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Stress Tied to Change in Children's Gene Expression - Related To Emotion Regulation, Physical Health

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Associations Between Early Life Stress and Gene Methylation in Children

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Children who have been abused or neglected early in life are at risk for developing both emotional and physical health problems. In a new study, scientists have found that maltreatment affects the way genes are activated, which has implications for children's long-term development. Previous studies focused on how a particular child's individual characteristics and genetics interacted with that child's experiences in an effort to understand how health problems emerge. In the new study, researchers were able to measure the degree to which genes were turned "on" or "off" through a biochemical process called methylation. This new technique reveals the ways that nurture changes nature—that is, how our social experiences can change the underlying biology of our genes.

The study, from researchers at the University of Wisconsin, Madison, appears in the journal *Child Development*. Nearly 1 million children in the United States are neglected or abused every year.

The researchers found an association between the kind of parenting children had and a particular gene (called the glucocorticoid receptor gene) that's responsible for crucial aspects of social functioning and health. Not all genes are active at all times. DNA methylation is one of several biochemical mechanisms that cells use to control whether genes are turned on or off. The researchers examined DNA methylation in the blood of 56 children ages 11 to 14. Half of the children had been physically abused.

They found that compared to the children who hadn't been maltreated, the maltreated children had increased methylation on several sites of the glucocorticoid receptor gene, also known as NR3C1, echoing the findings of earlier studies of rodents. In this study, the effect occurred on the section of the gene that's critical for nerve growth factor, which is an important part of healthy brain development.

There were no differences in the genes that the children were born with, the study found; instead, the differences were seen in the extent to which the genes had been turned on or off. "This link between early life stress and changes in genes may uncover how early childhood experiences get under the skin and confer

lifelong risk," notes Seth D. Pollak, professor of psychology and pediatrics at the University of Wisconsin, Madison, who directed the study.

Previous studies have shown that children who have experienced physical abuse, sexual abuse, and neglect are more likely to develop mood, anxiety, and aggressive disorders, as well as to have problems regulating their emotions. These problems, in turn, can disrupt relationships and affect school performance. Maltreated children are also at risk for chronic health problems such as cardiac disease and cancer. The current study helps explain why these childhood experiences can affect health years later.

The gene identified by the researchers affects the hypothalamic-pituitary-adrenal (HPA) axis in rodents. Disruptions of this system in the brain would make it difficult for people to regulate their emotional behavior and stress levels. Circulating through the body in the blood, this gene affects the immune system, leaving individuals less able to fight off germs and more vulnerable to illnesses.

"Our finding that children who were physically maltreated display a specific change to the glucocorticoid receptor gene could explain why abused children have more emotional difficulties as they age," according to Pollak. "They may have fewer glucocorticoid receptors in their brains, which would impair the brain's stress-response system and result in problems regulating stress."

The findings have implications for designing more effective interventions for children, especially since studies of animals indicate that the effects of poor parenting on gene methylation may be reversible if caregiving improves. The study also adds to what we know about how child maltreatment relates to changes in the body and mind, findings that were summarized recently in an SRCD *Social Policy Report* by Sara R. Jaffee and Cindy W. Christian.

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Summarized from *Child Development*, Associations Between Early Life Stress and Gene Methylation in Children by Romens, SE (formerly at University of Wisconsin, Madison, now at University of Pittsburgh), McDonald, J (formerly at University of Wisconsin, Madison, now at William S. Middleton Memorial Veterans Hospital), Svaren, J, and Pollak, SD (University of Wisconsin, Madison).