

Root causes and organic budgeting: funding health from conception to the grave



**Robert F Anda[†] &
David W Brown**

[†]Author for correspondence
Centers for Disease Control
and Prevention, 4770 Buford
Hwy NE (MS K67) Atlanta,
GA 30341, USA
E-mail: rfa1@cdc.gov

‘Thus, ACEs become biology, leading to social, emotional and cognitive impairments that increase the risk of unhealthy (but probably adaptive) behaviors, risk of violence or revictimization, poor psychosocial functioning, disease and disability.’

Place: ‘Developed’ country. Time: Present day. Event: A sperm penetrates an egg. Months later, a child born at term, without identifiable genetic defects, normal birth weight, APGAR 10, and all organ systems exquisitely formed. Fantastic!

Supposition 1: For a child like this, social determinants of health [101] are the major forces that affect your public-health goal of ‘wellness in every stage of life’ [102].

Supposition 2: You have sole power over the economic resources of your nation. Challenge: As holder of this economic power, your challenge is to choose the major predictor of this newborn child’s future social and cognitive development, health and wellbeing, adolescent and adult behavior, physical and mental health, adult functioning, risk for a variety of diseases, and cause of death. To determine where to place the money that will shape public-health policy and services that meets all of these needs, you must place a bet on the ‘root’ origins of health and wellbeing for children.

Your choices: We live in a world of categorical thinking and categorical funding, so you only get one choice for your bet. Would you choose access to healthcare [1]? School achievement [103]? Racial disparities in health [2]? Socioeconomic status [3]? Poverty [104]?

Now, consider the life stages in reverse order, since a ranking of health expenditures – from highest to lowest – would be ranked similarly.

Start with the last stage of life: dying. In 1993, McGinnis and Foege quantified the contribution of adverse health behaviors (e.g., smoking, alcohol use and physical inactivity) to the leading causes of death, which they termed the ‘actual’ causes of death, in the

USA [4], a huge step forward for thinking about using your nation’s health resources! If you also were aware of a common set of biologically plausible exposures that increase the risk of these nonrandom adverse health behaviors, you might term these the root causes of death.

Next stage: adult health. Consider some of the major causes of a lack of wellbeing, and morbidity, in adults. The list would include heart, lung and liver disease, obesity, substance abuse, depression, anxiety, sexually transmitted diseases and intimate-partner violence. And do not forget important problems with respect to functioning as an adult, such as inability to maintain lasting relationships, nurture children, manage finances or perform in the workforce.

Now, move backward again in time to the stage we call adolescence. The list of major issues would include early intercourse, teen smoking, alcohol or drug use, teen pregnancy and paternity, suicide attempts, violence and poor school performance.

‘...we believe the priority should be for children and public-health policy: reduce the cumulative exposure of children to the activated stress response during critical periods of neurodevelopment.’

Consider the *in utero* life stage. Can the same root causes play a role in spontaneous abortion or fetal death? Evidence is also emerging to suggest that these root causes exposures may alter genomic expression, helping you tie this all together from generation to generation [5].

You enlist a group of experts on health and social services to help you develop a list of top priorities across the lifespan that that will inform your decision. The following problems would probably appear on your list:

- Prevalent diseases: ischemic heart disease, stroke, cancer, chronic lung disease, skeletal fractures, sexually transmitted diseases, diabetes, liver disease, suicide attempts;
- Risk factors for common diseases/poor health: smoking, alcohol abuse, promiscuity, obesity, illicit drug use, injected drug use, multiple

somatic symptoms, poor self-rated health, self-reported high risk of AIDS;

- Poor mental health: depressive disorders, anxiety, hallucinations, panic reactions, sleep disturbances, memory disturbances, poor anger control, risk of perpetrating or being a victim of domestic violence;
- Sexual and reproductive health: early age at first intercourse, sexual dissatisfaction, teen pregnancy, unintended pregnancy, teen paternity, spontaneous abortion or fetal death;
- Poor general health and social problems: high perceived stress, inability to maintain a marriage relationship, marriage to an alcoholic;
- Obviously expensive items: difficulty with job performance, prescriptions for psychotropic drugs, unexplained medical symptoms.

‘The ACE Score has a strong dose–response relationship to every problem on your list of health priorities from your consultants.’

The Roots

What preventable exposure do all of these priorities have in common? Our choice (sorry, it was not on your list) comes from a study of a cohort of more than 17,000 adults surveyed during 1995–1997 as part of the Adverse Childhood Experiences (ACE) study [6]; all were enrolled in a health-maintenance organization in San Diego (CA, USA), so they all had access to healthcare. Moreover, they are a well-educated group of Americans: 40% were college graduates, 36% had some college education and 17% were high-school graduates. Only 7% had not graduated from high school. These are people who have, on average, done ‘better’ than the general population of the country in which they reside. So, from a socioeconomic standpoint, things are looking pretty good, at least on the surface.

The individual ‘ACEs’ and their prevalence in this study population were common. Their prevalence was as follows [7]:

- Abuse (emotional: 10.2%; physical: 26.4%; sexual: 21.0%)
- Neglect (emotional: 14.8%; physical: 9.9%)
- Witnessing domestic violence: 13.0%
- Household members who abuse alcohol or drugs (28.2%) or are mentally ill (20.3%)
- Parental separation or divorce: 24.1%
- Imprisonment of a household member: 6.0%

In the study cohort, ACEs are highly inter-related such that a child who experiences one usually experiences several others [7]. The number of ACEs was counted to create an ‘ACE Score’ that was designed to capture the cumulative exposure to this variety of highly inter-related stressful exposures. The ACE Scores in this well-educated population of 17,000 people were: 0: 33%; 1: 26%; 2: 15%; 3: 10%; 4 or more: 20% [7]. It seems logical to assume that ACE Scores would probably look worse in most other populations.

The ACE Score has a strong dose–response relationship to every problem on your list of health priorities from your consultants [105,106]. The biologically plausible mechanism potentially linking ACEs to all of these problems is grounded in findings from studies of the effects of stress on neurodevelopment. Breakthroughs in neurobiology show that excessive stress disrupts neurodevelopment and can have profound lasting effects on brain structure and function [8]; these biologic pathways likely explain the strength of the findings from the ACE Study [9]. Thus, ACEs become biology, leading to social, emotional and cognitive impairments that increase the risk of unhealthy (but probably adaptive) behaviors, risk of violence or revictimization, poor psychosocial functioning, disease and disability. This is where we believe the priority should be for children and public-health policy: reduce the cumulative exposure of children to the activated stress response during critical periods of neurodevelopment [8,9].

Others, including a Nobel laureate economist, have asserted that [10]:

“...the most efficient strategy for strengthening the future workforce both economically and neurobiologically, and improving its quality of life is to invest in the environments of disadvantaged children during the early childhood years”

If ACEs are considered root causes of health-related problems in your country, other social disadvantages such as racism, poverty, socioeconomic status and access to healthcare are the ‘soil’ in which these roots are embedded.

Plants die and decompose, and the roots become new soil. Each sustains the other.

Organic budgeting anyone?

Additional information

The ACE Study questionnaires are included as an Appendix within *Preventing Child Maltreatment:*

A Guide to Taking Action and Generating Evidence, available from the WHO [107]. More information regarding the ACE study is available online [105,108].

Disclaimer

The findings and conclusions in this report are those of the author(s) and do not represent the views of the Centers for Disease Control and Prevention.

Financial & competing interests disclosure

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

No writing assistance was utilized in the production of this manuscript.

Bibliography

1. Mackenbach JP: An analysis of the role of health care in reducing socioeconomic inequalities in health: the case of the Netherlands. *Int. J. Health Serv.* 33(3), 523–541 (2003).
2. Satcher D, Fryer GE, McCann J, Troutman A, Woolf SH, Rust G: What if we were equal? A comparison of the black–white mortality gap in 1960 and 2000. *Health Aff. (Millwood)* 24(2), 459–464 (2005).
3. Isaacs S, Schroeder S: Class – the ignored determinant of the nation’s health. *N. Engl. J. Med.* 351(11), 1137–1142 (2004).
4. McGinnis JM, Foegen WH: Actual causes of death in the United States. *JAMA* 270(18), 2207–2212 (1993).
5. Champagne FA, Curley JP: How social experience influence the brain. *Curr. Opin. Neurobiol.* 15, 704–709 (2005).
6. Felitti VJ, Anda RF, Nordenberg D *et al.*: The relationship of adult health status to childhood abuse and household dysfunction. *Am. J. Prev. Med.* 14, 245–258 (1998).
7. Dong M, Anda RF, Felitti VJ *et al.*: The interrelatedness of multiple forms of childhood abuse, neglect, and household dysfunction. *Child Abuse Negl.* 28(7), 771–84 (2004).
8. Teicher MH, Andersen SL, Polcari A, Anderson CM, Navalta CP: Developmental neurobiology of childhood stress and trauma. *Psychiatr. Clin. North Am.* 25(2), 397–426 (2002).
9. Anda RF, Felitti VJ, Walker J *et al.*: The enduring effects of abuse and related adverse experiences in childhood: a convergence of evidence from neurobiology and epidemiology. *Eur. Arch. Psychiatry Clin. Neurosci.* 256(3), 174–186 (2006).
10. Knudsen EI, Heckman JJ, Cameron J, Shonkoff JP: Building America’s future workforce: economic, neurobiological and behavioral perspectives on investment in human skill development. *Proc. Natl Acad. Sci. USA* 103(27), 10155–10162 (2006).
103. Freudenberg N, Ruglis J: Reframing school dropout as a public health issue. *Prev. Chronic Dis* 4(4) (2007) www.cdc.gov/pcd/issues/2007/oct/07_0063.htm.
104. Braveman P: Do we have real poverty in the United States of America? *Prev. Chronic Dis.* 4(4), (2007) www.cdc.gov/pcd/issues/2007/oct/07_0124.htm
105. Anda R: The health and social impact of growing up with adverse childhood experiences: human and economic costs of the status quo. Adverse childhood experiences (Accessed 10/31/07) www.acestudy.org
106. CDC Adverse Childhood Experiences (released July 2005) <http://webdev.nccd.cdc.gov/nccdphp/ace/index.htm>
107. WHO Violence and Injury Prevention and Disability www.who.int/violence_injury_prevention/violence
108. CDC: Adverse Childhood Experiences Study www.cdc.gov/NCCDPHP/ACE

Websites

101. Metzler M: Social determinants of health: what, how, why, and now. *Prev. Chronic Dis.* 4(4) (2007) www.cdc.gov/pcd/issues/2007/oct/07_0136.htm
102. Steinberg K: Wellness in every stage of life: a new paradigm for public health programs. *Prev. Chronic Dis.* [serial online] (2007)