Does maternal psychological stress harm the developing fetus?

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“For behold, the moment that the sound of thy greeting came to my ears, the babe in my womb leapt for joy.” Luke 1:44

“When a pregnant woman falls, the baby in the womb answers” West African Proverb

“He’s not right. It was grief that caused the boy to be like he is. Wavey was carrying him when Sevenseas Hector went over. Lost her husband”. The Shipping News (1993), A. Proulx

The maternal-fetal interface
Challenges of linking developmental outcomes to prenatal, biological effects on the developing brain:

Development is difficult to measure
- Maternal report of child temperament, development, behavior, etc. is not a suitable method in studies on this topic

Psychological stress is difficult to measure
- Paper and pencils of stress, anxiety, depression, are all highly related and difficult to distinguish from one another and from maternal personality

Animal models may provide little insight into human experience and animal models have mixed results

Challenges of linking developmental outcomes to prenatal, biological effects on the developing brain:

Inability to randomly assign
- Prenatal and postnatal risks covary
- Shared inheritance

Use of a novel design to disentangle inherited vs exposure effects

Does prenatal maternal stress cause adverse child mental health outcomes?
- 779 women using IVF: 574 related; 205 genetically unrelated
  - Child anxiety: initial association with maternal prenatal stress in unrelated pairs but disappeared when controlled for maternal postnatal anxiety
  - Child ADHD symptoms: Significant association with prenatal maternal stress only in genetically related offspring
  - Child behavioral problems: Significance of prenatal stress persisted after appropriate controls

Note: novel design promising but still relies on maternal report
Rice et al, 2010
Pregnancy is a state of natural hypercortisolism

Maternal circulating cortisol is essentially unrelated to how anxious, depressed or stressed pregnant women feel:

e.g., Wadhwa et al., (1996); Petraglia et al., (2001); Buitelaar et al., (2003); Gutteling et al., (2007); Pleuss et al., (2010), Voegtline et al (under review), etc.

When detected, associations are very small:

e.g., Sukar et al (2006); women awaiting amniocentesis. $r = .18$ plasma cortisol - anxiety
**Johns Hopkins Fetal Neurobehavioral Development Project (est. 1991)**
(DiPietro & Costigan)

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<th>Core hypotheses:</th>
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<td>a. Neurodevelopment during the fetal period indicates patency of the developing nervous system</td>
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<td>b. Individual differences that are observable during early childhood are established and measurable during the fetal period</td>
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**AIMS:**
- Document ontogeny in the human fetus
- Evaluate antenatal stability
- Predict child outcomes from fetal measurement
- Examine maternal factors that influence the fetus
- Identify maternal changes during gestation
- Examine fetal factors that influence the mother

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**Associations between MDI/PDI at age 2 and prenatal maternal anxiety (n = 94)**

*Significant positive associations persist after controlling for postnatal anxiety, stress, & depression at 6 weeks postnatal and 24 months*

DiPietro, Novak et al. (2006). *Child Dev*

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**Brainstem auditory evoked potential**
Based on the totality of the existing literature, the current evidence that maternal stress during pregnancy harms the developing human fetal brain, as reflected by disordered child development, is not compelling.

However, because maternal psychological distress adversely affects early parenting, and prenatal maternal distress predicts postnatal maternal distress, pregnancy provides a key opportunity for maternal mental health interventions, particularly given the number of provider contacts that occur in routine prenatal care.
Fetal motor response to induced maternal arousal ($n = 137$)

DiPietro et al. (2003), *Early Hum Dev*

Fetal motor response to induced maternal relaxation ($n = 100$)

DiPietro et al. (2008), *Biol Psychol*
Maternal response to evoked fetal response

- Maternal heart rate
- Maternal skin conductance

Yerkes-Dodson Law of arousal (1908)

- Optimal arousal for performance
- Performance levels: Poor, Moderate, High
- Arousal levels: Low, Moderate, High

- Maximum performance reached at optimal arousal level.