Adverse Childhood Experiences:

Connecting a Developmental Lens to the Health of Society

Robert Anda, MD, MS
ACE Study Concepts

www.RobertAndaMD.com
www.acestudy.org
www.cdc.gov/ace
The Walk to Paradise Garden

W. Eugene Smith
Seeing the Pain
America's physicians confront family violence
Early connections in the brain

The brain is undoubtedly one of nature's most remarkable creations: cells that can react to impulses, analyze and control behavior. As early as in the seventh week, nerve cells in the brain have begun to touch one another by means of projections, and some have even become connected in primitive nerve paths. The picture above shows nerve cells at this time, greatly enlarged. The rate of production is tremendous: 100,000 new nerve cells are created every minute, and by the time the baby is born, there will be some 100 billion. *Left,* the posterior lobes of the cerebrum shimmer through the skin of the forehead.
SYNAPTIC DENSITY: Synapses are created with astonishing speed in the first three years of life. For the rest of the first decade, children’s brains have twice as many synapses as adults’ brains.

Drawings supplied by H.T. Chugani.
Barriers to Educational Achievement Emerge at a Very Young Age

RAPID EARLY DEVELOPMENT: These PET scans suggest that the brain of a one year old more closely resembles an adult’s brain than a newborn’s.

Source: H.T. Chugani
Persistent Stress Changes Brain Architecture

Normal

Toxic stress

Prefrontal Cortex and Hippocampus

Sources: Radley et al. (2004) Bock et al. (2005)
“The Creation of Adam”
Michelangelo 1508–1512
The Adverse Childhood Experiences (ACE) Study

Examines the health and social effects of ACEs throughout the lifespan among 17,421 members of the Kaiser Health Plan in San Diego County

A Primary Care Setting…

Educated…

Middle Class...

Predominantly White…
ACE Study Design

Survey Wave I
(N=9,508)

Follow-up
(N = 17,421)

Survey Wave II
(N=8,667)

Mortality
National Death Index
Morbidity
Hospital Discharge
Outpatient Visits

Emergency room
visits
Pharmacy Utilization

Comprehensive medical
Evaluations abstracted
# Adverse Childhood Experiences Are Common

**Household dysfunction:**

- Substance abuse: 27%
- Parental sep/divorce: 23%
- Mental illness: 17%
- Battered mother: 13%
- Criminal behavior: 6%

**Abuse:**

- Psychological: 11%
- Physical: 28%
- Sexual: 21%

**Neglect:**

- Emotional: 15%
- Physical: 10%
Adverse Childhood Experiences Rarely Occur in Isolation…

They come in groups.
Alcohol Abuse in the Home and the Risk of Other ACEs...
Alcohol Abuse in the Home and the Risk of Childhood Abuse

Number of alcohol abusers:
- 0
- 1
- 2 or more

Percent Abused (%)

Type of Abuse
- Emotional
- Physical
- Sexual
Domestic Violence in the Home and the Risk of Other ACEs...
Prevalence of Childhood Abuse by Frequency of Witnessing Domestic Violence

Frequency of witnessing domestic violence
- Never
- Once, Twice
- Sometimes
- Often
- Very often

Percent (%)

Childhood Abuse
- Emotional
- Physical
- Sexual
ACEs tend to come in groups...

<table>
<thead>
<tr>
<th>Additional ACEs (%)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>≥5</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you had:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A battered mother</td>
<td>95</td>
<td>82</td>
<td>64</td>
<td>48</td>
<td>52</td>
</tr>
<tr>
<td>ACE Score</td>
<td>Prevalence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>0</td>
<td>33%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>26%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>16%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 or more</td>
<td>16%</td>
<td></td>
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</tr>
</tbody>
</table>
ACEs, Smoking, and Lung Disease

- Early smoking initiation
- Current smoking
- COPD

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

Percent With Health Problem (%)
The ACE Score…
Alcohol Use and Abuse

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

Percent with alcohol related problem

Ever heavy drinker
Problem with alcohol use
Alcoholic
Married an Alcoholic
ACE Score and HIV Risks

ACE Score

- 0
- 1
- 2
- 3
- 4 or more

Percent With Health Problem (%)

Ever Injected Drugs

Had 50 or More Intercourse Partners

Ever Had an STD

Percent With Health Problem (%)
The ACE Score and the Prevalence of Liver Disease (Hepatitis/Jaundice)
The ACE Score and the Prevalence of Coronary Heart Disease
A Focus on Mental Health...
The ACE Score and a Lifetime History of Depression

![Graph showing the percentage of depressed individuals by ACE Score for men and women.]

- **Graph Title:** The ACE Score and a Lifetime History of Depression
- **X-axis:** ACE Score
- **Y-axis:** Percent depressed (%)
- **Legend:**
  - Women
  - Men

The graph illustrates the relationship between ACE Score and the percentage of depressed individuals, categorized by gender. Higher ACE scores are associated with a higher percentage of depressed individuals, particularly among women.
The ACE Score and the Prevalence of Attempted Suicide

ACE Score

Percent attempted (%)

0 1 2 3 >=4

ACE Score

Percent attempted (%)

0 1 2 3 >=4

The chart shows the relationship between ACE Score and the prevalence of attempted suicide. The percentage of attempted suicide increases with higher ACE scores.
Cumulative ACEs Increase the Number of Lifetime DSM-IV Diagnoses*

National Comorbidity Survey – Replication Sample

N=5692

*Putnam, Harris, Putnam unpublished data, 2011
“The Kiss”
Constantin Brancusi
1909
ACE Score and the Risk of Being a Victim of Domestic Violence

Women

Men

Risk of Victimization (%)

ACE Score

0 1 2 3 4 ≥5

0 1 2 3 4 ≥5
ACE Score and the Risk of Being Sexually Assaulted as an Adult

Risk of Sexual Assault (%) vs. ACE Score

Women

- 0
- 1
- 2
- 3
- 4
- >5

Men

- 0
- 1
- 2
- 3
- 4
- >5

ACE Score
ACEs and Reproductive Behavior

.... Are they self replicating??
Ace Score and Teen Sexual Behaviors

ACE Score

- 0
- 1
- 2
- 3
- 4 or more

Percent with Health Problem (%)

Intercourse by Age 14
Teen Pregnancy
Teen Paternity
Relationship Between Number of Adverse Childhood Experiences and Adolescent Pregnancy

ACE Score vs. Percent who had a teen pregnancy

0 1 2 3 4 5 6 7 8

0 10 20 30 40 50 60

Percent who had a teen pregnancy

ACE Score
Percent of Women Who Ever Had an Unintended Pregnancy by ACE Score
Relationship Between Number of Adverse Childhood Experiences and Fetal Death—First or Second Pregnancy
<table>
<thead>
<tr>
<th>Mental Health:</th>
<th>PAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current depression</td>
<td>54%</td>
</tr>
<tr>
<td>Depressed affect</td>
<td>41%</td>
</tr>
<tr>
<td>Suicide attempt</td>
<td>58%</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Drug Abuse:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcoholism</td>
<td>65%</td>
</tr>
<tr>
<td>Drug abuse</td>
<td>50%</td>
</tr>
<tr>
<td>IV drug abuse</td>
<td>78%</td>
</tr>
</tbody>
</table>

Promiscuity                         | 48%  |

<table>
<thead>
<tr>
<th>Crime Victim:</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Sexual assault</td>
<td>62%</td>
</tr>
<tr>
<td>Domestic violence</td>
<td>52%</td>
</tr>
</tbody>
</table>

*Based upon the prevalence of one or more ACEs (62%) and the adjusted odds ratio >1 ACE.
ACEs Changed the Landscape

• Provided a compelling tabulation of childhood adversity that directly related to easily understood costly outcomes

• Largely responsible for increased awareness of policy makers of the role of childhood trauma in costly medical, psychiatric and social problems

• Legitimized and stimulated interest in childhood adversities for researchers in a range of fields
ACEs Changed the Landscape

• **Pervasiveness of ACEs**
  – Huge number of major public health problems that were ACE-related (e.g., Depression, Substance Abuse, STDs, Cancer, Heart Disease, Chronic Lung Disease, Diabetes)
  – Significant number of middle-class Americans had ACEs

• **Perniciousness of ACEs**
  – Major contributors to the leading causes of death and disability
  – Life-shortening (~20 years for people with 6+ ACEs)

• **Persistence of ACEs**
  – Life-time effects
  – Likelihood of intergenerational transmission
Beyond ACEs

• Link ACEs to existing and future programs seeking to prevent mental illness, medical diseases, substance abuse, health risk behaviors, and social dysfunction

• Prevent ACEs
  – Zero ACEs is protective
  – Prevent further ACEs in maltreatment victims

• Identify and treat ACEs early in life

• Identify mechanisms (behavioral and biological) through which ACEs negatively impact life trajectories
The Walk to Paradise Garden

W. Eugene Smith
The Costs of the Status Quo..

Reflect the Costs of Ignoring and Impairing Early Childhood Development
Significant Adversity Impairs Development in the First Three Years

Source: Barth et al. (2008)
Washington School Classroom (30 Students)
Adverse Childhood Experiences (ACEs)

- 6 students with no ACE
- 5 students with 1 ACE
- 6 students with 2 ACEs
- 3 students with 3 ACEs
- 7 students with 4 or 5 ACEs
- 3 students with 6 or more ACEs
Students with 3 or more ACEs:

- Are 2 ½ times more likely to fail a grade
- Score lower on standardized tests
- Have language difficulties
- Are suspended or expelled more
- Are designated to special education more frequently
- Have poorer health

Courtesy of Chris Blodgett, PhD
Washington State University
Costs of the Status Quo

Criminal Justice

..the prison pipeline
ACEs Among Youth on Probation
Pierce County, Washington
ACE Exposure and Youth Outcomes

History of Alcohol & Drug Use and ACE Score

- 50% 54%
- 63% 68%
- 71% 77%
- 74% 80%
- 72% 74%
- 81% 84%

Legend:
- Alcohol
- Drug
ACE Score and Repeated Suspension/Expulsion
Youth on Probation, Pierce County, WA

History of ≥ 7 expulsions or suspensions since the first grade

Prevalence (%) of History of > 7 expulsions or suspensions since the first grade

ACE Score
0.1
1
10

0 1 2 3 4 5+
aOR (95% CI)

16.9% (n=69) 25.5% (n=158) 35.3% (n=148) 35.7% (n=124) 38.6% (n=148) 39.4% (n=148)
ACE Score and Poor Academic Performance
Youth on Probation, Pierce County, WA

Poor academic performance during most recent school term

<table>
<thead>
<tr>
<th>ACE Score</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>16.9% (n=11)</td>
</tr>
<tr>
<td>1</td>
<td>25.0% (n=68)</td>
</tr>
<tr>
<td>2</td>
<td>29.1% (n=132)</td>
</tr>
<tr>
<td>3</td>
<td>28.1% (n=117)</td>
</tr>
<tr>
<td>4</td>
<td>32.3% (n=105)</td>
</tr>
<tr>
<td>5+</td>
<td>35.7% (n=135)</td>
</tr>
</tbody>
</table>

aOR (95% CI)
ACE Score and Felony Re-offense

Felony Re-offense Post Probation and ACE Score

- 0% 12% 16% 10% 18% 16% 16% 11% 20% 19% 25% 25% 31%

- Within One Year: 0, 1, 2, 3, 4, ≥ 5
- Within Two Years: 0, 1, 2, 3, 4, ≥ 5
Costs of the Status Quo

Health Care
Prescription Drugs in the United States (2003)

- nearly $180 billion spent

- 11% of total national health expenditures

- more than four times the amount spent in 1990
ACE Score and Rates of Antidepressant Prescriptions

![Bar chart showing the correlation between ACE Score and prescription rate (per 100 person-years). The x-axis represents ACE Score (0, 1, 2, 3, 4, >=5), and the y-axis represents prescription rate (0 to 100). The chart visually demonstrates an increase in prescription rates with higher ACE scores.](image-url)
Costs of the Status Quo

Corporations and the Workforce
Drains on Profitability..

Depression and its work related outcomes, absenteeism, reduced productivity, and medical expenses: $44 billion per year

Back pain in the workforce: $28 billion per year

Chemical dependency: $246 billion per year

These massive losses occur despite the existence of workplace safety programs and the most expensive system of medical care in the world.
ACE Score and Indicators of Impaired Worker Performance

- Absenteeism (≥2 days/month)
- Serious Financial Problems
- Serious Job Problems

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

Prevalence of Impaired Performance (%)
4 Areas of Health and Well-Being as Mediators

- Relationship Problems
  - marital
  - family
  - sexual
- Emotional Distress
  - depressed mood
  - panic reactions
  - difficulty with anger
- Somatic Symptoms
  - back pain
  - headaches
  - joint problems
- Substance Abuse
  - alcoholism
  - smoking
  - illicit drug use

Adverse Childhood Experiences

Poor Worker Performance
“In the brain, as in the economy, getting it right the first time is ultimately more effective and less costly than trying to fix it later. “

James Heckman
Nobel Laureate Economist

ACEs Effect An Array of Brain Functions

Affect Regulation
Panic reactions, depression, anxiety, hallucinations

Somatic Issues
Sleep disturbances, severe obesity, pain

Substance Use
Smoking, alcoholism, illicit drug use, IV drug use

Sexuality
Early intercourse, promiscuity, sexual dissatisfaction

Memory
Amnesia (childhood)

Arousal
High stress, problems with anger, perpetrating domestic violence
Neurobiology and Epidemiology Converge

**Complex Trauma—Trauma Spectrum Disorders and the mean number of a variety of problems**

![Bar chart showing the mean number of co-occurring outcomes across different ACE scores.](chart.png)
ACEs appear to affect multiple brain systems and functions. This leads to multiple problems in different health and social domains.

*Developmental Trauma Disorder*
Adverse Childhood Experiences
As a National Health Issue

ACEs have a strong influence on:
- adolescent health
- reproductive health
  - smoking
  - obesity
  - alcohol abuse
  - illicit drug abuse
- sexual behavior
  - mental health
- risk of violence and revictimization
- stability of relationships
- performance in the workforce
Adverse Childhood Experiences As a National Health Issue

ACEs increase the risk of:
- Early death
- Heart disease
- Chronic Lung disease
- Lung cancer
- Liver disease
- Autoimmune disease
- Suicide
- Injuries
- HIV and STDs
- other risks for leading causes of death
Beham, (Hans) Sebald (1500-1550): Hercules slaying the Hydra, 1545 from The Labours of Hercules (1542-1548).
A Public Health Framework For Change

Treatment

Education  Prevention

All must consider Intergenerational transmission
Bridging The Chasm

Intergenerational Care

Consolidation and Coordination

Child health as it stands today

Child and adult health as it could be
Bridging The Chasm

Breakthroughs in molecular genetics and neurobiology:
- Mental illness
- Substance abuse
- Violence

Improved recognition and treatment of:
- Mental illness
- Substance abuse
- Domestic violence
- Child abuse

Child health as it stands today

Child health as it could be
Bridging The Chasm

Mass education about child development & parenting:
- Media
- Schools

Promoting Healthy Neurodevelopment through better early childhood development
(Promoting Resilience)
Bridging The Chasm

Harnessing Brain Plasticity To Overcome the Effects of Adversity (Resilience or Recovery)

Documenting the societal burden of child health as it stands today

New directions in prevention, treatment, and policy
Limits of Understanding

by Paul Klee
(1879-1940)
..the prison pipeline extends into adulthood
ACE Scores
Kaiser Health Plan

Messina and Greila
Am J Pub Health
October, 2006
ACE Scores
Kaiser vs Adult Women In Prison

Percent (%)

ACE Score

0 1 2 3 4 >=5

Messina and Greila
Am J Pub Health
October, 2006
These Mediators Account for Most of the Effect of ACEs on Worker Performance

<table>
<thead>
<tr>
<th>Indicators of Worker Performance</th>
<th>% Mediation by 4 Areas of Health and Well-Being</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absenteeism</td>
<td>50-67%</td>
</tr>
<tr>
<td>Serious Financial Problems</td>
<td>50-83%</td>
</tr>
<tr>
<td>Serious Job Problems</td>
<td>79-100%</td>
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</tbody>
</table>
Public Health Surveillance

Information for Program Applications

Data Analysis → Data Interpretation → Information Dissemination → Program Planning → Program Implementation → Program Evaluation → Data Collection → Data Analysis

Source: Remington and Goodman 1998
States With ACE Studies in 2008

Source: Behavioral Risk Factor Surveillance System, CDC.
States With ACE Studies in 2009

States With ACE Studies in 2009

Source: Behavioral Risk Factor Surveillance System, CDC.
States With ACE Studies in 2009-2010

Source: Behavioral Risk Factor Surveillance System, CDC.
States With ACE Studies in 2009-2011

Source: Behavioral Risk Factor Surveillance System, CDC.
ACEs: A Global Challenge

Preventing Child Maltreatment:
a guide to taking action and generating evidence

Guide sur la prévention de la maltraitance des enfants:
trevenir et produire des données

-world health organization

Adverse Childhood Experiences (ACE) and Health-Risk Behaviors among Adults in a Developing Country Setting

Bernadette J. Madrid and Laurie S. Ramiro
University of the Philippines Manila and Child Protection Unit Network Inc.

This study aimed to determine the relationship between adverse childhood experiences, health-risk behaviors and the occurrence of certain diseases, in a developing country setting. One thousand and sixty-eight (1,068) males and females aged 35 years and above, and residing in the selected urban communities in Quezon City, Philippines participated in the study. Using the Adverse Childhood Experiences (ACE) Questionnaires developed by the US Center for Disease Control and Kaiser Permanente, the results revealed that sexual abuse and having a smoker and an alcoholic in the home were the most common adverse experiences in childhood. The probability of being exposed to more than one category ranged from 7 percent to as high as 86 percent. Significantly more categories of exposure were found among males, those belonging to the middle socio-economic class and those who had lower levels of education. This present study revealed that certain health-risk behaviors occur even with only a single exposure or two. The results also show that just about two types of exposures can result in various diseased conditions.

Key words: adverse childhood experiences, health-risk behaviors, developing country, Philippines
Costs of the Status Quo

Health Care
Corporations and the Workforce
Criminal Justice
Significant risk of early use/abuse of:
- Alcohol, tobacco, illicit & prescription drugs
- Slowed language & reading
- Lateralization
- Diminished IQ
- Poor decision making skills
- Attention problems
- ADD
- ADHD
- Aggressive behavior
- Social isolation among peers
- Poor understanding of social cues = conflict

Significant risk of early use/abuse of:
- Alcohol, tobacco, illicit & prescription drugs
- Special education
- School failure
- Dropping out
- Suspension
- Expulsion
- Delinquency
- Dropping out

EARLY TRAUMA & STRESS

Predictable patterns of brain development, traits & behaviors

ADVERSE CHILDHOOD EXPERIENCE

THE FAST TRACK TO POVERTY

- Low-wage jobs
- Unemployment
- Public Assistance
- Prison
- Chronic health problems
- Debilitating mental health
Human Brain Development
Neural Connections for Different Functions Develop Sequentially

Sensory Pathways (Vision, Hearing)
Language
Higher Cognitive Function

First Year
Birth (Months) (Years)

The brain’s activity can be measured in electrical impulses—here, “hot” colors like red or orange indicate more activity, and each column shows a different kind of brain activity. Young children institutionalized in poor conditions show much less than the expected activity.

Preventive Intervention is More Efficient and Produces Higher Returns than Later Remediation

Heckman, J. (2007)

Rates of return to human capital investment

Programs targeting the earliest years

Preschool programs

K-12 interventions

Job training

0-3 4-5 6-18 19+

Age