0.00	0.00
Infant age	1.80***	0.28	0.27	3.12***	0.34	0.38	3.20***	0.37	0.36	1.93***	0.33	0.17	2.14***	0.31	0.29
Birthweight	0.03	0.02	0.06	0.07***	0.02	0.12	0.11***	0.02	0.16	0.09***	0.02	0.25	0.06***	0.02	0.11
R²	.100***			.157***			0.174***			.133***			.133***		
F for change in R²	12.2***			21.1***			23.8***			17.2***			16.7***		

*p < .05, **p < .01, ***p < .001.

Communication
- The full model explained 10.0% of the variance at 6 months old, however subjective and objective stress exposure were not significant predictors. Increased age predicted better communication development at 6 months old.

Gross Motor Skills
- The full model explained 15.7% of the variance. Increased age and birthweight predicted better gross motor skills at 6 months old.

Fine Motor Skills
- The full model explained 17.4% of the variance. Increased age and birthweight predicted better fine motor skills at 6 months old. Additionally, females scored higher on the gross motor scale on average compared to males.

Personal Relationship
- The full model explained 13.3% of the variance. Higher birthweight, child age, and maternal education were associated with higher scores on the personal relationship scale at 6 months old. Additionally, females scored higher on the personal relationship scale on average compared to males.

Problem Solving Skills
- The full model explained 13.3% of the variance. Higher birthweight, child age, mothers having higher education, and female sex all related to higher scores for 6-month-old infants in Problem Solving. Negative cognitive appraisal of the storm, or mothers who reported the consequences of Harvey as negative, was associated with worse problem-solving development at 6 months old.

Discussion & Future Directions

Our findings did not support the hypothesis or previous findings that exposure to prenatal stress, such as a natural disaster, impacted child development at 6 months old. Specifically, maternal socioeconomic status was associated with children's abilities to solve problems, seek help, and interact with others. This is consistent with prior research that has found poverty as a risk factor for brain development and cognitive functioning in young children (Lee & Jackson, 2017). Further, these results suggest that mother's appraisal of the stressful event is important in predicting infant outcomes. This work emphasizes the importance of examining maternal stress during pregnancy to understand developmental risks in early childhood.

References

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