POVERTY AND NEGLECT ARE BAD FOR THE BRAIN — BUT COULD LASTING EFFECTS BE AVOIDED?

Childhood adversity leaves tangible and long-lasting marks on the developing brain that could lead to lifelong health and psychological problems. Early intervention may help to avert some of the fallout.

FOCUS OF ARTICLE:

Scientists are building a deeper understanding of how harmful experiences during childhood make their mark on a child’s developing brain. Brain imaging technologies show that children growing up malnourished or neglected have less grey and white brain matter, and these children exhibit impaired intellectual capacities. However, a recent study suggests that if children are relocated to improved living conditions early in life, some of the long-term consequences can be avoided. This highlights early intervention as a potential strategy for helping more children develop to their full potential.

BACKGROUND

Childhood experiences shape adult life profoundly, but the biological mechanisms of this process are generally not well understood. Growing up in environments of poverty or neglect harms a child’s long-term health, as shown by epidemiological studies in which participants were followed from birth to adulthood. In addition to increased prevalence of diabetes, heart disease and cancer in later life, these children also have cognitive difficulties and a higher risk of physical and mental health problems such as addiction, obesity, and depression. A deeper understanding of the biological processes by which adverse life experiences become ingrained in the body may enable strategies to avert these long-lasting harmful effects.

To determine how this interaction affects the brain, Dr. Charles Nelson, senior fellow in CIFAR’s program in Child & Brain Development, examined how adverse challenges in early life affect young brains. Nelson and colleagues first studied children who were abandoned as babies in derelict orphanages of post-communist Romania, half of whom were later moved to foster care. While the orphans who remained behind had their basic physical needs met, their childhoods were confined within institution walls, deprived of ordinary world experiences and care from adults.

More recently, Nelson started studying Bangladeshi children growing up in abject poverty in the crowded slums of Dhaka. Unlike the Romanian orphans, these children have access to environmental stimulation and adult contact. However, they lack food, clean water and medicine, with almost half exhibiting stunted growth while struggling to fight off incessant infections. Initially collecting brain scans from six-month-old babies and three year olds, Nelson and colleagues will later collect follow-up measurements when the participating children turn two and five years old, respectively.

METHODS

To determine the effects of early adversity on developing brains, both studies collected data using magnetic resonance imaging (MRI). MRI allows researchers to distinguish between grey and white matter in the brain — which contain nerve cells and communicate information, respectively — and can support a three-dimensional reconstructed image of the brain. However, MRI is not best suited for young children as it requires them to lie still in a noisy chamber. For this reason the Dhaka study also
collected functional near-infrared spectroscopy (fNIRS) data, which provides similar information to functional MRI but is less cumbersome to collect. Overall electrical activity in the brain was also measured using electroencephalography (EEG), for which a child wears a cap studded with electrodes that detect nerve impulses beneath the skull.

KEY FINDINGS

These studies demonstrate that neglect and conditions of poverty (such as malnourishment and maternal depression) present distinct challenges, and both contexts leave visible traces on brain development. By the time Romanian orphans were eight, their brains had less grey and white matter volume in the regions associated with attention and language than children growing up in biological or foster families. Similarly, Bangladeshi infants and toddlers who were physically stunted had less brain volume and demonstrated atypical responses to social stimuli — preferring the sound of trucks to female faces, for example.

Both studies also show developmental differences across time. In Dhaka, data across multiple measures indicate many effects of adversity are not apparent when children are six months old but emerge by three years of age. In Romania, orphans who were placed into foster families before they turned two went on to exhibit typical brain development and score higher on cognitive tests than those children that remained in institutional settings — even compared to other children who went on to join foster families beyond age two.

IMPLICATIONS

Hundreds of millions of children are growing up without their basic needs met, including food, medicine and care. Although grim in nature, the neuroimaging studies also highlight opportunities for interventions that can change the course of a child’s life: the findings suggest that there is a critical window of time in early life when adverse experiences have not irreversibly impacted the developing brain. Intervening during this crucial period could protect children from the long-term impacts of early adversity on their developing brains and bodies.

In Dhaka, the researchers are also collecting blood samples to gain molecular-scale insights into the direct or indirect mechanisms through which adversity like malnutrition, infection, and maternal depression affect the brain. Their findings could shed light on the most promising avenues and timeframes for intervention — such as food and medicine provisions, sanitation improvements, and maternal mental health supports when they matter most.

Ultimately, the goal is to support children who have experienced early neglect or poverty to develop healthy brains and bodies throughout life.

REFERENCES:

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CIFAR’S PROGRAM IN CHILD & BRAIN DEVELOPMENT

CIFAR Fellows in Child & Brain Development are expanding what we know about the effects of early childhood adversity and enrichment on mental, physical and emotional health throughout life. This program has led the way in moving beyond the debate of “nature vs. nurture,” examining the neurobiological mechanisms that are governed by gene-environment interactions and how they determine individual differences in child development and health. CIFAR Fellows in this program are also concerned with the larger societal context of children who grow up in poverty or are raised in more sustaining environments.

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