What you eat could alter your unborn children and grandchildren's genes and health outcomes

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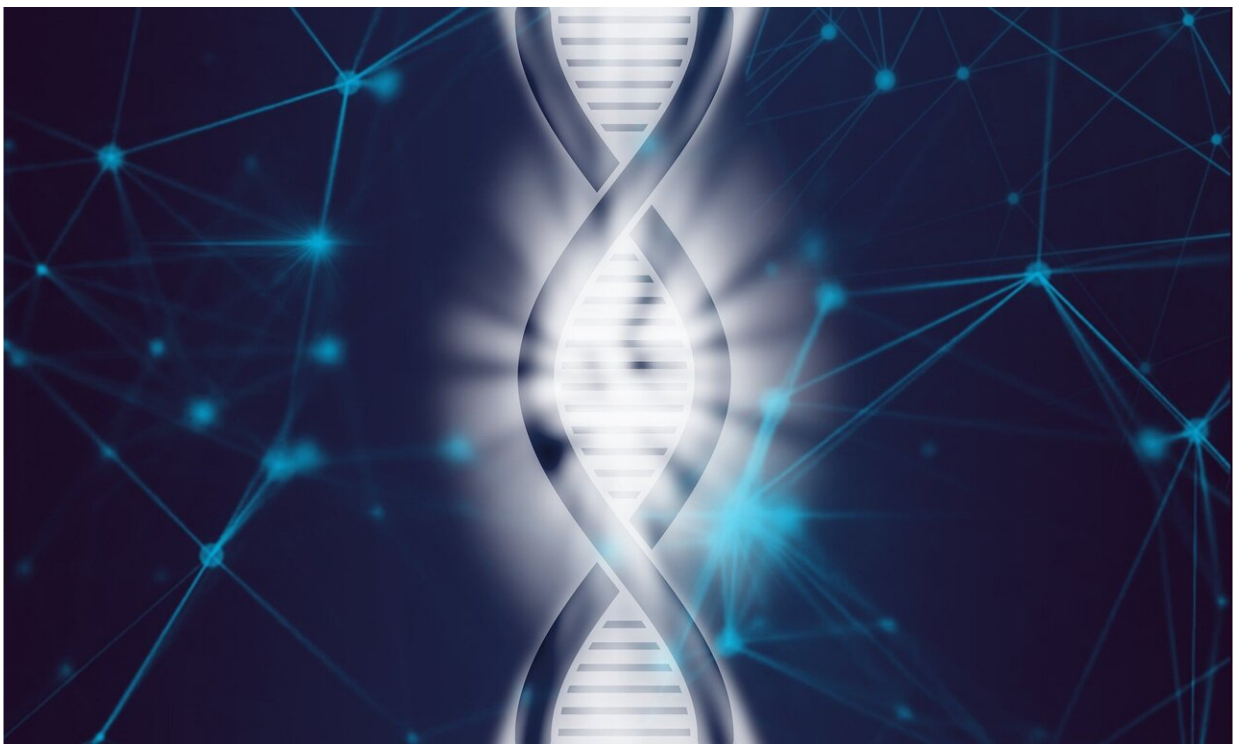

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Within the last century, researchers' understanding of genetics has undergone a profound transformation.

Genes, regions of DNA that are largely responsible for our physical characteristics, were considered unchanging under the original model of genetics pioneered by biologist Gregor Mendel in 1865. That is, genes were thought to be largely unaffected by a person's environment.

The emergence of the field of epigenetics in 1942 shattered this notion.

Epigenetics refers to shifts in gene expression that occur without changes to the DNA sequence. Some epigenetic changes are an aspect of cell function, such as those associated with aging.

However, environmental factors also affect the functions of genes, meaning people's behaviors affect their genetics. For instance, identical twins develop from a single fertilized egg, and as a result, they share the same genetic makeup. However, as the twins age, their appearances may differ due to distinct environmental exposures. One twin may eat a healthy balanced diet, whereas the other may eat an unhealthy diet, resulting in differences in the expression of their genes that play a role in obesity, helping the former twin have lower body fat percentage.

People don't have much control over some of these factors, such as air quality. Other factors, though, are more in a person's control: physical activity, smoking, stress, drug use and exposure to pollution, such as that coming from plastics, pesticides and burning fossil fuels, including car exhaust.

Another factor is nutrition, which has given rise to the subfield of nutritional epigenetics. This discipline is concerned with the notions that "you are what you eat"—and "you are what your grandmother ate." In short, nutritional epigenetics is the study of how your diet, and the diet of your parents and grandparents, affects your genes. As the dietary choices a person makes today affects the genetics of their future children, epigenetics may provide motivation for making better dietary choices.

Two of us work in the epigenetics field. The other studies how diet and lifestyle choices can help keep people healthy. Our research team is comprised of fathers, so our work in this field only enhances our already intimate familiarity with the transformative power of parenthood.

A story of famine

The roots of nutritional epigenetics research can be traced back to a poignant chapter in history—the Dutch Hunger Winter in the final stages of World War II.

During the Nazi occupation of the Netherlands, the population was forced to live on rations of 400 to 800 kilocalories per day, a far cry from the typical 2,000-kilocalorie diet used as a standard by the Food and Drug Administration. As a result, some 20,000 people died and 4.5 million were malnourished.

Studies found that the famine caused epigentic changes to a gene called IGF2 that is related to growth and development. Those changes suppressed muscle growth in both the children and grandchildren of pregnant women who endured the famine. For these subsequent generations, that suppression led to an increased risk of obesity, heart disease, diabetes and low birth weight.

These findings marked a pivotal moment in epigenetics research—and clearly demonstrated that environmental factors, such as famine, can lead to epigenetic changes in offspring that may have serious implications for their health.

The role of the mother's diet

Until this groundbreaking work, most researchers believed epigenetic changes couldn't be passed down from one generation to the next. Rather, researchers thought epigenetic changes could occur with early-life exposures, such as during gestation—a highly vulnerable period of development. So initial nutritional epigenetic research focused on dietary intake during pregnancy.

The findings from the Dutch Hunger Winter were later supported by animal studies, which allow researchers to control how animals are bred, which can help control for background variables. Another advantage for researchers is that the rats and sheep used in these studies reproduce more quickly than people, allowing for faster results. In addition, researchers can fully control animals' diets throughout their entire lifespan, allowing for specific aspects of diet to be manipulated and examined. Together, these factors allow researchers to better investigate epigenetic changes in animals than in people.

In one study, researchers exposed pregnant female rats to a commonly used fungicide called vinclozolin. In response to this exposure, the first generation born showed decreased ability to produce sperm, leading to increased male infertility. Critically, these effects, like those of the famine, were passed to subsequent generations.

As monumental as these works are for shaping nutritional epigenetics, they neglected other periods of development and completely ignored the role of fathers in the epigenetic legacy of their offspring. However, a more recent study in sheep showed that a paternal diet supplemented with the amino acid methionine given from birth to weaning affected the growth and reproductive traits of the next three generations. Methionine is an essential amino acid involved in DNA methylation, an example of an epigenetic change.

Healthy choices for generations to come

These studies underscore the enduring impact parents' diets have on their children and grandchildren. They also serve as a powerful motivator for would-be parents and current parents to make more healthy dietary choices, as the dietary choices parents make affect their children's diets.

Meeting with a nutrition professional, such as a registered dietitian, can provide evidence-based recommendations for making practical dietary changes for individuals and families.

There are still many unknowns about how diet affects and influences our genes. What research is starting to show about nutritional epigenetics is a powerful and compelling reason to consider making lifestyle changes.

There are many things researchers already know about the Western Diet, which is what many Americans eat. A Western Diet is high in saturated fats, sodium and added sugar, but low in fiber; not surprisingly, Western diets are associated with negative health outcomes, such as obesity, type 2 diabetes, cardiovascular disease and some cancers.

A good place to start is to eat more whole, unprocessed foods, particularly fruits, vegetables and whole grains, and fewer processed or convenience foods—that includes fast food, chips, cookies and candy, ready-to-cook meals, frozen pizzas, canned soups and sweetened beverages.

These dietary changes are well known for their health benefits and are described in the 2020-2025 Dietary Guidelines for Americans and by the American Heart Association.

Many people find it difficult to embrace a lifestyle change, particularly when it involves food. Motivation is a key factor for making these changes. Luckily, this is where family and friends can help—they exert a profound influence on lifestyle decisions.

However, on a broader, societal level, food security—meaning people's ability to access and afford healthy food—should be a critical priority for governments, food producers and distributors, and nonprofit groups. Lack of food security is associated with epigenetic changes that have been linked to negative health outcomes such as diabetes, obesity and depression.

Through relatively simple lifestyle modifications, people can significantly and measurably influence the genes of their children and grandchildren. So when you pass up a bag a chips—and choose fruit or a veggie instead—keep in mind: It's not just for you, but for the generations to come.

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