

Noble Brains, Healthy Lives

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Humans have long sought to make sense of the brain. Each age has puzzled over this oddly-shaped organ and its role in the complex workings of the body. In times long past, heated debates erupted among scientists and philosophers: Is the brain a cold or a hot organ? Wet or dry? Does the mind exist separate from the brain? Is it the seat of common sense, of memory? Of the soul itself?

Alcmaeon of Croton, a medical writer in the 6th century BCE, was the first to champion the brain as the center of perception, understanding and cognition. He taught that the senses were connected to the brain by "channels," a theory that originated with his discovery of the optic nerve. Alcmaeon also appreciated the fragility of the brain; if disturbed, he wrote, the "channels" become obstructed and the sensory connections are lost. The brain was something to be handled with care.

Alcmaeon lectured widely on science and philosophy. One of his observations—that "from noble fathers noble children are born," and that the same was unfortunately true of "baser" parents—resonates today as we consider recent discoveries in brain research. Alcmaeon had unknowingly touched on a fundamental truth of neurodevelopment: early childhood experiences, whether "noble" or "base," shape not only character but the anatomy and physiology of the brain itself, with lifelong health impacts.

A young child's brain is a wondrous thing. By age five it contains about one *quadrillion* neural connections, more than all the links in the entire Internet. But by adulthood one-third of those connections disappear. The pathways

used most frequently in childhood are strengthened and streamlined, while those less trafficked simply wither away.

Stress, both physical and emotional, is an inevitable part of life. When buffered by caring and supportive adult relationships, early life stress can be a positive experience, leading to healthy adaptive responses later in life. When stress is chronic and unaddressed, however, it becomes toxic, triggering a cascade of biochemical events that enhance unhealthy neural pathways.

The areas of the brain most affected by toxic stress are the amygdala, the hippocampus and the prefrontal cortex. The amygdala, rich in stress hormone receptors, becomes hypertrophic, while the hippocampus and prefrontal cortex—essential to dampening the body's stress reactions—lose neurons and neural connections. An overheated, unchecked amygdala can lead to persistent anxiety, impaired memory, learning difficulties and poor executive functioning. Children exposed to toxic stress may overreact to perceived threats, much like combat veterans with post-traumatic stress disorder.

Structural changes in the brain impact other organs as well, through dysregulation of the hypothalamic-pituitary-adrenocortical axis. The overstimulated amygdala spurs the adrenal cortex to secrete excessive cortisol, norepinephrine and adrenaline. An accompanying increase in inflammatory cytokines accelerates wear and tear in the heart, lungs, immune system, and elsewhere throughout the body. Toxic stress in childhood can thus result in lifelong, multi-system disease.

Once a developing brain is altered by toxic stress, setting things right becomes difficult. In their landmark 1998 Adverse Childhood Experiences study,

Drs. Vincent Felitti and Robert Anda demonstrated the impact of toxic childhood stress on adult health. They found that adults exposed to multiple stresses in early childhood—such as abuse or neglect, loss of a parent, or maternal depression—were at high risk of cardiovascular disease, depression, substance abuse, and other chronic illnesses, even if the stress resolved before adulthood.

If we are to lessen the burden of chronic illness, we must strengthen the neural pathways that enable children to handle stressful events. This is best accomplished by providing support to families, the people from whom a child will learn (or not) about how to cope with life's stresses.

As physicians, we have a choice to make. We can accept ever-increasing rates of chronic physical and mental illness as inevitable, or we can attack these problems at their early-life roots. To borrow a phrase from Frederick Douglass, "It is easier to build strong children than to repair broken men."

You can build healthier brains and bodies right here at home. Get acquainted with regional and national programs like the Center for Youth Wellness, Too Small to Fail, and Futures Without Violence, and learn how you can ameliorate the effects of toxic stress in your daily practice. Donate to local organizations that provide parenting support to families in need, such as Child Parent Institute (CPI).

You can act on a personal level, too. Talk to your children. Read to your grandchildren. Teach the young people around you how to positively handle life's stresses. Today's children—tomorrow's adults—will be glad that you did. ♦

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