Link between High Soy Diet during Pregnancy and Nursing and Eventual Developmental Changes in Children

Two separate studies -- one in animals and the other in humans -- that considered together suggest that a diet high in soybeans and other legumes during pregnancy and breastfeeding may have a subtle but long-term impact on the development of children.

Soybeans and other food-source plants contain compounds, called phytoestrogens or isoflavones, which have been found to produce a variety of mild hormonal actions within the human body.

Studies in recent years are confirming that the estrogenic effects of these compounds may be beneficial in preventing or treating a variety of conditions such as the unpleasant symptoms of menopause.

We are a very different creature when we are an embryo or a fetus or a child or a teenager. We're very different when we are a reproductive-age adult or an aging adult.

At each stage, we have a different profile of risk or benefit. At the beginning of the life span, when tissues in our bodies are being organized in utero and in the first months of life, there is good reason to believe -- based on animal studies and in some human observations -- that sex hormones are very important in getting things organized properly.

These hormones influence the way the brain is organized, the way the reproductive organs and cells develop, even the way immune function develops. Therefore, if mom is eating something or has in her body fat something that can act like sex hormones, it is logical to wonder if that could change the baby's development. If there is an impact, is it positive, negative or irrelevant?

To determine if unborn babies are indeed exposed to phytoestrogens, the researchers analyzed amniotic fluid samples of 54 pregnant women from the Los Angeles area. No phytoestrogens were detected in 11 samples, extremely high levels were found in seven samples, and the remaining 36 contained modest levels.

The study concluded that about 80 percent of the fetuses were exposed to estrogenic isoflavones at concentrations ranging from 20 to 180 times the levels of naturally occurring female sex hormones in the amniotic fluid of female fetuses.

The amniotic fluid samples were taken during routine amniocentesis between 16 and 20 weeks of gestation -- after a baby's organs have formed but during a critical stage of development.

The researchers used an animal model to begin to determine whether this in utero phytoestrogen exposure might affect the organizational stage of the fetus and the future development of the child. In a controlled study, they fed pregnant female rats genistein, an isoflavone that is known to have significant estrogenic properties.

The rat study was carefully designed to take into account the obvious differences that exist in the developmental and life cycles of rats and humans, and to correlate as closely as possible to the timing of the amniotic fluid sampling. The mother rats were given genistein from day 14 of gestation through post-natal day 21 when the rat pups were weaned.

Developmentally, this time period is almost exactly the same time that the human amniotic fluid samples were obtained. The major steps of formation of organs in the body occur early on, in both rats and humans. Therefore, the treatment of the rats was intentionally delayed until major organ formation had occurred.

The goal was to assess the effects of exposure on the developing organism, and this is about as close as one can get to being able to take measurable samples from humans and match them up with meaningful findings in an animal model.

According to the results, the genistein fed to the mother rats had a "masculinizing" effect on both male and female pups, based on the accepted criterion of anogenital distance -- the distance between the anus and genitals, adjusted for the animal's overall size. The lengthening of the anogenital distance strongly suggests a relative masculinization of the pups.

This may be caused by the anti-estrogenic properties of the genistein being transferred through the mother's milk to the babies or it is possible that the mom's intake of genistein changed the amount of her own steroids going into the milk. That's a little more complicated but if these compounds are reducing the amount of hormones she's producing, either from her ovaries or her adrenal glands, it could have the same effect.

Male rat pups whose mothers received genistein also experienced early onset of puberty. Normal puberty in a rat life cycle begins about two weeks after weaning. Whatever the clocks are in the brain that control the timing of puberty appear to have been advanced by a couple of days, which is highly significant in this kind of animal model. It is known that sex hormones have important organizational effects in primates in the second and third trimesters of pregnancy through the first six months of life.

Studies have shown that altered male or female hormone levels at this time of life in a rhesus macaque, for example, can change the timing of puberty in males. Concern is based on the expectation that animal models will be at least somewhat predictive of what occurs in humans. There is no reason to assume that there will be gross malformations of fetuses but there may be subtle changes, such as neurobehavioral attributes, immune function, and sex hormone levels.

The researchers are seeking a grant to track outcomes of human babies for whom exposure assessments have been made. There are many long-term health questions that come about when the little clocks in our heads are changed. There may be subtle things occurring and we don't know it. Or it could be that humans are much more resistant to these effects than are other animals, and this is not an issue.

Researchers in the Center conducted the studies presented for Women's Health and the Department of Obstetrics and Gynecology at Cedars-Sinai Medical Center, The Centre for Toxicology at the University of Calgary in Canada, and the Department of Obstetrics and Gynecology at Duke University in North Carolina. For media information and to arrange an interview, please e-mail sandy@vancommunications.com or call 1-800-396-1002.

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