Unpacking the Black Box: Understanding the Biological Impact of ACEs

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### Defining Adversity: Not all stress is equal

<table>
<thead>
<tr>
<th>Positive Stress</th>
<th>Tolerable Stress</th>
<th>Toxic Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal, typical childhood experiences</td>
<td>More complicated, scary and challenging</td>
<td>Severe, long-lasting, uncontrollable, and/or frequent stress</td>
</tr>
<tr>
<td>Childcare drop off; playground injuries; losing a game</td>
<td>Natural tragedy; death of loved one; financial strain</td>
<td>Physical, sexual, emotional abuse, exposure to violence, severe economic hardship</td>
</tr>
<tr>
<td>No buffering necessary</td>
<td>Caring adult buffers stress</td>
<td>No adult buffers stress</td>
</tr>
<tr>
<td>Temporary, mild elevation in stress hormones; brief increases in heart rate</td>
<td>More continuing cardiovascular and stress hormone response</td>
<td>Prolonged activation of stress response system</td>
</tr>
<tr>
<td>Increased resiliency and confidence; development of coping skills</td>
<td>Adaptation and recovery likely, but potential for longer lasting negative outcomes</td>
<td>Possible lifelong changes in health, learning and behaviour</td>
</tr>
</tbody>
</table>
Mechanisms by which ACEs influence adult health

https://www.cdc.gov/violenceprevention/acestudy/about_ace.html
Linking ACEs to Adult Outcomes: Unpacking the Black Box

Adverse Childhood Experiences → TOXIC STRESS

- Dysregulated stress response
- Brain architecture changes
- Epigenetic modifications

→ Poor Adult Outcomes
Dysregulated Stress System
System never completely ‘shuts off’

Triggers a state of arousal in the body – a heightened state of alertness and fearfulness for one’s safety.

Chronic adversity

Cortisol

Increases in stress hormones
Decreased regulation of the stress system
Cascading effect on other systems

Changes in immune function
Cellular changes in the brain
Changes in gene expression
Changes in Brain Architecture
Early experiences build brains

Early experiences determine which pathways are used and are formed.

Connections that are used more grow stronger and more efficient and support new pathways – these circuits form the basic foundation of the child’s brain.

Rapid brain development in the first few years of life.
• **Brain’s executive center:**
  Abstract thought, reasoning, impulse and emotion regulation, judgement, attention

• **Brain’s alarm system:**
  Involved in processing and interpreting emotions
  • Impulsivity

• **Brain’s filing cabinet:**
  Memory formation and learning – retrieval of memories
Epigenetic modification
Epigenetic modification

- Epigenetics is the change in gene activity that does not change the DNA code itself – occurs through chemical changes it influences how the code is used

\[
\text{Genome} = \text{Determine the boundaries of what is possible}
\]

\[
\text{Epigenome} = \begin{align*}
&\text{Need operating system to tell it what to do} \\
&\text{Epigenome is operating system directing the function of a gene’s DNA hardware}
\end{align*}
\]
Epigenome is responsive to adverse childhood experiences

Adverse childhood experiences have been consistently linked to changes in genes associated with the stress system. Child maltreatment has been associated with methylation differences in genes related to cortical development, cognition, neuroplasticity, and systems associated with mental and physical health.
Limitations of ACE biology research

- Very few traditional ‘ACE’ studies related to biology
- Single snapshot in time – need to study trajectories
- Most of the research comes from high-income countries
- May be qualitative differences due to compounding environmental factors in LMIC
- Resilience factors often not addressed – see brain changes in maltreated individuals with no psychopathology. Why?
- Rarely studied in the context of intervention
Big Question: How do we deal with the black box?

Are there ways to mitigate or treat the effects of toxic stress?
Dealing with the Black Box

Adverse Childhood Experiences  \rightarrow  Poor Adult Outcomes

Evidence-based interventions to promote safe, stable and nurturing relationships that turn off physiologic stress response:
  e.g.
  - Nurse Family Partnership
  - Parenting for Lifelong Health

Provide health and social services to deal with adverse outcomes