The Impact of Poverty and Adverse Childhood Events on Child Health

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Faculty Disclosure Information

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I do not intend to discuss an unapproved/investigative use of a commercial product/device in my presentation.
Recent Childhood Poverty Trends

Childhood Poverty and Poor Health Outcomes

• Children living in poor families have IQ scores that are 6 to 13 points lower

• Children living in poverty have higher rates
  – Developmental delay
  – Learning problems
  – School problems

• Economically distressed children have higher rates of chronic illness, hospital admissions, and mortality
How Child Poverty Impacts Lifelong Health

- Child poverty increases the risk of unemployment and adult poverty.
- By age 4, poor children have heard 30 million fewer words than well-off children.
- Poor children are more likely to be hungry and less likely to have affordable quality health coverage.
- Poor children are less likely to graduate from high school.
Adverse Childhood Experience Study

- Published by CDC/Kaiser in 1998
- Surveyed 17,000 policy holders
- Understand relationship between childhood adversity & adult health outcomes

Adapted from Felitti et al., 1998
Graded Relationship Between ACE Score and Cardiovascular Disease

Association between ACE Score and Risk for Cardiovascular Disease

Increased Risk of CVD

ACE Score

Adapted from Dong et al., 2004
# Graded Relationship Between ACE Score and Health Outcomes

<table>
<thead>
<tr>
<th>Health Risk Behaviors</th>
<th>Mental Health Conditions</th>
<th>Physical Health Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smoking</td>
<td>Depression</td>
<td>Cardiovascular Disease</td>
</tr>
<tr>
<td>Alcohol Abuse</td>
<td>Anxiety</td>
<td>Diabetes</td>
</tr>
<tr>
<td>Drug Abuse/Illlicit Drug Use</td>
<td>PTSD</td>
<td>Emphysema</td>
</tr>
<tr>
<td>High Risk Sexual Behavior</td>
<td>Hallucinations</td>
<td>Cancer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Obesity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Liver Disease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Headaches</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Autoimmune Disease</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sexually Transmitted Infections</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Self-Reported Health</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Disability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fetal Death</td>
</tr>
</tbody>
</table>

Health outcomes highlighted in red are among the top ten leading causes of death in the US
Individuals with 4 or More ACEs are at Highest Risk for Poor Outcomes

- 4- to 12-fold increased risk for health risk behaviors
- 1.4- to 1.6-fold increased risk for adult diseases

Adapted from Felitti et al., 1998
Population Attributable Risk of ACEs

Adapted from ACE Interface 2013
ACEs are Interrelated

<table>
<thead>
<tr>
<th>ACE Category</th>
<th>Additional ACEs (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Emotional Abuse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Physical Abuse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Sexual Abuse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>22</td>
</tr>
<tr>
<td>Emotional Neglect</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Physical Neglect</td>
<td></td>
</tr>
<tr>
<td></td>
<td>11</td>
</tr>
<tr>
<td>Parental Separation or Divorce</td>
<td></td>
</tr>
<tr>
<td></td>
<td>18</td>
</tr>
<tr>
<td>Household Substance Abuse</td>
<td></td>
</tr>
<tr>
<td></td>
<td>19</td>
</tr>
<tr>
<td>Household Mental Illness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Domestic Violence</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Incarcerated Care Provider</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

Adapted from Dong et al, 2004
ACEs Impact Outcomes Across Different Sectors of Society

Adapted from Anda et al., 2004
Economic Costs Associated with ACEs

ACEs and Social Problems
- Job problems
- Work absenteeism
- Homelessness
- Exposure to violence
- Juvenile & criminal justice system involvement
- Poor academic achievement
- Residential mobility

Lifetime Economic Toll
- Total - $124 billion
- Productivity loss - $83.5 billion
- Health care - $25 billion
- Special education - $4.6 billion
- Child welfare - $4.4 billion
- Criminal justice - $3.9 billion

Adapted from Fang et al, 2011
ACEs are Associated Poor Pediatric Health Outcomes

Common Pediatric Conditions
- Fetal death
- Developmental delay
- Cognitive impairment
- Behavioral problems
- Headaches
- Somatic complaints
- ADHD
- Adolescent pregnancy
- Early initiation of sexual activity and smoking

ACE Score and Risk of Fetal Demise After First Pregnancy

ACE Score
- 0
- 1 to 2
- 3 to 4
- 5 or more

Increasing Risk of Fetal Demise

Adapted from Hillis et al., 2004
ACE Exposure Associated with Academic Problems

- Academic Failure
- Problems with School Attendance
- School Behavior Concerns

Risk for Academic Problems

ACE Score

Adapted from C. Blodgett et. al., 2014
School Readiness and Engagement May Mediate the Association of ACEs with Poor Academic Achievement

• 3 or more ACEs associated with decreased readiness for school
  (Jimenez et. al., Pediatric Academic Society 2015 Abstract)
  – Below average language and literacy skills (aOR 1.7 95% CI 1.1-3.0)
  – Poor teacher rated literacy skills (aOR 3.6 95% CI 1.9-6.7)

• ACEs associated with repeating a grade in school and school engagement
  (Bethell et. al., Health Affairs 2014)
  – Children with 2 or more ACEs 2.7 times as likely to have repeated a grade
  – Children with 0 ACEs 2.6 times as likely to report always being engaged in school
How Does Childhood Stress Get Under the Skin?

ACEs → Social, emotional, and cognitive impairment → Adoption of health risk behavior → Altered HPA axis and immune activity → Disease, Disability, Social Problems, Early Death
Key Areas of Brain Impacted by Adverse Childhood Experiences

- Prefrontal Cortex
  - Center of executive functioning
  - Regulates thoughts, emotions, and actions

- Hippocampus
  - Center of short term memory
  - Connects emotion to fear

- Amygdala
  - Triggers emotional responses
Adverse Childhood Experiences Impact Child Brain Development

<table>
<thead>
<tr>
<th>Area of the Brain</th>
<th>Volume Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hippocampus</td>
<td>↓</td>
</tr>
<tr>
<td>Amygdala</td>
<td>↑, ↓</td>
</tr>
<tr>
<td>Prefrontal Cortex</td>
<td>↓</td>
</tr>
<tr>
<td>Cerebral</td>
<td>↓</td>
</tr>
</tbody>
</table>
### Adverse Childhood Experiences Impair Cognitive Skills

<table>
<thead>
<tr>
<th>IQ</th>
<th>Foster Care</th>
<th>Orphanage</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbal Comprehension</td>
<td>87.48</td>
<td>81.22</td>
<td>110.18</td>
</tr>
<tr>
<td>Perceptual Reasoning</td>
<td>83.81</td>
<td>82.30</td>
<td>106.79</td>
</tr>
<tr>
<td>Working Memory</td>
<td>87.80</td>
<td>83.88</td>
<td>108.92</td>
</tr>
<tr>
<td>Full Scale IQ</td>
<td>81.46</td>
<td>76.16</td>
<td>107.00</td>
</tr>
</tbody>
</table>

Adapted from the Bucharest Early Intervention Project
Biology of the Stress Response

Cortisol Actions

- Increases heart rate & blood pressure
- Increases blood sugar levels
- Increases blood flow to muscles
- Increases breathing rate
Normal Cortisol Physiology

Cortisol Stress Response

- Stress
- Activity
- Recovery

Daily Cortisol Levels

- Morning
- Noon
- Evening

Adapted from McEwen, 2006
Childhood Trauma Changes Normal Cortisol Stress Response

- Normal Stress Response
- Prolonged Stress Response (Hyper)
- Inadequate Stress Response (Blunted)
Childhood Adversity Disrupts Normal Stress Response

Childhood adversity causes chronic HPA activation

Childhood adversity causes blunted HPA response

Adapted from Carrion et al., 2002

Adapted from MacMillan et al., 2009
# Effects of Too Much Cortisol

<table>
<thead>
<tr>
<th>Cortisol Actions</th>
<th>Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impair Immune Cell Function</td>
<td>Infections/Cancer</td>
</tr>
<tr>
<td>Change Fat Metabolism</td>
<td>Obesity</td>
</tr>
<tr>
<td>Hyperglycemia</td>
<td>Diabetes</td>
</tr>
<tr>
<td>Increased Blood Pressure</td>
<td>Hypertension</td>
</tr>
<tr>
<td>Decrease Bone Formation</td>
<td>Osteoporosis/Fractures</td>
</tr>
<tr>
<td>Toxic to Brain</td>
<td>Depression/Anxiety/Decreased Brain Volumes</td>
</tr>
</tbody>
</table>
Basics of Gene Theory

DNA 
- Genes contain instructions for making proteins 
- Proteins act alone or in complexes to perform many cellular functions
Epigenetics

Epigenetic mechanisms are affected by these factors and processes:
- Development (in utero, childhood)
- Environmental chemicals
- Drugs/Pharmaceuticals
- Aging
- Diet

DNA methylation
Methyl group (an epigenetic factor found in some dietary sources) can tag DNA and activate or repress genes.

Histones are proteins around which DNA can wind for compaction and gene regulation.

HEALTH ENDPOINTS
- Cancer
- Autoimmune disease
- Mental disorders
- Diabetes

Histone modification
The binding of epigenetic factors to histone "tails" alters the extent to which DNA is wrapped around histones and the availability of genes in the DNA to be activated.
Epigenetic Changes Mediate Changes in Stress Reactivity

Source: Levitt (2008), adapted from Liu et al. (1997)
Epigenetic Changes Mediate Intergenerational Transmission of Stress Effects

- Blunted cortisol production in offspring of stressed mice
- Identified several associated genes
- Many of these genes involved in epigenetic processes

Adapted from Rodgers et al., 2013
ACE Study Population is not Representative of Urban Populations

<table>
<thead>
<tr>
<th>Demographics</th>
<th>ACE Study</th>
<th>Philadelphia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>56</td>
<td>34</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td>79% White</td>
<td>41% White</td>
</tr>
<tr>
<td></td>
<td>5% African American</td>
<td>43% African American</td>
</tr>
<tr>
<td></td>
<td>5% Hispanic</td>
<td>12% Hispanic</td>
</tr>
<tr>
<td>High school graduates</td>
<td>94%</td>
<td>36%</td>
</tr>
<tr>
<td>College graduates</td>
<td>43%</td>
<td>13%</td>
</tr>
<tr>
<td>Percent below FPL</td>
<td>Not measured</td>
<td>25%</td>
</tr>
</tbody>
</table>
ACE Scale Can Be Improved by Adding Additional Adversities to the Measure

**Original**
- Emotional abuse
- Physical abuse
- Sexual abuse
- Physical neglect
- Emotional neglect
- Mother treated violently
- Household substance abuse
- Household mental illness
  - Incarcerated household member
  - Parental separation or divorce

**Additional Adversities**
- Property victimization
- Peer victimization
- Exposure to community violence
- Socioeconomic status
- Someone close had a bad accident or illness
- Below-average grades
- Parents always arguing
- No good friends
The Philadelphia ACE Study

A collaborative, led by the Institute for Safe Families (ISF), to develop and implement research, practice, and policies in urban pediatric settings based on the Adverse Childhood Experiences (ACE) study.
Survey Methods

- Survey was completed as a follow up to the Southeastern Pennsylvania Household Health Survey (SEPA HHS).
  - Survey of over 13,000 children and adults in Southeastern Pennsylvania
  - Comprehensive survey on a broad range of topics

- Philadelphia ACE Survey re-contacted original SEPA HHS Philadelphia respondents who were 18 years or older

- Telephone survey (landline and cell phones)

- Completed by trained male and female interviewers

- Interviews were conducted in English and Spanish

- Interviewed 1,784 Philadelphia adults age 18 and older

- Response rate 67.1%
## Philadelphia ACE Study Questions

<table>
<thead>
<tr>
<th>Conventional ACEs</th>
<th>Expanded ACEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Abuse</td>
<td>Witnessing Violence</td>
</tr>
<tr>
<td>Emotional Abuse</td>
<td>Living in Unsafe Neighborhoods</td>
</tr>
<tr>
<td>Sexual Abuse</td>
<td></td>
</tr>
<tr>
<td>Emotional Neglect</td>
<td>Experiencing Racism</td>
</tr>
<tr>
<td>Physical Neglect</td>
<td></td>
</tr>
<tr>
<td>Domestic Violence</td>
<td>Living in Foster Care</td>
</tr>
<tr>
<td>Household Substance Abuse</td>
<td></td>
</tr>
<tr>
<td>Incarcerated Care Provider</td>
<td>Experiencing Bullying</td>
</tr>
<tr>
<td>Mental Illness in the Home</td>
<td></td>
</tr>
</tbody>
</table>
Many of the Traditional ACEs are More Prevalent in an Urban Setting

<table>
<thead>
<tr>
<th></th>
<th>Philadelphia ACE Study (N = 1,784)</th>
<th>CDC-Kaiser ACE Study (N = 17,337)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional abuse</td>
<td>33.2%</td>
<td>10.6%</td>
</tr>
<tr>
<td>Physical abuse</td>
<td>35.0%</td>
<td>28.3%</td>
</tr>
<tr>
<td>Sexual abuse</td>
<td>16.2%</td>
<td>20.7%</td>
</tr>
<tr>
<td>Physical neglect</td>
<td>19.1%</td>
<td>14.8%</td>
</tr>
<tr>
<td>Emotional neglect</td>
<td>7.7%</td>
<td>9.9%</td>
</tr>
<tr>
<td>Substance abusing household member</td>
<td>34.8%</td>
<td>26.9%</td>
</tr>
<tr>
<td>Mentally ill household member</td>
<td>24.1%</td>
<td>19.4%</td>
</tr>
<tr>
<td>Witnessed domestic violence</td>
<td>17.9%</td>
<td>12.7%</td>
</tr>
<tr>
<td>Household member in prison</td>
<td>12.9%</td>
<td>4.7%</td>
</tr>
</tbody>
</table>
## Prevalence of Expanded ACEs

<table>
<thead>
<tr>
<th>Expanded ACE Indicators</th>
<th>Respondents (N = 1,784)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Witnessed violence</td>
<td>40.5%</td>
</tr>
<tr>
<td>Felt discrimination</td>
<td>34.5%</td>
</tr>
<tr>
<td>Adverse neighborhood experience</td>
<td>27.3%</td>
</tr>
<tr>
<td>Bullied</td>
<td>7.9%</td>
</tr>
<tr>
<td>Lived in foster care</td>
<td>2.5%</td>
</tr>
</tbody>
</table>
Prevalence of Conventional ACEs
CDC-Kaiser vs. Philadelphia ACE Study

ACE Prevalence (%)

- 1 or more Conventional ACEs
  - CDC-Kaiser ACE Study
  - Philadelphia ACE Study

- 4 or more Conventional ACEs
  - CDC-Kaiser ACE Study
  - Philadelphia ACE Study
Overlap Between Exposure to Conventional and Expanded ACEs

- 17.2% No ACEs
- 19.6% > 1 Conventional ACE
- 49.3% 1 Conventional ACE & > 1 Expanded ACE
- 13.9% > 1 Expanded ACE
Relationship Between Philadelphia ACE Score and Smoking History
Relationship Between Philadelphia ACE Score and Mental Health

Conventional ACEs

Risk for Mental Illness

Expanded ACEs

Total ACEs

Risk for Mental Illness

- 0
- 1 to 4
- 4+

0
1
2
3
4
5
6

0
1
2
3
4
5
6

Risk for Mental Illness
Relationship Between Philadelphia ACE Score and Cardiovascular Disease

- **Conventional ACEs**
  - 0
  - 1 to 3
  - 4+

- **Expanded ACEs**
  - 0
  - 1 to 3
  - 4+

- **Total ACEs**
  - 0
  - 1 to 3
  - 4+
## Demographic Characteristics for Philadelphia Adults with Four or More ACEs

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Respondents (N = 1,784)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>58.2%</td>
</tr>
<tr>
<td>Female</td>
<td>41.8%</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>48.6%</td>
</tr>
<tr>
<td>White</td>
<td>34.0%</td>
</tr>
<tr>
<td><strong>Poverty Level</strong></td>
<td></td>
</tr>
<tr>
<td>Below 150% of poverty guidelines</td>
<td>68.2%</td>
</tr>
<tr>
<td>Above 150% of poverty guidelines</td>
<td>31.8%</td>
</tr>
</tbody>
</table>

*p<0.05; **p<0.01; ***p<0.001
Impact of Toxic Stress

Toxic Stress

Hyper-responsive stress response

Chronic fight or flight/Increased cortisol

Changes in Brain Architecture
Breaking the Cycle of Trauma

Nurturing Supportive Relationships
Changes You May Wish to Make in Practice

• Increase awareness of impact of ACEs and poverty on child health
• Adopt universal ACE assessment as first step in addressing toxic stress
• Leverage relationships with community partners
• Understand contextual issues in surrounding of ACEs
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• Study Participants