Nutrient in eggs and meat may influence gene expression from infancy to adulthood

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Just as women are advised to get plenty of folic acid around the time of conception and throughout early pregnancy, new research suggests another very similar nutrient may one day deserve a spot on the obstetrician's list of recommendations.

Consuming greater amounts of choline – a nutrient found in eggs and meat – during pregnancy may lower an infant's vulnerability to stress-related illnesses, such as mental health disturbances, and chronic conditions, like hypertension, later in life.

In an early study in The FASEB Journal, nutrition scientists and obstetricians at Cornell University and the University of Rochester

Medical Center found that higher-than-normal amounts of choline in the diet during pregnancy changed epigenetic markers – modifications on our DNA that tell our genes to switch on or off, to go gangbusters or keep a low profile – in the fetus. While epigenetic markers don't change our genes, they make a permanent imprint by dictating their fate: If a gene is not expressed – turned on – it's as if it didn't exist.

The finding became particularly exciting when researchers discovered that the affected markers were those that regulated the hypothalamic-pituitary-adrenal or HPA axis, which controls virtually all hormone activity in the body, including the production of the hormone cortisol that reflects our response to stress and regulates our metabolism, among other things.

More choline in the mother's diet led to a more stable HPA axis and consequently less cortisol in the fetus. As with many aspects of our health, stability is a very good thing: Past research has shown that early exposure to high levels of cortisol, often a result of a mother's anxiety or depression, can increase a baby's lifelong risk of stress-related and metabolic disorders.

"The study is important because it shows that a relatively simple nutrient can have significant effects in prenatal life, and that these effects likely continue to have a long-lasting influence on adult life," said Eva K. Pressman, M.D., study author and director of the high-risk pregnancy program at the University of Rochester Medical Center. "While our results won't change practice at this point, the idea that maternal choline intake could essentially change fetal genetic expression into adulthood is quite novel."

Pressman, who advises pregnant women every day, says choline isn't something people think a lot about because it is already present in many things we eat and there is usually no concern of choline deficiency.

Though much more research has focused on folate – functionally very similar to choline and used to decrease the risk of neural tube defects like spina bifida – a few very compelling studies sparked her interest, including animal studies on the role of choline in mitigating fetal alcohol syndrome and changing outcomes in Down syndrome.

A long-time collaborator with researchers at Cornell, Pressman joined a team led by Marie Caudill, Ph.D., R.D., professor in the Division of Nutritional Sciences at Cornell, in studying 26 pregnant women in their third trimester who were assigned to take 480 mg per day, an amount slightly above the standard recommendation of 450 mg per day, or about double that amount, 930 mg per day. The choline was derived from the diet and from supplements and was consumed up until delivery.

The team found that higher maternal choline intake led to a greater amount of DNA methylation, a process in which methyl groups – one carbon atom linked to three hydrogen atoms – are added to our DNA. Choline is one of a handful of nutrients that provides methyl groups for this process. The addition of a single methyl group is all it takes to change an individual's epigenome.

Measurements of cord blood and samples from the placenta showed that increased choline, via the addition of methyl groups, altered epigenetic markers that govern cortisol-regulating genes. Higher choline lessened the expression of these genes, leading to 33 percent lower cortisol in the blood of babies whose mom's consumed 930 mg per day.

Study authors say the findings raise the exciting possibility that choline may be used therapeutically in cases where excess maternal stress from anxiety, depression or other prenatal conditions might make the fetal HPA axis more reactive and more likely to release greater-than-expected amounts of cortisol.

While more research is needed, Caudill says that her message to pregnant women would be to consume a diet that includes choline rich foods such as eggs, lean meat, beans and cruciferous vegetables like broccoli. For women who limit their consumption of animal products, which are richer sources of choline than plant foods, she adds that supplemental choline may be warranted as choline is generally absent in prenatal vitamin supplements.

"One day we might prescribe choline in the same way we prescribe folate to all pregnant women," notes Pressman, the James R. Woods Professor in the Department of Obstetrics and Gynecology. "It is cheap and has virtually no side effects at the doses provided in this study. In the future, we could use choline to do even more good than we are doing right now."

Provided by University of Rochester Medical Center