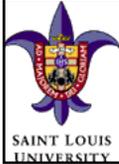


The Science of Toxic Stress and Long-Term Health Outcomes

Implications for health through the life course

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The Child is father of the Man.

- William Wordsworth

*Careful the things you say:
Children will listen.*

- Stephen Sondheim

Stress

Positive

Brief increases in heart rate,
mild elevations in stress hormone levels.

Tolerable

Serious, temporary stress responses,
buffered by supportive relationships.

Toxic

Prolonged activation of stress response systems
in the absence of protective relationships.

Stress

- **Positive:**
 - Physiologic state is brief, mild to moderate in magnitude.
 - Caring, responsive adult who helps the child cope
 - Provides a protective effect and return to baseline.
- **Tolerable:**
 - Nonnormative experiences that present greater adversity
 - Context of buffering protection by supportive adults
 - Facilitate the child's adaptive coping and sense of control
 - Risk of excessive stress response leading to physiologic harm and long-term consequences for health and learning is greatly reduced

Toxic Stress

- Results from strong, frequent, or prolonged activation of the body's stress response systems
- Multiple stressors, eg, child abuse or neglect, parental substance abuse, and maternal depression
- Absence of the buffering protection of a supportive, adult relationship.
- Disruption of brain circuitry and other organ and metabolic systems during sensitive developmental periods.
- May result in anatomic changes and/or physiologic dysregulations
- Precursors of later impairments in learning and behavior
- Roots of chronic, stress-related physical and mental illness.

Toxic Stress



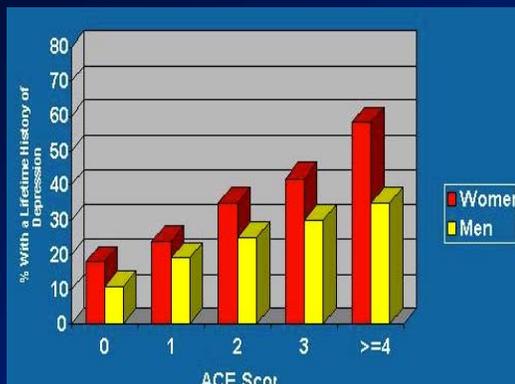
Adverse Childhood Experiences (ACE)

<https://acestoohigh.com>

- 10 questions about what a person experienced/witnessed as a child, e.g.:
 - Did a parent...ever hit you so hard that you had marks?
 - Was a household member depressed or mentally ill?
- Higher scores → increased risk of physical or psychological problems throughout life, e.g.,

Alcoholism and alcohol abuse	Liver disease
Risk for intimate partner violence	Multiple sexual partners & STDs
Smoking	Suicide attempts
Unintended pregnancies	COPD
Depression	Fetal death
Health-related quality of life	Ischemic heart disease (IHD)

Adverse Childhood Experiences (ACE)



ACE vs Depression



ACE vs Liver Disease

Epigenetics

- Study of the molecular biological mechanisms that affect gene expression without altering DNA sequence
- DNA methylation and histone acetylation
- The environmental On/Off switch for gene expression
- No longer “nature vs. nurture”
- *Now:* “Nature dancing with nurture over time”

Poverty Affects Child Health

- Children living in poverty have worse health outcomes for infant mortality, developmental delays, asthma, ear infections, obesity, nutrition, and child abuse and neglect.
- Child poverty also adversely impacts health across the life course and into adulthood.
- Families in poor/low-income homes have difficulty accessing health care, meeting basic needs crucial for healthy child development. In the United States in 2012:
 - 22% of all children under 18 lived in poverty (16 million children)
 - 45% of all children under 18 lived in low-income households (32.7 million children)

Epigenetic Regulation by Caregiving

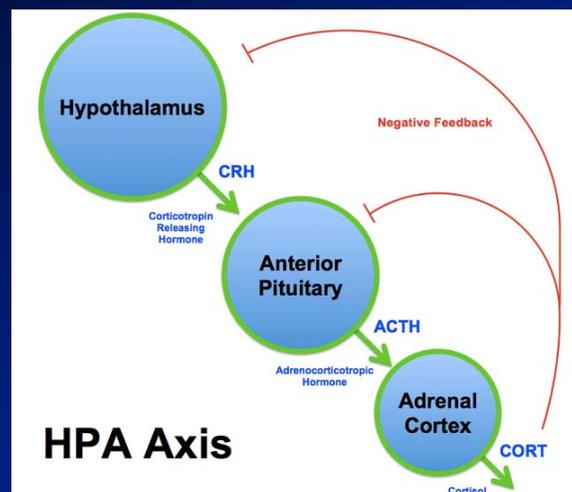
- Young children cared for by individuals who are available and responsive to their emotional and material needs develop immune systems that are better equipped to deal with initial exposures to infections and to keep dormant infections in check over time.
- Children exposed to risk factors for toxic stress, including poverty, intimate partner violence, and community violence, are more likely to develop or report asthma; asthma has a known inflammatory/stress component.

So how is all this connected?

Altriciality

- Humans are distinguished by their altriciality; that is, we need a caregiver in early life to survive.
- We emerge from the womb more immature than virtually any other similar-sized species.
- The parent-child relationship is therefore “evolutionarily expected” as the context for a major part of postnatal maturation.
- In the absence of this expected parent-child bond, children must make adaptations that allow them to survive.
- These adaptations are essential in the short term, but they carry long-term costs by limiting an individual’s ability to cope with new demands as they mature.

Hypothalamic-Pituitary-Adrenal (HPA) Axis



[http://upload.wikimedia.org/wikipedia/commons/5/55/HPA_Axis_Diagram_\(Brian_M_Sweis_2012\).png](http://upload.wikimedia.org/wikipedia/commons/5/55/HPA_Axis_Diagram_(Brian_M_Sweis_2012).png)

Hypothalamic-Pituitary-Adrenal (HPA) Axis

- A primary consequence of early life toxic stress is HPA dysregulation.
- The developing neuroendocrine system is chronically pressed into action.
- Too much cortisol suppresses immunity and increases the chance of infection.
- Too little cortisol and the inflammatory response persists after it is no longer needed.

Early Environments & Immune Development

- Animal models demonstrate that prenatal maternal distress undermines fetal immune development.
- Chronic maternal prenatal stress and anxiety have been linked in both humans and animals to an altered cellular immune response at birth and more illnesses and health complaints in newborns.
- After birth, the infant's immune system must up-regulate T-helper 1 cellular immunity and downregulate T-helper 2 cellular immunity.
- A dominant T-helper 2 cell response early in life creates life-long immune hyperreactivity, including allergies and asthma.

Early Environments & Immune Development

- Infants at risk for toxic stress are also more likely to encounter physical environments that increase the chance of immune hyperreactivity.
- For example, poor children are more likely to be exposed to secondhand smoke, mold, rodents, cockroaches, and dust mites.

Effects of Toxic Stress

- Emergence of Executive Function Disorders
- Disturbances in:
 - Working memory
 - Self-regulation
 - Attention, organization, impulse control
 - Sequencing and planning
 - Social flexibility

Biological Sensitivity to Context: The Orchid-Dandelion Hypothesis



Biological Sensitivity to Context: The Orchid-Dandelion Hypothesis

- Sensitivity – heightened genetic reactivity to experience
 - Environment plays an equally important role
 - *Biological sensitivity to context.*
- Plasticity – the brain's ability to change and adapt
 - Results from learning, experience, memory formation, or from damage to the brain.
 - Environment and genetics play essential roles
- Resilience – ability to cope effectively with problems and setbacks
 - Internal locus of control

Biological Sensitivity to Context: The Orchid-Dandelion Hypothesis

- Interactions of genes and environment
- Gene variants (orchid genes):
 - SERT gene:
 - depression/anxiety
 - 25% of population
 - DRD4 gene
 - externalizing behaviors, antisocial risk, ADHD risk
 - 20% of population
- “Vulnerability becomes plasticity and responsiveness.”

Adversity/Toxic Stress

- “Social-emotional buffering is the primary factor distinguishing level of stress.”
 - Andy Garner, MD, COPACFH
- Toxic stress occurs when there is an absence of social-emotional buffering.
- Metric for adversity is the body’s stress response.
- Implication: “Toxic stress is the key intergenerational transmitter of social and health disparities.”

Early Brain and Child Development (EBCD) Building Health

- Promoting the healthy early childhood foundations for life course health
- Promoting relational health
- Promoting kindergarten readiness
- Mitigating toxic stress effects on health and developmental trajectories
- Strengthening the systems and community supports to address the social determinants of health

Early Brain and Child Development (EBCD) Implications for Public Policy

- Prevention of exposure to Toxic Stress is not just nice, it is scientifically sound and fiscally responsible.
- Child development is the foundation for community and economic development.
- Brains are built over time – prenatally to young adulthood.
- Then interactive influences of genes and experience shape the architecture of the developing brain.
- Toxic stress on the developing brain has lifelong effects on learning, behavior, and health.
- Creating the right conditions in early childhood is more effective and far less costly to the individual, to the family, and to society than addressing problems later on.

