Epigenetic marks lay foundations for a child's future abilities

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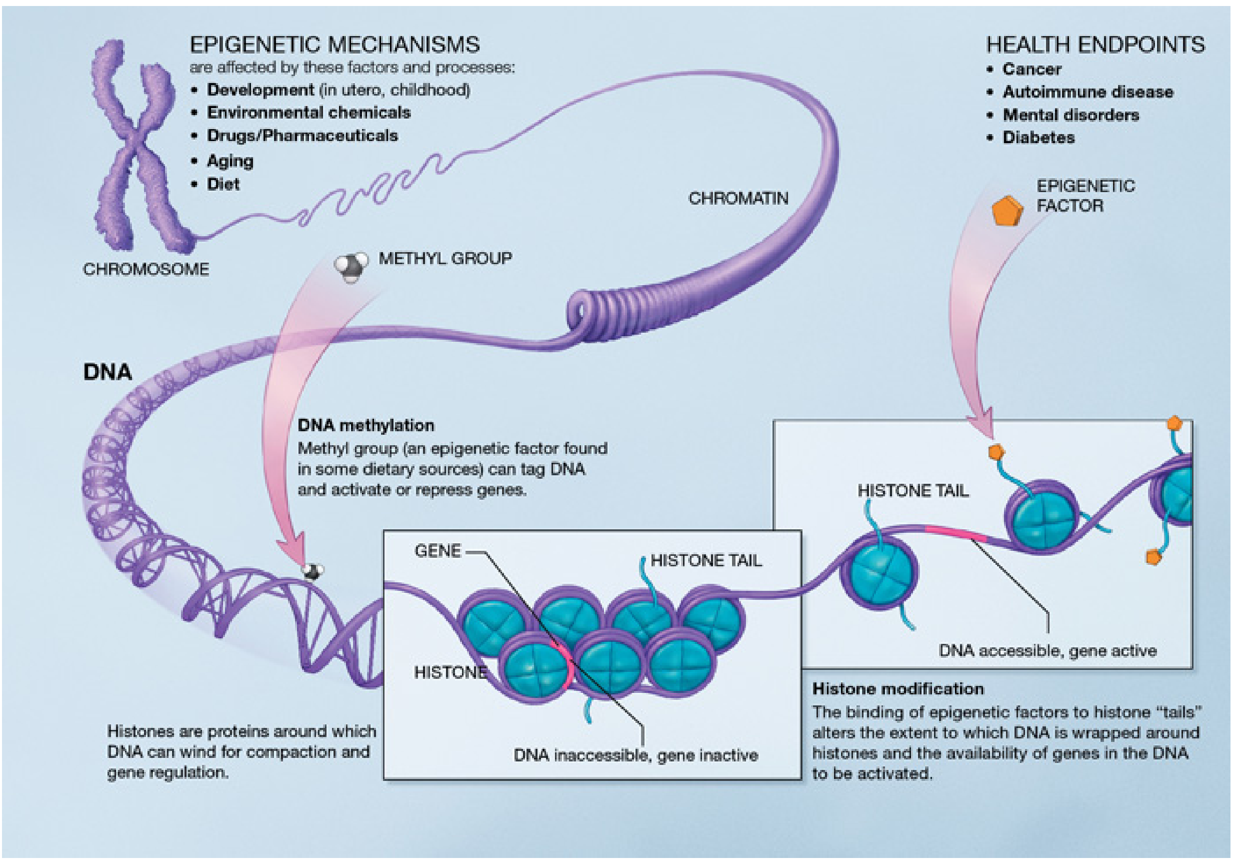

Epigenetic mechanisms are affected by several factors and processes including development in utero and in childhood, environmental chemicals, drugs and pharmaceuticals, aging, and diet. DNA methylation is what occurs when methyl groups, an epigenetic factor found in some dietary sources, can tag DNA and activate or repress genes. Histones are proteins around which DNA can wind for compaction and gene regulation. Histone modification occurs when the binding of epigenetic factors to histone “tails” alters the extent to which DNA is wrapped around histones and the availability of genes in the DNA to be activated. All of these factors and processes can have an effect on people's health and influence their health possibly resulting in cancer, autoimmune disease, mental disorders, or diabetes among other illnesses. Credit: National Institutes of Health/public domain

Although it is now widely recognized that a poor start to life has long-term effects on a child's later ability to learn, the mechanisms by which the environment in early life affects later life chances are poorly understood.

Research published today in the *International Journal of Epidemiology* provides new evidence that so-called 'epigenetic processes' influence brain development to have an important influence on a child's later ability to learn and their cognitive performance. The study was led by University of Southampton researchers with teams from New Zealand and Singapore.

Epigenetic marks on our DNA account for how all cells in the body have the same DNA sequence, inherited from our parents, but nonetheless there are hundreds of different cell types. The body uses epigenetics as its principal control system, to increase or decrease the expression of our genes, and epigenetic processes are known to be important in memory and other aspects of brain function.

The new research used umbilical cord tissue collected at birth and identified epigenetic marks in a key brain development gene called HES1 that were linked to the child's ability to learn and their cognitive performance at ages 4 and 7 years. The findings in two groups of children in Southampton, UK, were accompanied by additional findings in children from Singapore that HES1 epigenetic marks at birth were associated with aspects of socially disruptive behaviour that have previously been linked with a reduced school performance.

Professor Karen Lillycrop and Dr Paula Costello who led the research explained, "Alongside the findings in different groups of children in the UK and Singapore we also found evidence for an effect of the epigenetic marks on the function of the HES1 gene in laboratory studies. Together, the findings provide substantial support for a role for epigenetics in mediating the long-term consequences of the early life environment on brain development and later cognitive performance."

Professor Keith Godfrey, a member of the research team from the Medical Research Council Lifecourse Epidemiology Unit at the University of Southampton comments "To date the main focus of research to identify what determines a child's ability to learn has been on influences acting after birth. The strong links between epigenetic marks at birth and a child's ability to learn point to a much greater influence of brain development before birth than previously recognised. Research is now making progress in defining how the mother's lifestyle and emotional wellbeing during pregnancy can alter epigenetic processes in the baby before birth – in time this could lead to new approaches to diminish disparities in later school performance."

Dr Anne Rifkin-Graboi, Head of the Neurodevelopment Research Centre at A*STAR's Singapore Institute of Clinical Sciences and a key investigator in the Growing Up in Singapore Towards healthy Outcomes (GUSTO) study included in the research adds, "This is the first time that epigenetic marks at birth have been linked with substantial effects on a child's ability to learn. The effects on later cognitive function and behaviour in two culturally diverse populations are particularly noteworthy as they relate to healthy children within the normal range of size at birth. The research marks an important step forward in determining biological mechanisms through which brain development is susceptible to environmental exposures."

More information: "Association between perinatal methylation of the neuronal differentiation regulator HES1 and later childhood neurocognitive function and behaviour." *International Journal of Epidemiology*, DOI: 10.1093/ije/dyv052

Provided by University of Southampton

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