



Material/Fetal Programming of Vitamin D in Relationship to Childhood Obesity March 12, 2013

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Overview: The purpose of this presentation is to help you understand the research field of maternal-fetal programming, explain the implications of maternal vitamin D deficiency, and explore the relationship between maternal vitamin D status, neonatal vitamin D status, and neonatal adiposity. The national prevalence of childhood obesity is about 18%, but varies by state. The complications of childhood obesity include psychosocial issues (self-esteem, depression, eating disorders) and metabolic-related complications that affect all of the different organ systems.

Dr. Josefson's Research: what's going on in pregnancy nutrition that may be programming children to be obese in utero? Can interventions be instituted early to prevent the onset of obesity?

Fetal Programming: The environment encountered in fetal and neonatal life exerts a profound influence on physiological function and risk of disease in adult life. All maternal fuel and stress levels effect the development of the child's organs, endocrine axes, etc.

Recent research on diabetes during pregnancy (conducted at Northwestern and in the Pima Indian population) found that pregnant women with type I diabetes or gestational diabetes have children with more fat tissue at birth, and are at higher risk for obesity. The Pedersen/Freinkel Hypothesis states that if the mother has increased glucose levels during pregnancy, insulin does not cross the placenta, but elevated sugar does cross, so baby responds by making own insulin, which causes babies to become obese.

The term "fetal programming" was coined by Barker in early 90s after studying women with decreased nutrition during pregnancy. The children of these women had an increased risk of heart disease, cardiovascular disease, and metabolic syndrome.

Therefore, there appears to be a prenatal risk to babies at both ends of the spectrum: low birth weight babies with undernourished mothers have low muscle mass but increased growth of fat mass, and overnourished mothers give birth to higher weight babies that are also at risk for developing these issues – and many animal models, including embryo transfer and cross-fostering experiments, also support these hypotheses. The belief is that the fetal DNA is changed during gestation and puts children at an increased risk of developing childhood obesity

BMI vs. Adiposity: Obese babies are two to nine times more likely to become obese adults, but Body Mass Index (BMI) is not the best predictor of the correlation of adiposity in childhood because it measures both lean muscle mass and fat mass. One recent study found that there is absolutely no correlation between birth weight and weight nine years later; however, there is a correlation between percent body fat at birth and percent body fat nine years later.

Risk of Obesity: Data in the literature is lacking in whether adiposity at birth predicts obesity in childhood, adolescence, adulthood. The HAPO Follow UP Study at Northwestern University is hoping to answer all of these questions.

Vitamin D in Pregnancy: Babies are completely dependant on Mom for vitamin D because they do not produce their own in utero; therefore, levels in the baby are directly correlated to mom's levels. Adults synthesize most of their vitamin D from exposure to sunlight. Vitamin D is used to maintain calcium balance in the body, therefore a vitamin D deficiency causes weak bones, as well as hyperparathyroidism, hypertension, fatigue, and depression. Vitamin D deficiency is also associated with obesity, but scientists are not entirely sure how.

Vitamin D deficiency is common during pregnancy, especially during the winter and spring months and is associated with increased C-section rate, gestational diabetes, pre-eclampsia, low birth weight, and other health conditions (increased rates of asthma, type 1 diabetes, schizophrenia in babies). Causes of vitamin D deficiency include: darker skin and inadequate sun exposure.

Vitamin D and Obesity: People who are obese and take a vitamin D supplements do not raise vitamin D levels as much as people who were not obese. Vitamin D is fat soluble, so in obese people there might be sequestering, which is making it less available for use. Implications of this are unclear. Supplementation with vitamin D does not appear to reduce the disease burden (of obesity), but one small study showed that vitamin D supplements reduced insulin-resistance.

Obesity in pregnancy is common – about 40% of American women enter pregnancy overweight or obese; vitamin D deficiency is also common. What is the relationship between vitamin D deficiency and obesity in pregnancy?

Dr. Josefson's Study on Vitamin D and Obesity in Pregnancy: The hypothesis is that obese pregnant women transfer less vitamin D to their offspring because they sequester more vitamin D in their adipose tissue. The objective of this study is to determine the relationship between vitamin D levels in mothers and their newborns, as influenced by maternal obesity, and evaluate these associations with neonatal adiposity. The results demonstrate that babies born to obese women were slightly heavier and had a slightly higher fat percentage. Both groups of moms had similar vitamin D levels (because they were all taking a prenatal vitamin), but babies born to obese moms had significantly less vitamin D in their cord blood. This study found that maternal vitamin D, obesity, age and neonatal body fat all correlated with amount of vitamin D in cord blood. Conclusions: obese pregnant women transfer less vitamin D to their neonates than normal weight women, which is consistent with the theory of reduced bioavailability of vitamin D in obesity; therefore, obese women may need larger amounts of vitamin D for their newborns to have sufficient vitamin D levels.