aces aware
SCREEN. TREAT. HEAL.

The Science of ACEs and Toxic Stress

This fact sheet explains Adverse Childhood Experiences (ACEs) and the impact of ACEs and toxic stress on health.

The term Adverse Childhood Experiences (ACEs) comes from the landmark 1998 study by the Centers for Disease Control and Prevention (CDC) and Kaiser Permanente. It describes 10 categories of adversities in three domains experienced by age 18 years: abuse, neglect, and/or household dysfunction (Figure 1).[1]

Data show that 62% of California residents have experienced at least one ACE and 16% have experienced four or more ACEs, using 2011-2017 Behavioral Risk Factor Surveillance System (BRFSS) data from a random-digit-dialed telephone survey.[2]

Figure 1: 10 Categories of Adverse Childhood Experiences (ACEs)

Abuse: physical, emotional, and sexual abuse

Neglect: physical and emotional neglect

Household dysfunction: parental incarceration, mental illness, substance use, parental separation or divorce, and intimate partner violence

Key findings of the ACE Study and subsequent body of research include:

- **ACEs are highly prevalent.** Two thirds of respondents in the Kaiser Permanente/CDC study reported at least one ACE and one in eight reported four or more ACEs.[1, 3,4] Subsequent studies have shown a rate of four or more ACEs that is closer to one in six.[5,6]

- **ACEs are strongly associated, in a dose-response fashion, with some of the most common and serious health conditions** facing our society today, including at least nine of the 10 leading causes of death in the U.S. (Figure 2). Find the ACE-Associated Health Conditions as part of the ACE Screening Workflows, Risk Assessment and Treatment Algorithms, and ACE-Associated Health Conditions at **ACEsAware.org/assessment-and-treatment**.

- **ACEs affect all communities.** The original ACE Study was conducted among a population that was mostly Caucasian, middle class, employed, college educated, and privately insured.[1,3,4] Subsequent studies have found higher prevalence rates of ACEs in people who are low-income, of color, justice-involved, and/or part of the lesbian, gay, bisexual, transgender, and queer (LGBTQ+) community.[5-10]

Figure 2: Leading Causes of Death in the U.S.

	Leading Causes of Death in the U.S., 2017	Odds Ratios for ≥ 4 ACEs (relative to no ACEs)
1	**Heart disease**	2.1
2	**Cancer**	2.3
3	**Accidents** (unintentional injuries)	2.6
4	**Chronic lower respiratory disease**	3.1
5	**Stroke**	2.0
6	**Alzheimer's** or dementia	11.2
7	**Diabetes**	1.4
8	**Influenza and pneumonia**	Risk unknown
9	**Kidney disease**	1.7
10	**Suicide** (attempts)	37.5

Source of **causes of death**: CDC, 2017.[11]
Sources of **odds ratios**: Hughes *et al.*, 2017 for 1, 2, 4, 7, 10.[12]
Petrucelli *et al.*, 2019 for 3 (injuries with fracture), 5.[3,5,13]
Center for Youth Wellness, 2014 for 6 (Alzheimer's or dementia).[14]
Center for Youth Wellness, 2014 and Merrick *et al.*, 2019 for 9.[5,14]

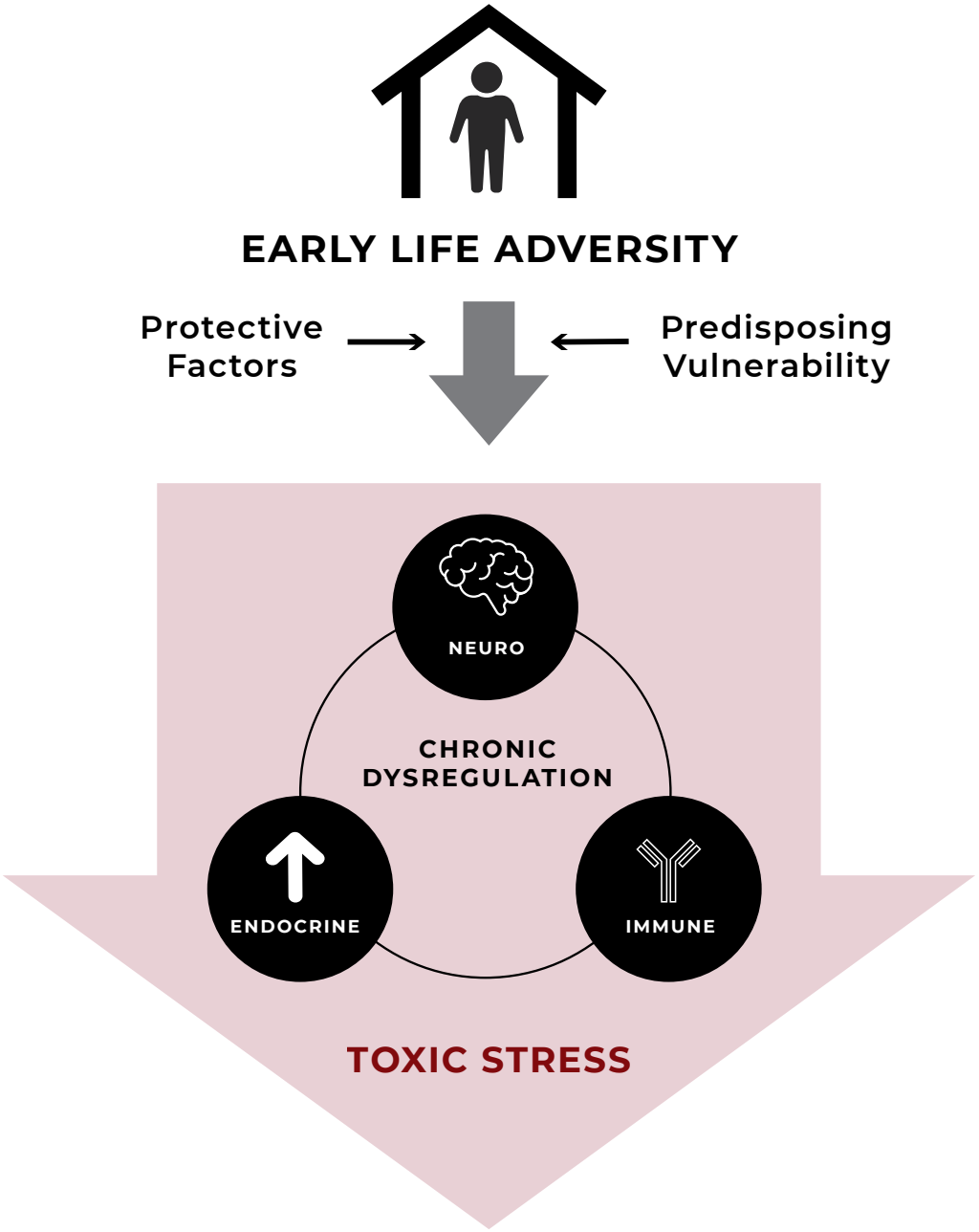
Toxic Stress

Several decades of scientific research have identified the biological mechanisms by which early adversity leads to increased risk of negative health and social outcomes through the life course. Repeated or prolonged activation of a child's stress response, without the buffering protections of trusted, nurturing caregivers and safe, stable environments, leads to long-term changes in the structure and functioning of the developing brain, metabolic, immune, and neuroendocrine responses, and even the way DNA is read and transcribed. This is known as the **toxic stress response** (Figure 3).[15-18]

These biological changes play an important role in the clinical progression from ACE exposure to negative short- and long-term health and social outcomes. Further, both the disrupted biology and the associated negative outcomes demonstrate a pattern of high rates of intergenerational transmission. Development of the toxic stress response is influenced by a combination of cumulative adversity, buffering or protective factors, and predisposing vulnerability.

In addition to ACEs, social determinants of health (SDOH), such as poverty, discrimination, and housing and food insecurity, are associated with health risks and may also be risk factors for toxic stress. While validated odds ratios are available in large, population-based studies utilizing the 10 standardized ACE criteria, the strengths of associations between SDOH and health outcomes have not been similarly standardized.

Figure 3: Toxic Stress Response



CLINICAL IMPLICATIONS

Epigenetic		
Endocrine Metabolic Reproductive	Neurological Psychiatric Behavioral	Immune Inflammatory Cardiovascular

Adapted from *Bucci et al.*, 2016[16]

The Impact of ACEs and Toxic Stress on Health

ACEs are associated with increased risk of a wide range of negative health conditions in both pediatric and adult populations. The life expectancy of individuals with six or more ACEs is 19 years shorter than that of individuals with none.[20] Find a list of ACE-Associated Health Conditions for pediatrics and adults as part of the ACE Screening Workflows, Risk Assessment and Treatment Algorithms, and ACE-Associated Health Conditions at **ACEsAware.org/assessment-and-treatment**.

Pediatric Health

The effects of toxic stress are detectable as early as infancy. In babies, high doses of adversity are associated with failure to thrive, growth delay, sleep disruption, and developmental delay. School-aged children may have increased risk of viral infections, pneumonia, asthma, and other atopic diseases, as well as difficulties with learning and behavior.

Among adolescents with high ACEs, somatic complaints — including headache and abdominal pain, increased engagement in high-risk behaviors, teen pregnancy, teen paternity, sexually transmitted infections (STIs), mental health disorders, and substance use — are common.

Adult Health

As noted above, ACEs are associated with some of the most common and serious health conditions facing our communities. Learn more about ACE-Associated Health Conditions for adults at: **ACEsAware.org/assessment-and-treatment**.

Mental and Behavioral Health

The higher the ACE score, the greater the likelihood an individual may experience mental health disorders such as depression, post-traumatic stress disorder, anxiety, and sleep disorders, and engage in risky behaviors such as early and high-risk sexual behaviors and substance use.[5,12,13] High doses of childhood adversity are associated with increased risk of engaging in high-risk behaviors that can lead to negative health outcomes.

However, even in the absence of health-damaging behavior, strong associations between cumulative childhood adversity and increased risk of serious health conditions persist. Evidence suggests that the toxic stress response likely plays a role in mediating both behavior-related and non-behavior-related pathways.

Cost of ACEs in California

Considering just five ACE-Associated Health Conditions (asthma, arthritis, COPD, depression, and cardiovascular disease) and three health risk factors (lifetime smoking, heavy drinking, and obesity), the **annual total cost of these health-related impacts of ACEs in California is $112.5 billion**. This includes direct healthcare expenditures ($10.5 billion), and the cost in disability and years of productive life lost to ACEs ($102 billion).[21,22]

In sum, ACEs are common, highly consequential for health and well-being, and very costly—and thus constitute a major and under-addressed public health crisis of our era.

For information on the clinical response to ACEs, see the "Clinical Response to Adverse Childhood Experiences and Toxic Stress" fact sheet at **ACEsAware.org/toolkit/clinical-response**.

References

1 Felitti VJ, Anda RF, Nordenberg D, et al. Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults. The Adverse Childhood Experiences (ACE) Study. Am J Prev Med 1998; 14: 245–58.

2 California Department of Public Health, Injury and Violence Prevention Branch (CDPH/IVPB), University of California, Davis, Violence Prevention Research Program, California Behavioral Risk Factor Surveillance System (BRFSS), 2011-2017.

3 Dube SR, Felitti VJ, Dong M, Giles WH, Anda RF. The Impact of Adverse Childhood Experiences on Health Problems: Evidence from Four Birth Cohorts Dating Back to 1900. Preventive Medicine 2003; 37: 268–77.

4 Anda RF, Felitti VJ, Bremner JD, et al. The Enduring Effects of Abuse and Related Adverse Experiences in Childhood: A Convergence of Evidence from Neurobiology and Epidemiology. European Archives of Psychiatry and Clinical Neuroscience 2006; 256: 174–86.

5 Merrick MT, Ford DC, Ports KA, et al. Vital Signs: Estimated Proportion of Adult Health Problems Attributable to Adverse Childhood Experiences and Implications for Prevention—25 States, 2015–2017. MMWR Morb Mortal Wkly Rep 2019; 68. DOI:10.15585/mmwr.mm6844e1.

6 Merrick MT, Ford DC, Ports KA, Guinn AS. Prevalence of Adverse Childhood Experiences from the 2011-2014 Behavioral Risk Factor Surveillance System in 23 States. JAMA Pediatr 2018; 172: 1038–44.

7 Baglivio M, Swartz K, Sayedul Huq M, Sheer A, Hardt N. The prevalence of Adverse Childhood Experiences (ACEs) in the lives of juvenile offenders. Journal of Juvenile Justice 2014; 3: 1–23.

8 Liu SR, Kia-Keating M, Nylund-Gibson K, Barnett ML. Co-Occurring Youth Profiles of Adverse Childhood Experiences and Protective Factors: Associations with Health, Resilience, and Racial Disparities. American Journal of Community Psychology 2019; published online Sept 6. DOI:10.1002/ajcp.12387.

9 Liu SR, Kia-Keating M, Nylund-Gibson K. Patterns of adversity and pathways to health among White, Black, and Latinx youth. Child Abuse & Neglect 2018; 86: 89–99.

10 Maguire-Jack K, Lanier P, Lombardi B. Investigating racial differences in clusters of adverse childhood experiences. American Journal of Orthopsychiatry 2019; published online Feb 28. DOI:10.1037/ort0000405.

11 Centers for Disease Control and Prevention. Leading causes of death by age group 2017. https://www.cdc.gov/injury/images/lc-charts/leading_causes_of_death_by_age_group_2017_1100w850h.jpg (accessed May 8, 2019).

12 Hughes K, Bellis MA, Hardcastle KA, et al. The Effect of Multiple Adverse Childhood Experiences on Health: A Systematic Review and Meta-Analysis. The Lancet Public Health 2017; 2: e356–66.

13 Petruccelli K, Davis J, Berman T. Adverse childhood experiences and associated health outcomes: A systematic review and meta-analysis. Child Abuse & Neglect 2019; 97: 104127.

14 Center for Youth Wellness. Data Report: A Hidden Crisis. Findings on Adverse Childhood Experiences in California. 2014.

15 Bucci M, Marques SS, Oh D, Harris NB. Toxic Stress in Children and Adolescents. Advances in Pediatrics 2016; 63: 403–28.

16 Garner AS, Shonkoff JP, Committee on Psychosocial Aspects of Child and Family Health, Committee on Early Childhood, Adoption, and Dependent Care, Section on Developmental and Behavioral Pediatrics, et al. Early Childhood Adversity, Toxic Stress, and the Role of the Pediatrician: Translating Developmental Science into Lifelong Health. Pediatrics 2012; 129: e224–31.

17 Shonkoff JP, Garner AS, Dobbins MI, et al. The Lifelong Effects of Early Childhood Adversity and Toxic Stress. Pediatrics 2012; 129: e232–46.

18 Danese A, McEwen BS. Adverse Childhood Experiences, Allostasis, Allostatic Load, and Age-Related Disease. Physiology & Behavior 2012; 106: 29–39.

20 Brown DW, Anda RF, Tiemeier H, et al. Adverse childhood experiences and the risk of premature mortality. American Journal of Preventive Medicine 2009; 37: 389–96.

21 Waehrer GM, Miller TR, Silverio Marques SC, Oh DL, Burke Harris N. Disease burden of adverse childhood experiences across 14 states. PLoS ONE 2020; 15: e0226134.

22 Miller TR, Waehrer GM, Oh DL, et al. Adult Health Burden and Costs in California During 2013 Associated with Prior Adverse Childhood Experiences. PLoS ONE 2020; 15: e0228019.

Visit **ACEsAware.org** and join us as we launch a movement — led by the Office of the California Surgeon General and the California Department of Health Care Services — to ensure everyone is ACEs Aware.

5/5/20