The Effects of Maternal Nutrition on the Developing Fetus Later in Life

An analysis of studies and theories that have shown how poor nutrition during pregnancy can lead to metabolic and psychological conditions and suggested dietary guidance to prevent these occurrences

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Summary

In every country in the world, especially in the US, the prevalence of metabolic diseases is drastically increasing every day. Though there are more unhealthy food choices and options today, it has been suggested through new genetic research that predisposition to these conditions could have been established even before birth. In the first section, specific areas of research are looked at to find a correlation between the effects of malnutrition, the interactions between vitamins and minerals, and deficiencies on the fetus’s genetic makeup. It also shows the important features of dietary guidelines on the body and the fetus including specific complications that could occur when these guidelines are not followed. In the second section, a service project of posting questions on three pregnancy blogs and answering them to spread awareness of the effects of maternal nutrition is described. Through a collaboration of several studies, it can be determined that maternal nutrition is an extremely important determinant of whether or not a baby will develop metabolic diseases later in life. (BE)

Video Link: http://www.youtube.com/watch?v=_Doyo6zu-G8&feature=youtu.be

1. The Effects of Maternal Nutrition on the Fetus

1.1 Introduction

Everyone has heard the expression of “eating for two” in reference to pregnant women when referring to her dietary habits, but to what extent is this actually true? According to a new field of genetics called epigenetics, this expression is not only completely true but holds more importance than ever before. However, just eating enough for two is not enough to prevent all the discovered medical problems that can be created from malnutrition right from the womb. According to several studies and hypotheses that are outlined in this paper, what a mother puts
into her body can greatly determine the health of her baby later in life. This includes vitamins, minerals, and caloric intake. If food is abused or is restricted or if the mother is deficient in certain vitamins and minerals the fetus can have a multitude of problems that range from cardiovascular disease to psychological problems. The most important thing a mother can do during pregnancy is take care of her own body so that the baby can flourish later in life. By evaluating several hypothesis and theories and a further look into how maternal nutrition effects the intrauterine environment and the fetus’s development, more pregnant mothers can have the knowledge and tools to help her child be healthier at birth all the way through adulthood. Addressed first will be the important vitamins and nutrients that are vital for a healthy pregnancy. The next section addressed will be public health issue, due to lack of these vitamins and nutrients. The final section will be hypotheses and studies that have been researched in response to the public health concerns.(BE)

Section 1: Important Vitamins and Nutrients

1.1 Folate

Folate is a water soluble B vitamin that serves a variety of functions within the cell. Some of the most important functions are associated within the developing fetus. These include producing and maintaining cell division especially during a time of rapid cell growth, make DNA and RNA, make red blood cells to prevent anemia, and most widely known, to prevent neural tube defects. In this case, a woman must have an adequate amount of folate just before becoming pregnant and right after becoming pregnant. Though important throughout the whole pregnancy, the neural tube closes within twelve weeks of pregnancy and therefore needs to get the most adequate amount of folate to develop properly.

Because of the importance of folate there are many foods where folate is naturally found and also where the food is enriched to include more folate. Some of naturally found selections include green leafy vegetables, fruit, dried beans and peas. Some foods that are enriched in folate include fortified cereal, corn meal, flour, and grain products. There are also many supplements that include folate that are especially recommended during the time of trying to conceive. Though very important, the recommended dietary intake of folate is 400 micrograms (.4 mg) and the most that should be consumed during one day is 100 microgram a day (1 mg). Too much folate consumption, especially in the absence of other vitamins such as B12 can lead to diseases later in life as discussed in 1.9 labeled The FoetalInsulin Hypothesis.


1.2 Vitamin B12

Vitamin B 12 is also a water soluble vitamin that serves many functions related to folate to help the fetus develop. Some of these include cell division and formation, neurological functions, and development of the brain. Vitamin B 12 is also used for DNA synthesis. This vitamin can be found in foods such as red meat, poultry, fish, shellfish, eggs, and tofu. Because vitamin B 12 is associated with many animal products, vegetarian and vegan are the most likely
to be deficient. A severe deficiency can lead to many consequences such as neural tube defects, spontaneous miscarriages, and preterm births. To be safe, anyone who is at risk for a deficiency should take prenatal vitamins high in B12. The recommended dietary intake for this vitamin is 2.6 micrograms a day and should be followed strictly.


1.3 Calorie Intake

Because malnutrition can cause so many complications during a pregnancy, it is important to consume the correct amount of calories and make them count. Though a pregnant mother is eating for her and her baby during pregnancy, she should not consume the amount of calories equivalent to two people. Instead, only about extra 300 calories a day is needed. The complete day’s calories should come from 6-11 servings of whole grains, 2-4 servings of fruit, 4 or more servings of vegetables (especially green leafy ones for their folate), and three servings of protein. Though extra calories are needed, they should not come from desserts and sugary food. The main reason is because of the risk of developing gestational diabetes. This type of diabetes only occurs during pregnancy and is due to the high hormone level in the body unable to produce insulin as readily. When eating too many sugary substances, the body produces a lot of glucose and therefore a lot of insulin is needed. When the body cannot keep up with the insulin demand, gestational diabetes occurs. To prevent this, the diet should be of careful consideration when pregnant especially how to consume the extra calories that are needed.


1.4 Iron

Unlike folate and vitamin B 12, iron is a mineral that serves several important functions in the body. The first function is to make hemoglobin in the blood. When hemoglobin is made, it carries oxygen throughout the body. Iron is also responsible for carrying oxygen to the muscles and to reduce stress on the body. During pregnancy iron become even more important because a pregnant woman makes about 50 percent more blood than before and needs to additionally make more hemoglobin. Iron is also important for the development of the placenta and for preterm growth of the baby.

Iron is found in a large quantity in red meat. However, for the vegetarian diet, it can also be found in legumes, vegetables and grains. During pregnancy, the recommended dietary intake of iron is 27 milligrams a day. Less than this for an extended amount of time can lead to several complications in the pregnancy. Some of these include preterm delivery, low birth weight and even mortality.

Section Two: Public Health Concerns

2.1 Obesity-Correlation Between Uterine Environment and Obesity

All infants at birth have diseased risks no matter their birth-weight; it has been found that those who are born underweight have an extreme increased risk for developing obesity. Prenatal factors contribute to reasons as to why a child is born underweight who then subsequently may develop obesity. Experimental data suggests that women who are nutrient poor during the first trimester of pregnancy have children that have an increased risk of obesity and insulin resistance.

The data was collected from a study in India where the birth size of a child was obese due to the small size of the mothers. This is caused to the fact that limited nutrients in the uterus lead to fat conservation instead of other important substrates. Another example of obesity in a population is the Dutch Famine.


2.2 Insulin Resistance

As already discussed in the section of 1.9 entitled Fetal Insulin Hypothesis, babies can become insulin resistant later in life when their intrauterine environment has low B12 concentration and an adequate folate concentration. However, recent research on baboons has also shown that this is not the only situation where the fetus is predisposed to type 2 diabetes that is due to maternal nutrition. This study showed that there was a correlation between baboons that were given 30% less food and their babies being insulin resistant. This surprising result suggests that fetuses that believe it is in a starving state will adapt to this environment and will be predisposed to type 2 diabetes later in life even if they are fed correctly after they are born. The baboon study also showed that the stress level of the baboon may have something to do with the increase in insulin resistance in adolescence. This could be due to the fact that stress can lead to fluctuations in glucose and insulin levels. No matter which hypothesis is correct, the main message is that maternal nutrition does have an effect on the chance of the developing fetus become insulin resistant later in life which can lead to multiple complications such as heart and kidney failure, amputations and blindness.


2.3 Psychological Disorders
It has been made a point and understood that a nutrient poor environment has
development effects on the fetus. What has only been researched lightly is the idea of lack of
brain development due to a nutrient poor environment. One such psychological disorder has been
studied having a correlation with underdevelopment of the fetal brain. Schizophrenia was
observed in the offspring of mothers who were ill during the period of brain development in the
fetus. Animal studies have also proven that undernourished offspring have higher anxiety levels
due to correlation with low grooming habits. Low grooming habits has been explained as
offspring that received low grooming in the critical period of brain development made them
predict a dangerous environment hence they would not explore their environment. The offspring
developed in a nutrient poor environment, so anxiety and low grooming may have been seen as
the appropriate adaptive response when using PARs.


2.4 Intrauterine Growth Retardation (IUGR)

In the US alone, 5 % of infants are born with intrauterine growth retardation (IUGR). Though genetics does contribute, embryo transfer studies have shown that the receiving
mother had more of an impact on the growth of the fetus than the donor. Both types of
malnourishment cause IUGR. When undernourished during pregnancy, there are less nutrients
being transferred from the mother to the fetus. In addition, the blood flow from the placenta is
reduced. This can lead to under nutrition, low birth weight, stunted fetal growth, and IUGR. An
example of this was a study done on people who survived the Dutch winter famine. The results
of the study found that the infants born to parents who had significantly less food during the
famine had a higher rate of diabetes, vascular disease, and earlier age of death as an adult. On
the other hand, over nutrition can also have detrimental effects. Some of them include stunted
fetal growth and increased mortality. Also, over nutrition can lead a woman to not realize she is
pregnant and therefore, not pay proper attention to her diet and vitamin intake.

IUGR caused by over nutrition and malnutrition can cause many complications. In recent
research it was found that 50% of stillborn deaths not having to do with the formation of the
fetus were caused by IUGR. Even if a fetus survives, they are at higher risks of intestinal,
respiratory, neurological and circulatory complications during their time remaining in the womb.
After being born, the infant still is at risk for chronic and metabolic diseases later in life.

Guoyao Wu, Bazer FW, Cudd TA, Meininger CJ, Spencer TE. “Maternal Nutrition and Fetal Development” Journal
<http://jn.nutrition.org/content/134/9/2169.full>

Section Three: Hypotheses and Studies

Hypotheses and studies are important factors in studying epigenetics and the effects it has
on fetal health. It is important to include these in the analysis of what effects fetal health because
they are the science behind the importance of prenatal nutrition. Hypotheses and studies together
provide a more concrete foundation in the study of fetal development. Evaluation of these studies
helps to generalize what could possibly happen to a fetus during and after development. These studies and theories help to show what research has already done and what needs to be further researched in order to understand the severity that lack of prenatal care can have on a fetus. The following hypotheses and studies provide insight into the public health concerns previously listed. This section will open with an explanation of epigenetics and will be followed by several studies and hypotheses that have been researched within the field.

3.1 Epigenetics

Epigenetics are the traits that are passed from mother to child but are not the by-product of a change in the sequence of DNA. This means that the DNA sequence remains the same but rather expressivity is changed. Expressivity deals with what genes are working or not working in a person. So the DNA sequence stays the same, but epigenetic factors change which genes are turned on or off (working or non-working). DNA methylation is a process that modifies the expression of genes. It is considered an epigenetic mechanism which can be affected by environmental exposures. This means that environmental factors influence the methylation (addition of a CH3 group to the DNA sequence) of DNA. Methylation controls expressivity which means that some genes may be turned on or off depending on environmental factors. How does epigenetics affect us? Epigenetics has been connected to many types of cancers due to the over methylation of certain genes. Methylation of the tumor suppressor gene along with activation cell differentiation and proliferation can lead to cancerous cells accumulating. An example of epigenetics in the fruit fly population relates temperature affects with fruit fly eye color. In populations where the temperature was raised about 10 degrees, flies hatched with red eyes instead of white eyes. These environmental factors that affect traits are also passed down and inherited to future generations. This means if a mother has an epigenetic change it can be passed on from generation to generation.


3.2 Twin Study

Epigenetic effects are also present outside of the womb. This was discovered during twin studies where twins who had similar lifestyles and spent a great deal of time together had similar methylation patterns. Those twins who had different lifestyles and did not spend as much time together showed very different methylation patterns. This finding can begin the process of researching epigenetic effects outside the uterus. Specifically the rate of disease discordance in identical twins is significant, which means that epigenetics contributes largely to the phenotype differences in them. Recently differences in DNA methylation in twins has been examined in epigenetic studies of the dopamine receptors. Differential methylation of a dopamine receptor leads to differences in psychological aspects of schizophrenic twins.
3.3 **Mice Study**

When the body ingests certain nutrients such as vitamin B and folic acid, they can be manipulated in such a way to make methyl groups; which silence genes that can promote obesity, cardiovascular disease, and diabetes. However when these genes are un-methylated, especially during pregnancy, the fetus’s genes can become expressed and cause severe problems later in life. The gene that has been studied to prove this has been the agouti gene in mice. During several studied on mice, there has been a lot of evidence collected that show the effects diet has on fetus’s genes later in life.

When mice have methylated agouti genes, they have brown fur and are thin. They also are free of metabolic related diseases. However, when the mice have unmethylated genes, they have yellow fur, are obese, and are prone to a range of diseases from cardiovascular disease to diabetes. The researchers that noticed this occurrence decided to see what would happen if yellow fur mice that were pregnant were fed a diet high in nutrients that methylated the agouti gene. What resulted extremely impacted the debate of if nutrition during pregnancy really affected the fetus later in life. When eating a diet high in nutrients such as folic acid and B vitamins, the yellow mice that were prone to many metabolic diseases produced pups that had a brown coat and were free of these diseases. This showed that even though the yellow mice had the un- methylated genes and had many metabolic diseases, their offspring were healthier as a result of a diet high in nutrients.


3.4 **Developmental Origin of Adult Disease**

The phenomenon of the developmental origin of adult disease is associated with developmental plasticity specifically. Developmental Plasticity deals with the neural connections that form during developmental phases of growth. This development or lack thereof has been shown to be a product of the environment. The responses to these developmental issues are called Predictive Adaptive Responses (PARs). PARs are the fetus’s adaptive responses to the environment of the placenta. Therefore if there is a lack of nutrition in the placenta, the fetus will adapt to this using minimal resources which then causes a slow growth pattern. Disease risk can be assessed by the PARs, in means of if the fetus’s predicted adaptive response is appropriate for the postnatal environment, then the disease risk is increased.

Developmental Origin of Adult Disease suggests that the relationship between the actual and the predicted environment may determine disease risk. If the predicted environment does not match the actual environment, disease risk is greater. This is due to the fact that physiological
pathways have been established to work with an environment that is different than predicted. If the fetus has developed in a nutrient poor environment, it will develop in response to this environment. Along with this adjusted development, the fetus will then be ready for an environment that is also nutrient poor. If the environment is not nutrient poor, the child will then suffer medical issues. It has been proven through experiment that changes in metabolic and cardiovascular control are induced by a change in the nutrients of the uterus. Prenatal and postnatal environments have an important interaction in the development of the infant. This is due to the fact that the prenatal environment will influence responses (called PARs) to the postnatal environment.


3.5 LHT (Life History Theory)

The life history theory deals with energy distribution as a fetus’s main adaptive strategy, which entails the idea of cost and benefits of predictive adaptive responses (PARs) to the environmental nutrition of the placenta. Each fetus has a budget of energy when growing and the distribution of this energy to fit the budget is what can cause problems. This means that each fetus must decide what is important or not important in the development phase and put energy towards the decision. In nutrient poor environments, slow growth may be opted for despite the fact that it can lead to a variety of problems. Low birth weight has effects on cell growth, reproduction, immune function, metabolism and cardiovascular function. In the realm of cell growth, low birth weight has consequences such as slow postnatal growth, irregular maturational timing and short stature. Reproductively, a low birth weight can lead to reduced hormone production and an earlier age in the onset of menopause. With a low birth weight the immune system is weaker, in means of reduced cell immunity and increased infectious mortality. The long term health effects of low birth weight in metabolism and cardiovascular function include increased insulin resistance, blood pressure and cholesterol.


3.6 Fetal Insulin Hypothesis

Throughout the past decade it has been established that folate is a very important and essential vitamin during pregnancy, especially for the prevention of neural tube defects. However research also has shown that adequate amounts of folate can have surprising effects when in the presence of inadequate amounts of vitamin B 12. The result is a much higher risk of the fetus having type 2 diabetes later in life. This discovery was first made after a study was done in India because it has been found that the people of India have the highest risk of type 2 diabetes in the world. What was surprising about the Indian population, however, was that these people with diabetes were very small and thin (low BMI) but had a very high adipose tissue index. To try to find out what was going on, the Pure Maternal Nutrition Study (PMNS) was conducted on 631 Indian mothers that were pregnant. Their diets were observed and after they gave birth, their babies were looked at every 6 months and tested for diabetes and cardiovascular disease at 6 years of age.
When checking their vitamin levels, they found all the mothers had low vitamin B12 concentrations but had adequate folate levels. This was contributed to two reasons. The first was that the Indian diet is mainly vegetarian. Though this supplies a lot of folate, it lacks B12 vitamins. The other reason is that the Indian government instated a policy that all pregnant mothers must receive 60 mg of iron and 500 micrograms of folate a day. Though important, there is not any education about the importance of vitamin B12 and therefore the mother’s lacked it. What was discovered when testing the babies was that mothers that had adequate folate and low B12 had babies that had low birth weights and small frames but also had high fat concentrations. There was also a suggested correlation that high folate and vitamin B12 interactions were responsible for high insulin resistance and type 2 diabetes. If this is actually correct, it is important for pregnant mothers to not only worry about how much folate they take in, but also how much B12 they ingest as well. They should be aware that they should have no more than 1000 micrograms of folate a day. Though this study is still being followed up, the take away message is to be aware of the amounts of vitamins and minerals that needs to be consumed, especially during pregnancy and to also have a balanced diet.


3.7 Fetal Origin Hypothesis

This hypothesis deals with the idea that malnutrition during the developmental phases of the fetus can permanently affect it in a negative manner. A famous example of this hypothesis is the Dutch Famine of 1944, where fetuses in their first trimester were deeply affected by the malnutrition experienced by their mothers. The fetuses suffered lifelong issues such as diabetes, obesity and other long term illnesses. In comparison, the fetuses that were later in the pregnancies (end of second trimester), when development is basically done, were less affected by the famine. This model produces concrete evidence as to why and how malnutrition affects development of a fetus. Those who suffered malnutrition early on in the pregnancy had a five time increase in the risk of developing cancer, decreased size of pelvic bones (causing trouble during a vaginal birth).


3.8 Maternal Effects & Intergenerational Phenotypic Inertia

Not only does lack of nutrition inhibit a fetus’s growth, but other factors such as “maternal constraints” also affect the fetus. Maternal constraints vary per person and depend on the size of the woman, the number of previous pregnancies, the age of the mother and reoccurrence of miscarriages. This idea is supported by a hypothesis which states that the placental environment of a fetus is highly correlated to the placental environment of the mother when she was a fetus. This can mean that if the mother was in a nutrient-rich placental environment, her fetus will also grow in a nutrient-rich environment.
This hypothesis is related to the idea of Intergenerational Phenotypic Inertia, which states that fetal growth response to nutrition is formed partially by the fetal experiences of the women in that direct line. This means that if a phenotype, such as nutrient-rich placental environment, is maintained throughout generations the pattern will continue to future generations, allowing the past nutrient history to predict the future placental environment. This has been proven by experimental data which concluded that mice had been born underweight due to lack of nutrition gave birth to mice who were underweight. These babies then matured and they gave birth to underweight babies, proving that intergenerational conditions of the placenta and fetus lead to future similar patterns. Intergenerational Inertia occurs via epigenetic mechanisms such as DNA methylation.

In terms of PARs, it has been proven that these can also be passed down through females of the family. This was exemplified by a study in Barcelona, where offspring that were born small also had insulin resistance and a small uterus. This small uterus trait affected the next offspring’s growth due to limited growth capacity so that they also will be small in size with a small uterus. Another explanation of this deals with the eggs of the fetus. As a fetus grows, all of her eggs she will ever bear are developed with her so that she is born with them. This means that each and every one of her eggs is affected by her mother’s nutrient poor or rich uterine environment. Mitochondrial DNA is passed from one female to the next in each generation. Folate in the first trimester is extremely important to the fetus’s mitochondrial DNA.


Section 4: Service Project: Pregnancy Website Blogging

4.1 Service Project Description

(BE) Our original service project plan was to create a lecture on the importance of prenatal nutrition and present it during a pregnancy group meeting at Planned Parenthood. However, this idea got denied by Planned Parenthood. Because of our concern that there was not enough awareness among pregnant women about how their nutritional choices effects their developing child, we decided to post questions on three different website blogs to continue with the idea of raising awareness about the importance of nutrition during pregnancy.

A total of 32 questions were posted (see section 2.2 Service Project Questions section) on three different websites. These included yahooanswers.com, parenting.com, and webmd.com. After the questions were posted, we would wait a few days to see if anyone responded and then post the answers from our research to make sure the correct and most helpful answer to the question also appeared on the site. Though yahooanswers.com was encouraging about posting questions in the pregnancy section of their website, Lauren got blocked from using both
wedmd.com and parenting.com after posting several questions. Questions 1-19 are marked with
an “X” to indicate blockage. This was concerning because the information we posted could help
spread awareness to women who are or would like to get pregnant and alter their perception of
their nutritional intake. Though it was a struggle to get our message out there, surprisingly a few
people did respond to the questions posted and showed interest in our topics. Though it is
obvious that a lot more awareness attempts need to be made, hopefully our questions and
answers that are available on the internet will put a foot in the door to start spreading the
awareness needed about maternal nutrition.

4.2 Service Project Questions
(LG/BE)
X Q1: How can Epigenetics effect your unborn child?
A: Traits passed from mother to child that are the by-product of an environment (external or
uterine) are what make up Epigenetics. Epigenetics are the traits that are passed from mother to
child but are not the by-product of a change in the sequence of DNA. This means that the DNA
sequence remains the same but rather expressivity is changed. Expressivity deals with what
genes are working or not working in a person. So the DNA sequence stays the same, but
epigeneric factors change which genes are turned on or off (working or non-working). For more
human studies you can refer to The Fetal Matrix: Evolution, Development and Disease by
Gluckman.

X Q2: When does parenting begin?
A: People think that parenting begins when a child is born, but in actuality it begins at the time of
conception. Everything a mother does affect her unborn child from the diet she eats to her
everyday environment.

X Q3: Many know that once you become pregnant, you should start taking prenatal vitamins,
but why?
A: It is important to take prenatal vitamins so that during the critical period of growth, the first
trimester, the fetus has all the nutrients for proper growth and development. During this period
the child’s body begins to grow, organs begin to form and importantly the brain begins to form.
Without these vitamins and other nutrients a baby will not be able to form properly.

X Q4: What are the effects of these prenatal vitamins that are so stressed during the critical
period of development?
A: Folate and B12 deficiency specifically can lead to neural tube defects such as: Spina Bifida
(hole in the spinal cord), Anencephaly (large portion of skull or brain matter missing) and
Encephaloceles (protrusion of brain from holes in the skull).

X Q5: How can a mother’s diet affect her child’s health?
A: Obesity is very prevalent in cases where children are born underweight due to nutrient poor
diets in the first trimester of pregnancy. The long term health effects of low birth weight in
metabolism and cardiovascular function include increased insulin resistance, blood pressure and
cholesterol.
Q6: How can a mother’s prenatal care affect future generations of women?  
A: Not only does a mother’s diet affect her unborn child, but in fact, her mother’s diet can attribute to factors in her fetus as well. This is due to the fact that your child, specifically, a daughter, develops in the fetus with all her eggs. What can be concluded from this is that a mother’s uterine environment directly affects their daughter and granddaughter.

Q7: Are there other types of health issues to worry about when thinking about prenatal care?  
A: It is not only physical health issues that occur, but also mental health issues. It has been proven that poor nutrients cause a lack of brain development which can lead to psychological disorders such as Schizophrenia.

Q8: Why is prenatal care most important in the first trimester?  
A: The first trimester is the critical period where a child begins to form and structures begin to take shape. A famous example of this is the Dutch Famine of 1944, where fetuses in their first trimester were deeply affected by the malnutrition experienced by their mothers.

Q9: Is prenatal care in the second trimester more important than the first trimester?  
A: Prenatal care in general is very important, but in comparing the two the first trimester is the more important of the two. This can be proven by the Dutch Famine of 1944 where the fetuses of poor first trimester prenatal care suffered lifelong issues such as diabetes, obesity and other long term illnesses. In comparison, the fetuses that were affected later on in the pregnancies, when development is basically done, were less affected by the famine.

Q10: How can a familial history of prenatal care affect you & your child?  
A: This calls upon an important concept of Intergenerational Phenotypic Inertia, which states that fetal growth response to nutrition is formed partially by the fetal experiences of the women in that direct line. This means that if a characteristic, such as nutrient-rich placental environment, is maintained throughout generations the pattern will continue to future generations, allowing the past nutrient history to predict the future placental environment.

Q11: Are there causes of Psychological disorders that stem from the uterus?  
A: What has only been researched lightly is the idea of lack of brain development due to a nutrient poor environment. One such psychological disorder has been studied having a correlation with underdevelopment of the fetal brain. Schizophrenia was observed in the offspring of mothers who were ill during the period of brain development in the fetus.

Q12: When pregnant should you really eat for two?  
A: The theory of “eating for two” is completely false and only about an extra 300 calories a day is needed. Though extra calories are needed, they should not come from desserts and sugary food due to a risk of developing gestational diabetes.

Q13: What is gestational diabetes?  
A: It only occurs during pregnancy and is due to the high hormone levels in the body unable to produce insulin as readily. When eating high sugar foods the body produces a higher amount of glucose and therefore a higher amount of insulin is needed. Gestational Diabetes occurs when the body cannot meet the demand for insulin production.
Q14: What is IUGR?
A: IUGR also called intrauterine growth retardation is caused by under and over nutrition of a fetus. When undernourished there is a reduced blood flow from mother to fetus, causes under malnutrition in the child, low birth weight and stunted fetal growth. Over nutrition has the same severity, but can cause stunted fetal grown and increased mortality.

Q15: What future problems can a fetus have, if in an ultrasound IUGR was identified?
A: Depending on over or under nutrition, children can have higher rates of diabetes, vascular disease, and earlier age of death as an adult. Others also include intestinal, respiratory, neurological and circulatory during the remainder of their time in the womb. After being born, the infant still is at risk for chronic and metabolic diseases later in life.

Q16: If I already take Iron supplements do I need to increase my dosage when I’m pregnant?
A: The answer to that is yes. During pregnancy iron becomes even more important because a pregnant woman makes about 50 percent more blood than before and needs to additionally make more hemoglobin.

Q17: How much Iron should I take per day if I’m pregnant?
A: During pregnancy, it is recommended to have an iron intake 27 milligrams a day. Less than this for an extended amount of time can lead to several complications in the pregnancy including preterm delivery, low birth weight and even mortality.

Q18: If I don’t want to take Iron supplements where can I get Iron from in my diet?
A: For meat eaters, Iron is found in a variety of foods such as red meat, egg yolks, mollusks (clams, scallops), turkey giblets and liver. For vegetarians Iron can be found in dark leafy greens (spinach, collards), dried fruits (raisins, prunes), iron-enriched cereals and grains, beans, lentils, chick peas, soybeans and artichoke.

Q19: Since Folate is so important to prenatal care, which foods should I eat to make sure I get enough?
A: The foods richest in Folate to date are: different types of beans such as edamame, pinto beans, black beans, black-eyed peas, garbanzo beans and kidney beans. Other greens such as romaine lettuce, okra, spinach, broccoli, Brussels sprouts, collard greens, and asparagus are also high in folate. Make sure you try to incorporate these into your diet along with prenatal vitamins.

Q20: Methylated agouti mouse gene study. Is it true and why?
A: The methylated agouti mouse gene study was a study done to prove that the food we eat affects a baby's health later in life. They fed one mouse food such as foods rich in B vitamins and folate. They then gave the other mouse a diet lacking these nutrients. What occurred was that the mouse that was fed the foods high in nutrients had pups with brown fur that were skinny, and free of metabolic diseases whereas the other mouse had pups with yellow fur that had many metabolic diseases later in life.

Q21: Why are folate and vitamin B12 so important for the growing baby during pregnancy?
I've also heard that if you have enough folate and lack B12 your baby can be at higher risk of being insulin resistant later in life! This was based on the Pure Maternal Nutrition Study (PMNS) done in India. Why is this?
A: Actually the PMNS study did prove that adequate amounts of folate and inadequate B12 can cause insulin resistance later in life. This is because in India, the government gives pregnant women the amount of folate they need daily. Indian women, however, are mostly vegetarian and do not get enough vitamin B12. After observing 631 pregnant mother's diets, and their babies every 6 months after they were born, they found a strong correlation between adequate folate, inadequate B12 and insulin resistant children. In addition, it was found that India has the largest population of insulin resistant people.

But what does vitamin B12 do to the intrauterine environment that makes it so important? Some of its most important functions are DNA synthesis, neurological functions, and cell division. Though vitamin B12 is important, folate is equally important. Its functions include the obvious of preventing neural tube defects, making DNA and RNA, rapid cell division during cell growth, and making red blood cells to prevent anemia. The key to a healthy baby? Always have everything in moderation, get adequate amounts, and do not favor one over the other. All nutrients during pregnancy are equally important and serve a variety of functions!

Q23: What is the folate insulin hypothesis?
A: The folate insulin hypothesis states that adequate amount of folate and an insufficient amount of vitamin B12 during pregnancy can lead to a baby that develops type two diabetes.

Q24: How should your caloric intake change during pregnancy?
A: A pregnant woman should only eat 300 extra calories a day! These calories should not come from sweets, but instead should come from food high in vitamins and minerals that are good for the baby’s development.

Q25: What is gestational diabetes?
A: Gestational diabetes occurs in a woman during pregnancy due to a large intake of sugary foods. This is due to the fact that when women are pregnant, their hormone levels are too high for the body to produce insulin as readily. When eating too many sugary substances the body produces more glucose than the body can handle because the insulin is in short supply. When this occurs, the woman develops gestational diabetes because the body cannot keep up with the insulin demand.

Q26: How can malnutrition during pregnancy affect the baby later in life?
A: In a study done on baboons, they found that when they gave the baboons 30 percent less food, their babies became insulin resistant later in life. The study concluded that they might develop diabetes because as a fetus, they believe they are in a starving state and their body adjusts accordingly to being born into starvation. No matter how they are fed after the are born, the body has already made the adjustment in the womb and they develop diabetes later in life.

Q27: How can stress affect the fetus during pregnancy?
A: Stress can affect the fetus by predisposing it to being insulin resistant during adolescence. This could be due to fluctuation glucose levels of the mother that occur during stress.
Q 28: What are some of the complications of becoming insulin resistant?
A: Some of the complications include heat failure, kidney failure, amputations, and blindness.

Q 29: Why is iron important during pregnancy?
A: Iron is important during pregnancy because a pregnant woman needs to make 50 percent more blood than before and essentially needs to make more hemoglobin. Iron is responsible for making the hemoglobin that is needed to carry oxygen throughout the blood.

Q30: Where is iron found in the diet?
A: Iron is found mostly in red meat. However for vegetarians it can also found in products such as legumes, vegetables, and grains.

Q31: What are some of the complications of not having enough iron during pregnancy and how much should be taken during pregnancy?
A: Some of these complications include preterm delivery, low birth weight, and even mortality. The recommended dietary intake of iron during pregnancy is 27 milligrams a day.

Q32: What is IUGR and what causes it?
A: IUGR is intrauterine growth retardation. This is caused by malnutrition during pregnancy. When malnourished, the blood flow from the placenta is reduced because less nutrients are being transferred from the mother to the fetus. Over nourished mothers also can have fetuses that develop IUGR. Intrauterine growth retardation has found to cause 50 percent of stillborn births. They also are at high risks for metabolic diseases later in life.

Letters to Editors/Editorials

Lauren Giannetti
Sent to Parenting Magazine (11/16/11)

Prenatal Care: A First Step in Parenting

People think that parenting begins when a child is born, but in actuality it begins at the time of conception. Everything a mother does affects her unborn child, from her diet to her everyday environment. Many know that once you become pregnant, you should start taking prenatal vitamins, but why? What are the effects of these stressed prenatal vitamins during the critical period of development? It is important to raise awareness about how certain nutrients ultimately affect a child. Prenatal nutrition and care has been stressed by OB/GYNs for years due to the fact that proper development is very dependent on a nutrient rich uterus. The most important prenatal vitamins are Folate and B12 due to the fact that a deficiency in either of these can lead to detrimental effects on a fetus.

Folate and B12 deficiency specifically can lead to neural tube defects such as: Spina Bifida (hole in the spinal cord), Anencephaly (large portion of skull or brain matter missing) and Encephaloceles (protrusion of brain from holes in the skull). These findings have been researched through rat studies that provide models of vitamin deficiencies. Neural tube defects are not the only public health concerns that lack of nutrients causes. Obesity is very prevalent in
cases where children are born underweight due to poor nutrients in the first trimester of pregnancy. It is not only physical health issues that occur, but also mental health issues. It has been proven that poor nutrients cause a lack of brain development which can lead to psychological disorders such as Schizophrenia.

Not only does a mother’s diet affect her unborn child, but in fact, her mother’s diet can attribute to factors in her fetus as well. This is due to the fact that your child, specifically, a daughter, develops in the fetus with all her eggs. What can be concluded from this is that a mother’s uterine environment directly affects their daughter and granddaughter. So now not only are you preparing for the good health of your own child, but your grandchildren as well. A healthy diet, correct caloric intake and prenatal vitamins are all important in the development of an unborn child. It is important to take each of these factors in consideration when pregnant in order to have the healthiest baby possible.

Britney Ellis
Sent to TheHill.com in response to the article “Mississippi to Vote on Proposed Measure Declaring ‘Personhood’ of Fetus” (11/15/11)

It is claimed that a “safe” abortion is up to 20 weeks of pregnancy. However in terms of nutrition, a fetus is effected by its mother’s uterine environment starting early in the first trimester. This was illustrated during the Dutch Famine in 1944 when many pregnant women were malnourished during their first trimester. As a result, the babies born during that time had many metabolic disease issues later in life including diabetes and obesity. However, when the pregnant women were malnourished during their second trimester, their babies did not have as many metabolic issues later in life. Coincidence? It does not seem that way with the new and upcoming field in genetics called epigenetics. The research done in this field displays over and over again that the fetus is developing, especially metabolically, from the first week of contraception.

Though many people believe that a mother has to start feeding her child properly after birth, epigenetics has shown that the way a child will develop later in life has everything to do with the uterine environment that it develops in during pregnancy. If a mother eats poorly during pregnancy and does not intake the proper vitamins and minerals such as vitamin B 12 and folate, the fetus’s genetic makeup changes to adapt to a nutrient poor life style. This has shown to lead adults to develop type 2 diabetes and cardiovascular disease even though they were fed well after they were born. If this is true and a fetus’s genetic makeup is starting to determine how it will develop when it is in adulthood, is it fair to stop this development and abort them at any stage during the pregnancy?

If the fetus can determine its fate as an adult before it is even born, especially metabolically, how can we say that this fetus does not have personhood? It is already taking control of its own life! It is the same thing as killing an eleven year old child who is developing into a teenager. Their body is rapidly changing to prepare for the next stage in their life. This is the same thing the fetus is doing as early as the first trimester! Their genetic makeup is rapidly changing to prepare the fetus for the life that it is going to be born into from the information that the uterine environment is supplying. By aborting the developing fetus, we are killing something
that is making its own choices about how it will best develop in the world when it is born. By being able to make these choices and change their genetic makeup as early as the first trimester, the fetus is displaying personhood and abortion at any stage of the fetus’s development starting at contraception should be illegal.

References


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