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**The Consequences of Adverse Childhood Experiences on Health
and Implications for the Future**

By

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Capstone Project

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Background

One of the most significant aspects of healthcare that is interwoven among complaints and their management, no matter the specialty, is mental health. The full spectrum and severity of mental health conditions is important, but one area that every member of society can relate to is stress. The mere existence of being a human confounded with the everyday demands of society creates a recipe for people of all ages and backgrounds to feel stress and anxiety at some point in their lives. Stress can evolve from an individual's family dynamic, demands of one's profession, societal position, sexuality, among many other realms of life. However, stress and anxiety are two elements of mental health that are not often considered when thinking of the pediatric population. Many would consider the lives of young children to be relatively stress-free, compared to adulthood. Although children may face some social anxiety navigating the world, one would consider common stressors in adulthood such as bills, income or deadlines to be absent in children. This perception, while in some ways is true, does not consider the delicate nature of brain development during crucial young ages, and the implications this may have for when a child eventually becomes an adult.

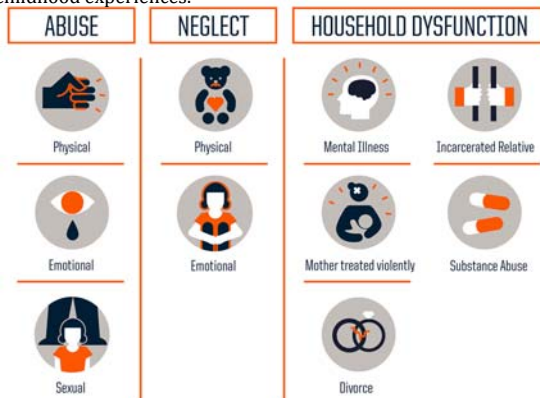
When considering all the new experiences a child must navigate, especially if being raised in an environment that may be more chaotic than most, the chaos alone can actually induce higher levels of stress for a longer period of time. Furthermore, high levels of stress during this crucial development period can actually alter cellular structure of the brain and can have a negative impact on health in adulthood. This review examines how mental and physical health are influenced by exposure to a high number of Adverse Childhood Experiences (ACEs) compared to a low number of ACEs. Much of the literature available on this topic is observational, and thus, susceptible to underreporting of experiences, especially in view of the sensitive nature of the questions asked in these types of studies. However, identifying patients

with high ACEs early is essential so that clinicians can provide treatment during a child's development, thus preventing poor physical and mental health outcomes in adulthood.

Discussion

While working at Kaiser in the mid 1980s, Dr. Vincent Felitti noticed a striking discordance among patients with respect to their long-term success while enrolled in a weight-loss program. Discussed in the book, *The Deepest Well* by Dr. Nadine Burke-Harris, one particular patient of Dr. Felitti's had successfully lost roughly 100 pounds in the program, but after 2 ½ years, regained it all.¹ Many other patients in the program experienced the same, significant initial success followed by regression. When talking with these patients, he found that all of them had a history of sexual abuse. After their initial success, a trigger of this childhood abuse caused reversion to poor food choices, unhealthy life style decision and using food as a coping mechanism. Although the patients weight problems were initially corrected, he suspected that the trauma obtained from early abuse was never addressed, thus resulting in their failure to sustain healthy weight losses.¹ This discovery about his patients lead him to develop The Adverse Childhood Experiences (ACE) Study. Collected over two waves with a sample size of almost 17,000 participants, this study was the first to truly publish the relationship of childhood abuse and household dysfunction to adult health risk behaviors, health status, and disease states.²

Figure 1. Visual representation of the ten categories of adverse childhood experiences.



Starcheski L. Take The ACE Quiz - And Learn What It Does And Doesn't Mean. NPR. <https://www.npr.org/sections/health-shots/2015/03/02/387007941/take-the-ace-quiz-and-learn-what-it-does-and-doesnt-mean>. Published March 2, 2015. Accessed March 5, 2019.

Together with Dr. Robert Anda, an epidemiologist from the Centers for Disease Control and Prevention (CDC), he and Dr. Felitti developed a questionnaire. Not only did patients self report on whether they had experienced any of the 10 categories listed in Figure 1 before the age of 18, but also, they reported exposure

to household dysfunction and current health-risk factors. This questionnaire not only covers a variety of experiences, but also provides a scoring system and questions regarding their current health status and history. Each category experienced equaled one point, with a maximum possible score of 10. The questionnaire was divided into two main sections, one with questions about abuse (psychological, physical and sexual) and the other asking about household dysfunction (substance abuse, mental illness, mother treated violently, and criminal behavior in household).² The results of this study not only drastically changed the way pediatrics considered social history, but also sparked further research unveiling how profoundly future health is affected by adverse childhood experiences. Overall, 67% of patients reported at least 1 ACE and 12.6% reported ≥ 4 ACEs.² These patients who experienced ≥ 4 ACE's, compared to those who experienced none, had 4-12 times increased health risks for alcoholism, drug abuse, depression and suicide attempt, a 2-4 time higher incidence of smoking, poor self-related health, ≥ 50 sexual intercourse partners and sexually transmitted disease, and a 1.4-1.6 times increase in severe obesity and physical inactivity.² In addition, a graded relationship was found between high ACEs and increased numbers of chronic diseases including ischemic heart disease, cancer, chronic lung disease, skeletal fractures and liver disease.

Once these correlations were unveiled, researchers were eager to understand, from a physiological standpoint, how increased stress during childhood caused a higher predisposition to chronic diseases. Many years later the same researchers from the original ACE study had begun to explore the neurobiology of stress. This exploration into the convergence of epidemiology and neurobiology not only relied on the original ACE sample size, but also added a second wave of participants, rounding out the total to 17,377 respondents.³ Neurobiology studies found the detrimental effects of traumatic stress on the developing neural networks and at the neuroendocrine systems that regulate them. These findings suggest that neural networks and neuroendocrine systems are the pathways that ACE's take to produce a variety of physical, mental and behavioral health problems.³ One example of dysfunction, is the correlation between neurobiological defects from early trauma and obesity. Via excessive stimulation of the glucocorticoid pathways, repeated stress and distress leads to increased intra-abdominal and other fat deposits.³ Results showed a 2.1-fold increased risk of obesity for respondents with ≥ 4 ACEs.³ These findings are especially important given that, according to the CDC in 2017, almost 40% of the adult US population is obese.⁴ Moreover, a high body mass index increases the risk for cardiovascular disease, diabetes, hypertension and many other metabolic and chronic conditions. Thus, to combat obesity, more consideration should be given to the screening and treatment of ACEs.

Of neurobiological systems, the monoamine neurotransmitter systems or norepinephrine, dopamine and serotonin have been well studied, revealing its place within a primary regulatory system comprised of large neural networks and its role in generating complex neural functions.³ Studies in young animals have shown that manipulation of these systems created behaviors similar to those seen in victims of abuse such as aggression, alcohol use, eating disorders, hyper-reactivity, stress-response dysfunction, as well as other negative

behaviors.³ Several studies have already been published that showed that the functionality of these monoamine systems in adults is influenced by childhood experiences.³ These findings, among other similar study results, support the hypothesis that ACEs have a critical role in shaping adulthood health. This particular study, including its second wave of participants, showed that as the ACE score increased, the mean number of comorbid outcomes increased in a graded fashion. Between the ACE scores of 0 and 7-8, the number of comorbid outcomes increased to 3 times normal, with those at the highest end of the ACE exposure reporting up to 4 or 5 outcomes.³ These epidemiologic findings converge with the observations in neurobiological studies, thus explaining how childhood trauma can have serious implications for future health. Furthermore, because the flight-or-fight response and its corresponding release of endogenous catecholamines and adrenal corticosteroids is invisible, it is essential to understand these physiologic changes that occur as a result.³ Through understanding, plans for screening and prevention can occur to help mitigate the effects of ACEs.

While these studies laid the foundation for further research into the ACE study, it is important to determine the current prevalence of ACEs in the United States. Key findings from a recent study with roughly 250,000 respondents further supported previously published data. Of the respondents, 61.55% reported at least 1 ACE and 24.64% reported ≥ 3 ACEs.⁵ Of the ACEs, emotional abuse was reported most frequently at 34.42%, followed by parental separation or divorce at 27.63%, and finally household substance abuse at 27.56%.⁵ The chief strength of this article is that it provided the most current as well as the largest and the most diverse collection of ACE data reporting the incidence of ACEs in the adult population. A limitation of this study is that it does not correlate the prevalence of specific chronic conditions with ACE's, and thus merely supports the premise that ACEs are highly prevalent in today's population.

Recently the CDC reported that the average life expectancy for Americans has declined for the second year in a row.⁶ ACE's partly explain this trend. In 2009, Brown et al sought to assess whether ACEs were associated with an increased risk of premature death during adulthood. Their results substantiated the premise that ACEs may have implications on overall life expectancy. In the first and second waves of this ACE study, follow ups were conducted correlating ACEs and premature death by using mortality records and computing expected years of life lost (YLL) and years of potential life lost (YPLL).⁷ Overall, respondents with ≥ 6 ACEs died roughly 20 years earlier on average than those without ACEs.⁷ Furthermore, the average YLL per death was nearly three times greater among people with ≥ 6 ACEs (25.2 years) than those without ACEs (9.2 years).⁷ Thus, people with a higher exposure to ACEs have a lower life expectancy. The increased premature death rates and increased YLLs are important contributors to the decline in our overall life expectancy and are a potential target for reversing this decline.

The CDC states that heart disease is the number one leading cause for death in the United States.⁶ While there are many confounding factors that lead to heart disease, one study explored how ACEs may have implications as well on its development. This study examined the most common associated risk factors and causes of ischemic heart disease, including smoking, physical inactivity, severe obesity, depressed affect, and anger. The prevalences of all of these CVD risk factors were increased for those participants with ≥ 4 ACEs.⁸ The likelihood and prevalence of having ischemic heart disease significantly increased among respondents exposed to any individual ACE, excluding parental marital discord.⁸ Overall, the study found a dose-response relation of ACEs to ischemic heart disease and a correlation between almost all individual ACEs and ischemic heart disease. Of all the factors studied, psychological risk factors showed a greater importance than the more traditional risks (smoking, sedentary lifestyle, obesity, diabetes and hypertension) in explaining the relationship of ACEs to the risk of ischemic

heart disease.⁸ Although the development of ischemic heart disease is complicated, considering and treating ACEs may prevent this complication from developing.

Additional statistics from the CDC reveal that cancer is the second leading cause of death in the United States.⁶ Similar to ischemic heart disease, while there are many factors that contribute to the development of cancer, research has also been done to investigate the role that ACEs have on predisposition to cancer. One study examined the association between ACEs and the diagnosis of cancer using a sample size of roughly 4,000 from the Behavioral Risk Factor Surveillance System Survey (BRFSS). Overall, about one in ten respondents reported having ever been diagnosed with cancer and of these, 62% reported being exposed to ACEs.⁹ Of the ACEs studied, sexual abuse was significantly associated with adulthood cancer whereas the other ACEs were not.⁹ However, a limitation of this cross-sectional study was that, given the nature of data collection through a survey, the study was unable to determine the age of ACE occurrence.

Furthermore, according to the CDC, lung cancer is the most common cancer in men and women in the United States and has been in the top 5 causes of death for many years.⁶ A prospective cohort study done in 2010 investigated whether ACEs are correlated with an increased risk of lung cancer during adulthood. Using the original data from the ACE studies with a sample size of roughly 17,000 respondents during 1995-1997, the data were examined specifically for any correlation between ACEs and the prevalence of lung cancer. Incidents of lung cancer through 2005 follow up were identified through hospital discharge and mortality records obtained from the National Death Index.¹⁰ Overall, the ACE scores correlated directly with the incidence of lung cancer in a linear relationship.¹⁰ The risk of lung cancer for those with ≥ 6 ACEs was increased 3-fold compared to persons without ACEs.¹⁰ The findings suggested that the causal pathway leading to this significant correlation was due to heightened increased risk of smoking, which in turn, causes lung cancer. However this study was limited because

environmental exposures were not assessed, and smoking status was based on one measurement at baseline, rather than the number of pack-years smoked. Assuming a cause and effect relationship, if ACEs increase smoking behavior as a coping mechanism, then identifying and treating ACEs can potentially prevent lung cancer associated with ACEs.

Moving residences is a common occurrence for many people across a lifespan. Not only do people move from their parent's home to one of their own, but for some there may be many instances of moving in between. One aspect of the ACE study revolves around residential mobility. It examined whether an increase in mobility was associated with higher instances of health problems in adolescence and adulthood. A key finding was that the odds of health risk for respondents who changed residences 8 or more times compared with respondents who never moved ranged from 1.3 times higher for smoking to 2.5 times higher for suicide.¹¹ This study also reported that the risk of an overall higher incidence of residential mobility during childhood (≥ 8 moves) was 1.7 to 3.1-fold higher for each ACE, and in general increased with the number of ACEs.¹¹ One of the major strengths to this study is that it shows how childhood residential mobility can be used as an indication for real-time screening to uncover otherwise hidden exposures to childhood trauma. Given that overall ACEs often remain undetected by childcare providers, mobility could be implicated as a general screening tool for the need to further investigate for possible ACEs.

The relationship of ACEs to causes of mortality besides chronic diseases and cancer were investigated, including mental health, which plays a key role in overall health. Suicide is listed in the top 10 causes of death per the CDC, and has been increasing in frequency over the last few years. A study performed in 2001 assessed the relationship between the risk of suicide attempts and the overall ACE score. A key finding of this study was that the lifetime prevalence of at least 1 suicide attempt was 3.8% and ACEs in any category increased the risk of attempted suicide 2

to 5-fold.¹² The adjusted odds ratio of ever attempting suicide among respondents with ≥ 7 ACEs was 31.1% compared to those with no ACEs.¹² Furthermore, the ACE score had a strong, graded-relationship to attempted suicide during childhood or adolescence and adulthood.¹² The main limitation of this study is that the data could only rely on suicide attempts and could not include completed attempts to assess as a cause of mortality.

Another mental health concern is substance use and abuse. One study used data specifically from the Chicago Longitudinal Study to assess the correlation between ACEs and indicators of health, mental health, and substance use. This study was different from the others discussed because of its small same size of roughly 1100 respondents. However, its strength was that its data were more differentiated compared to the original ACE study. Key findings included significant, graded associations between mental health and health outcomes and levels of exposure to ACEs. Respondents exposed to 2-5 ACEs reported significantly poorer overall health compared to the group with no ACEs.¹³ Furthermore, multiple ACE groups were significantly more likely to report low life satisfaction, frequent depressive symptoms, anxiety, tobacco and marijuana use compared to those with no ACEs as well.¹³ The results should be interpreted as correlative rather than causal since the nature of the study was cross sectional.

In 2016, a study focused on validating and replicating findings from previous studies that correlated cumulative ACE scores with high-risk health behaviors and comorbid conditions in US adults.¹⁴ Emphasis was on examining differential relationships between individual ACE components, high-risk health behaviors, and comorbid conditions. Data were extracted from the BRFSS survey instead of the ACE study, resulting in a sample size of almost 50,000. The key finding of this study was that an ACE score ≥ 4 was associated with increased odds for multiple risky behaviors including binge drinking, heavy drinking, smoking and HIV risky behavior, as well

as many comorbid conditions including diabetes, myocardial infarction, coronary heart disease, stroke and depression.¹⁴

Conclusion

Overall, the prevailing evidence in these studies showed that a high number of ACEs compared to a lower number of ACEs or no ACEs, increased risk mental and physical health disorders. While socioeconomic and other factors may predispose to poor health, specifically screening for ACEs should be implemented to prevent their contribution to the increased poor physical and mental health outcomes in adulthood. The study by Campbell, et al. investigated multiple high-risk behaviors and comorbid conditions, and postulated two broad mechanisms to explain how ACEs do, in fact, lead to comorbidity in adulthood. The first mechanism proposes that poor health outcomes are due to the delayed consequences of various adverse coping methods such as overeating, drug use, smoking and promiscuity.¹⁴ The second mechanism hypothesizes that chronic stress due to ACEs directly results in adverse physiologic consequences via neurologic reactions.¹⁴ Furthermore, ACEs exert their influence by both decreasing optimal growth during initial stages of life and increasing the rate at which function is lost in later stages of life.¹⁴

While small-scale studies at the Center for Youth Wellness in San Francisco and The Child Trauma Academy in Houston are already investigating how trauma associated with ACEs in childhood can be treated, further investigation is needed for detection and treatment on a national scale. Even though effective treatment (other than stopping the ACE) has not been determined yet, a method for screening has already been developed with the original questionnaire. If universal screening were done through clinicians and schools, patients with the highest risk would be identified and intervention would be possible. As treatment plans continue to develop, small steps could be taken to successfully treat the stress associated with

these experiences and thus, improve overall health outcomes during both childhood and later in life.

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