Prenatal Maternal Psychological Distress Predicts Fetal Developmental Trajectories

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Background: Accumulating evidence suggests that experiences during fetal life are associated with neurobehavioral development across the lifespan (O'Donnell & Meaney, 2017). Studies have linked prenatal maternal psychological distress with offspring brain structure and function into adolescence and adulthood (Mennes et al., 2019; Sandman et al., 2015). A major advantage to studying neurological development *in utero* is that the potential effects of maternal psychological distress can be examined prior to postpartum influences. Fetal heart rate (FHR) is an established index of central and autonomic nervous system maturation which demonstrates continuity with infant neurobehavior and prediction to postnatal developmental outcomes (Kinsella & Monk, 2012). FHR parameters (mean, variability) show consistent developmental patterns over gestation. Few studies have examined whether prenatal maternal psychological distress predicts deviations from these normative patterns (Doyle et al., 2015).
Objective: This study examined associations between maternal prenatal psychological distress and trajectories of FHR mean (FHRM) and FHR variability (FHRV) from mid to late gestation.
Design/Methods: The sample consisted of 182 maternal-fetal pairs participating in a prospective, longitudinal study. Women reported on their symptoms of depression (CESD-SF: Santor & Coyne, 1997), anxiety (STAI: Spielberger & Reheiser, 2009), pregnancy-specific anxiety (Rini et al., 1999), and perceived stress (PSS; Cohen & Williamson, 1988) at 15, 19, and 25 weeks' gestation. A maternal psychological distress composite was created by standardizing and averaging these measures. FHR monitoring was conducted at 25, 31, and 37 weeks' gestation using a Toitu MT-430 ultrasound fetal monitor, and FHRM and FHRV (standard deviation) were calculated over a 3-minute rest period.
Results: Linear mixed effects models indicated that FHRM decreased and FHRV increased over gestation, as expected. Maternal psychological distress predicted differences in trajectories of FHRM. Specifically, higher maternal psychological distress was associated with a less steep decrease in FHRM with advancing gestation (estimate = 0.16, SE = 0.09, p = .07). By 37 weeks' gestation, higher maternal psychological distress was associated with higher FHRM (estimate = 1.53, SE = 0.70, p = .03; see Figure 1). These associations were not explained by demographic (fetal sex, maternal age, maternal race/ethnicity, socioeconomic status) or pregnancy-related (obstetric risk, gestational age at birth) factors. Maternal psychological distress was not associated with trajectories of FHRSD.
Conclusions: Our *in utero* investigation represents a robust test of the potential programming effects of prenatal maternal psychological distress. Findings indicate that maternal prenatal psychological distress is associated with altered fetal neurological maturation. Future studies could examine whether deviations in fetal developmental trajectories have implications for lifelong neurobehavioral development and disease risk.

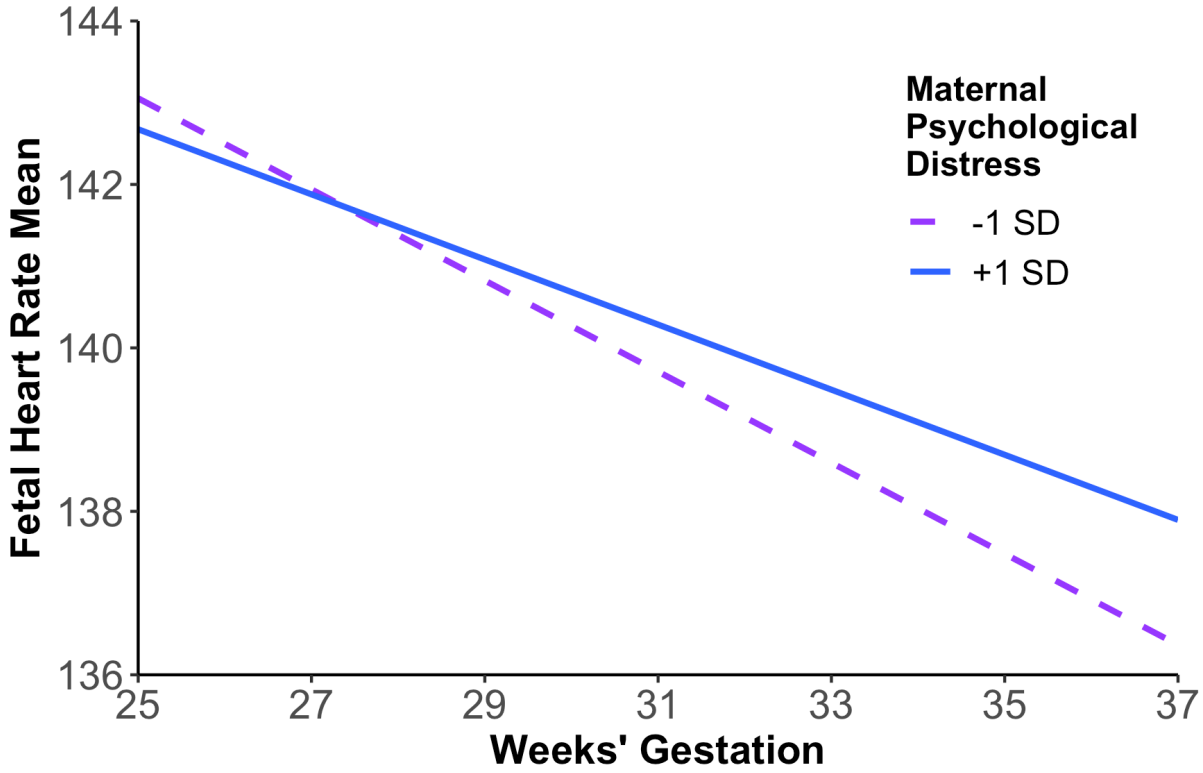

Figure 1. Results from a linear mixed-effects model with maternal psychological distress as a predictor of fetal heart rate mean trajectories over gestation. Maternal psychological distress was included as a continuous variable in the model but is presented dichotomously here for illustrative purposes.