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The Effect of Maternal Diet on Fetal Outcomes

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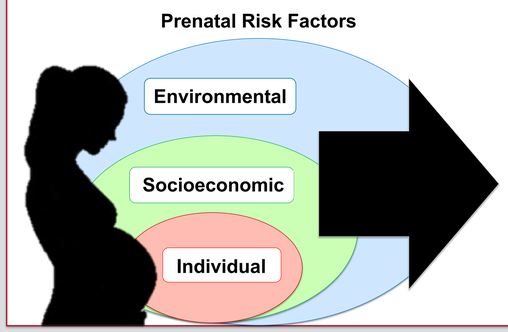
Introduction

- Maternal diet is critical for a successful pregnancy and desirable fetal health outcomes. Recent investigations reveal that dietary fats, such as omega-3 fatty acids, serve as substrates for the biosynthesis of specialized pro-resolving lipid mediators (SPM), which have anti-inflammatory and immune-stimulating effects.
- Obesity-associated inflammation in early development may have lifelong impacts on the offspring. Studies are needed to identify modifiable factors that can reduce inflammation and limit the negative consequences of obesity during pregnancy. Recent studies reveal certain omega-3 fatty acid derivatives actively attenuate and resolve pro-inflammatory processes.
- These SPMs may be key to the beneficial effects of omega-3 fatty acids. While the association between inflammation and obesity is clear, the protective mechanisms of SPMs against complicated birth in maternal-fetal health are a gap in the field.



Prolonged Labor
Miscarriage
Cesarean Section
Pre-eclampsia
Thromboembolism
Infection
Macrosomia
Prematurity
Neonatal Mortality

Current Understanding

- It is known that SPM production is dependent on intermediates of the omega-3 fatty acid metabolic pathway. However, the relationship between maternal omega-3 fatty acid intake and maternal and cord plasma SPM levels in normal weight versus obese pre-pregnancy body mass index (BMI) deliveries is unclear. In recent studies, the Anderson Berry Lab has found strikingly low intakes of omega-3 fatty acids in pregnant woman.
- Thus, understanding the therapeutic value of omega-3 fatty acid intake and the role of SPMs in maternal-fetal outcomes addresses an unmet need.
- We hope to achieve two specific aims: 1) to identify the relationship between maternal omega-3 fatty acid intake and maternal and cord plasma SPM levels in normal weight pre-pregnancy BMI and obese pre-pregnancy BMI deliveries and 2) to evaluate similarities and differences in intakes, food security, and transportation security.

In Vitro Expression of SPM Receptors

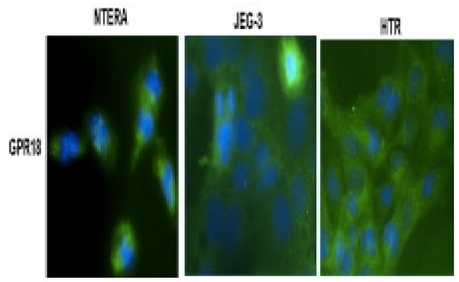


Figure 1. Preliminary Results A. GPR18 expression in placental trophoblast cells (HTR-8 and JEG-3). Cells were stained with anti-GPR-18 antibody (green) and nuclei were stained with DAP1. GPR18 expression in testicular cells (NETRA) and placental trophoblast cells were predominantly in cytoplasm. **B.** RvD1 (panel A) and RvD2 (panel B) concentrations in maternal and cord plasma at delivery. P<0.001 for both. **C.** RvD1 (panel A) and RvD2 (panel B) concentrations in maternal plasma with and without infant NICU administration. P = 0.03 for RvD1, p = 0.003 for RvD2.

Methods

Recruitment

- Over a 10-week period, the collection of informed consent, preparation of maternal and cord blood, preparation of placental tissue samples, and administration of a validated food frequency questionnaire was completed.

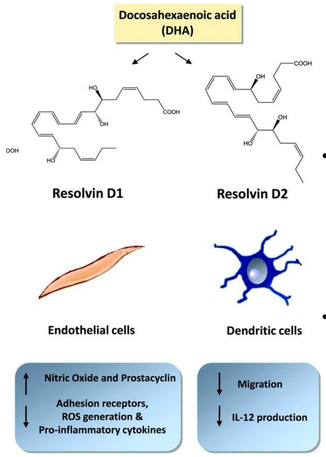
Data Collection

- Over 100 new subjects were successfully enrolled in the study. Preliminary evaluation of differences in intakes, food security, and transportation security between obese and normal weight groups was completed.

Evaluation

- Utilization of a targeted lipidomics approach to measure SPMs and determine the association between maternal omega-3 fatty acid dietary intake and maternal and cord plasma SPMs is in progress.

Future Direction



- We plan to employ a targeted lipidomics approach (liquid chromatography-tandem mass spectrometry-mediated lipid identification) to measure SPM levels and determine the association between maternal omega-3 fatty acid dietary intake and maternal and cord plasma SPM levels.
- Clinical and dietary data from 80 existing samples (40 mother-infant pairs) consisting of maternal, cord, placental, and neonatal blood and breast milk, 32% of which had a pre-pregnancy BMI >30 will be analyzed.
- Key lipids and metabolites to be characterized will include 18- HEPE, 15-HETE, RvE1, RvD1, RvD2, RVD3, RvD5, 17(R)-RvD1, Maresin-1, and protectin-D1. This technique will also allow for determination of the association between maternal and cord serum concentrations of SPMs of obese pre-pregnancy BMI delivery. Levels and associations with clinical pregnancy outcomes will be analyzed.

Conclusion

- Very little is known about the independent biological activity of dietary fats, but our findings demonstrate their possible impact on fetal outcomes.
- Further study is warranted to explore the impacts omega-3 fatty acids and SPMs have on both maternal and infant outcomes.

References

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