Epigenetics study reveals environmental influences can change gene behaviour

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In a study of pregnant women, a team of Deakin scientists has shown in humans for the first time that pregnancy can induce long-term epigenetic changes to our bodies, with major implications for understanding, preventing and treating disease.

Deakin University scientists have discovered that pregnancy can cause long-term changes to the way women's genes behave, which could affect the future health of them and their children.

The findings of a recent study from Deakin's Centre for Cellular and Molecular Biology, within the School of Life and Environmental Sciences, showed women experience major molecular changes during pregnancy that could remain with them well after their pregnancy has ended.

The changes are "epigenetic" – meaning they are not a mutation of the gene's structure, but a change to how genes behave.

Centre Director and lead researcher Professor Leigh Ackland said that while pregnancy was a critical period of hormonal changes, very little was known about epigenetic changes associated with the reproductive cycle.

"This study highlights how the physical effects of pregnancy are ongoing, and how once you go through pregnancy your body is altered at the most microscopic level," Professor Ackland said.

"Long-term epigenetic changes can lead to increased risks of disease for the next generation.

Studies have previously shown the offspring of women with diabetes have an increased risk of developing obesity, glucose intolerance and type 2 diabetes."

Professor Ackland said that her research is of major significance to the medical research community because it shows in people for the first time that their epigenetic fingerprint can change as a result of external factors.

"This has been seen in the laboratory or with animals before, but not human populations," she said.

"It contributes to a greater understanding of how epigenetic factors are giving scientists a much more sophisticated understanding of physiology."

She explained that epigenetic markers act like a switch that can alter the activity of genes and cells in the body. All individual cells have the same genetic material, but the behaviour of a gene is different in different tissues of the body. That behaviour can be determined by epigenetic factors, independent of the DNA sequences of the genes.

"This is ground-breaking in terms of helping us to understand how physiology is regulated by the environment. It is helping us to understand more complex diseases like cancer, for instance, where environmental factors can play a role in its development.

"Epigenetics has implications for understanding, preventing and combatting many diseases, from diabetes to cancer, providing understanding of how adverse environmental factors, including lifestyle, can cause disease. Once we know the causal pathways, researchers will be in a much better position to develop treatments. Coinciding with our own research, other researchers are already working on epigenetic enzymes to improve cancer treatments."

Professor Ackland's study compared groups of never-pregnant women, pregnant women, and women at 20 weeks postpartum, and made comparisons between the same groups of women at pregnancy, at eight to 10 weeks postpartum, and at 20 weeks postpartum. Similar comparisons were carried out among women with type 2 diabetes.

Professor Ackland said a significant finding was that women with type 2 diabetes had different epigenetic profiles from non-diabetic women, and their profiles underwent different changes during pregnancy.

"Pregnancy-induced epigenetic changes could lead to complications among these women with diabetes, such as downstream effects that may contribute to insulin resistance, as well as high risk pregnancy outcomes," she said.

Professor Ackland said further research would be needed to determine the full extent of the long-term effects.

"The epigenetic changes that occur in pregnancy most likely have both positive and negative effects on future health," she said.

"But we know that maternal malnutrition and other adverse events in pregnancy can cause problems for the next generation due to epigenetics."

The research follows a study Professor Ackland and her team released in 2016 mapping how the epigenetic profiles of pregnant women with gestational diabetes could help identify those at the greatest risk of developing type 2 diabetes.

"Identifying the markers that predict conversion from gestational diabetes to type 2 diabetes provides the potential to screen for women at the highest risk, who could then be targeted earlier for lifestyle interventions," she said.

The latest study "Transient epigenomic changes during pregnancy and early postpartum in women with and without type 2 diabetes" has been accepted for publication in *Epigenomics*.

Provided by Deakin University

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