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DNA changes during pregnancy persist into childhood

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Even before they are born, babies accumulate changes in their DNA through a process called DNA methylation that may interfere with gene expression, and in turn, their health as they grow up. But until now it's been unclear just how long these changes during the prenatal period persist. In a new study, researchers at the Columbia Center for Children's Environmental Health at the Mailman School of Public Health establish that signs of DNA methylation persist through early childhood, suggesting the factors that influence these changes during or before pregnancy could have effects throughout a child's life.

The study, published in an online edition of *PLOS ONE*, is the first to look at DNA methylation changes over time in children.

"The current dogma is that DNA methylation marks are set during early development and are mainly persistent thereafter. However, there were no data in humans to either support or refute this hypothesis. We set out to fill this data gap," explains lead author Julie Herbstman, PhD, assistant professor of Environmental Health Sciences at the Mailman School.

Recent evidence points to environmental exposures like arsenic, lead, and air pollution as factors in epigenetic changes—the umbrella term for DNA methylation and other alterations to gene expression that don't come from DNA mutations. While the health impact of small changes in DNA methylation is not yet clear, there is concern that alterations caused by environmental exposures during important periods of development

that could have effects across a lifetime. Generally, low levels of global DNA methylation have been linked to genomic instability, which can lead to DNA damage. (Global DNA methylation is defined as methylation levels measured in aggregate for all genetic material, not specific to one or more genes.)

Center researchers analyzed global DNA methylation levels in blood at two different time points. Cord blood was analyzed from 279 children who are part of the Center's Mothers & Newborns study in Northern Manhattan and the South Bronx. Of these children, 165 also had blood collected at age 3.

The authors found that cord blood methylation was correlated with and significantly predicted the level of methylation at 3 years old. This supports the hypothesis that DNA methylation changes occurring early in life may have lasting impacts.

Maternal BMI Affects Levels of DNA Methylation

The researchers examined one specific factor to see how it affected DNA methylation in children—the mother's body mass index prior to becoming pregnant. Children born to moms with high BMIs had low levels of global DNA methylation, an association that was seen again at age 3.

The new study provides further evidence that maternal factors like BMI prior to pregnancy can lead to molecular changes on an epigenetic level. The observation that these same factors continue to impact DNA methylation in blood at age 3 raises concern about the potential for pre-pregnancy and prenatal conditions to have lasting health effects. The association between pre-pregnancy BMI and decreased global DNA methylation is of particular interest given the high proportion of obesity among women of reproductive age.

The findings point to a need for further research to understand how factors, such as high BMI before pregnancy, could influence the trajectory of a child's health. "Understanding whether and how maternal characteristics and environmental factors during early development impact long-term child health is a critical first step in identifying targets for disease prevention," says Dr. Herbstman.

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