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# Adverse childhood experiences

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## Abstract

The long term poor health outcomes in those who have experienced multiple adverse events in childhood have been well documented since the late 1990's. People who have experienced four or more adverse childhood experiences (ACE) are at significantly increased risk of chronic disease as well as mental illness and health risk behaviours. There is growing evidence of the ways in which adversity and toxic stress, cause these poor outcomes. Exposure to adversity has been shown to alter the molecular and genetic makeup of a child as well as changing the way the neurological, immune and endocrine systems develop and function. ACEs are of great public health concern given their long term impact on an individual's health along with the impact on society through economic factors such as loss of productivity and increasing pressure on the healthcare system. Intergenerational and environmental factors have been implicated in perpetuating the cycle of ACEs. Thus, both primary and secondary preventive intervention programmes need to be considered in firstly preventing the occurrence of ACEs and secondly striving to mitigate their ill effects. This article describes the background scientific studies, prevalence and types of risk factors and their effects on human biology and goes on to outline how ACEs contribute to later adult health status and how we might mitigate these through improved primary and secondary prevention.

**Keywords** adverse childhood experiences (ACES); adverse outcomes; economics; identification; intervention; prevalence; prevention; programmes; resilience; risk

## Key points

- Adverse childhood experiences are common and have proven short, medium and long term adverse consequences for health and wellbeing
- Professionals working with children have a role in the early structured identification of ACEs
- It may be possible to mitigate some of the deleterious consequences of ACEs by promoting resilience and supporting initiatives which aim to prevent, recognize and intervene
- Acknowledging ACEs with your patients/clients can be helpful in its own right

## Introduction

Adverse childhood experiences (ACEs) are defined as potentially traumatic events, which occur at any stage in childhood from birth through to young adult life, which can have negative lasting effects on health and well-being.

There is growing evidence of how repeated adverse experiences can lead to toxic stress, cause permanent damage to the developing brain and also alter the functioning of the immune, neurological and endocrine systems in an individual. This alone, coupled with other environmental factors, has been shown to predispose individuals to increased risk of chronic disease and early death. Ideally these need to be addressed as early as possible in order to optimize health outcomes in later life.

Health systems are now being faced with the challenge of adapting to this evolving body evidence on ACEs and their impact on the individual, society and the economy.

## Background

The concept and impact of ACEs was first identified and formally studied in the US in the late 1990s. The CDC-Kaiser ACE Study was carried out when US health provider Kaiser-Permanente noted that there was a high prevalence of historical sexual abuse amongst patients attending an obesity clinic. The aim of the study was to further investigate the burden of unrecognized adverse childhood experiences. They developed a patient questionnaire which explored negative childhood experiences, divided into three broad categories: abuse, neglect and household challenges. The questionnaire was sent to over 17,000 patients who had attended for a standardized medical evaluation between 1995 and 1997. A total of 17,337 adults were included in the study, in two waves (neglect was added to the questionnaire in the second wave). The ACE questions all refer to experiences in the respondent's first 18 years of life.

There have been numerous other studies carried out subsequent to this original US benchmark study. While categorization of ACE's has evolved, they are still generally divided into the same three broad groups used in the initial CDC-Kaiser study, then further subdivided to 10 categories of ACE (Box 1, Figure 1).

## Prevalence

Research has shown that ACEs are common. The original CDC-Kaiser study showed that 64% of respondents had experienced at least one ACE and 12.5% had experienced four or more. Similar

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### Defining adverse childhood experiences

**ACE definitions CDC-Kaiser ACE Study 1998**

**Abuse**

**Emotional abuse:** A parent, step-parent, or adult living in your home swore at you, insulted you, put you down, or acted in a way that made you afraid that you might be physically hurt.

**Physical abuse:** A parent, step-parent, or adult living in your home pushed, grabbed, slapped, threw something at you, or hit you so hard that you had marks or were injured.

**Sexual abuse:** An adult, relative, family friend, or stranger who was at least 5 years older than you ever touched or fondled your body in a sexual way, made you touch his/her body in a sexual way, attempted to have any type of sexual intercourse with you.

**Household challenges**

**Mother treated violently:** Your mother or stepmother was pushed, grabbed, slapped, had something thrown at her, kicked, bitten, hit with a fist, hit with something hard, repeatedly hit for over at least a few minutes, or ever threatened or hurt by a knife or gun by your father (or stepfather) or mother's boyfriend.

**Household substance abuse:** A household member was a problem drinker or alcoholic or a household member used street drugs.

**Mental illness in household:** A household member was depressed or mentally ill or a household member attempted suicide.

**Parental separation or divorce:** Your parents were ever separated or divorced.

**Criminal household member:** A household member went to prison.

**Neglect**

**Emotional neglect:** Someone in your family helped you feel important or special, you felt loved, people in your family looked out for each other and felt close to each other, and your family was a source of strength and support.[1]

**Physical neglect:** There was someone to take care of you, protect you, and take you to the doctor if you needed it.[1]

You didn't have enough to eat, your parents were too drunk or too high to take care of you, and you had to wear dirty clothes.

[1]Reverse scored

https://www.cdc.gov/violenceprevention/acestudy/about.html.

**Box 1**

prevalence has been reported in the UK through population-based surveys carried out in both England and Wales. A 2014 survey of adults in England indicated a prevalence of 48% of adults experiencing one ACE and 9% experiencing at least four ACEs. In a 2015 Welsh study, 47% of adults reported at least one ACE and 14% experiencing four or more. A 2020 report from England stated that 80% of almost 400,000 children in England who had been identified as being 'in need' had experienced at least one ACE; this correlates to 2.5% of all children in the country. Data from UK studies shows parental separation and verbal abuse to be the most commonly reported ACEs, with drug use and parental incarceration to be the least frequently reported. Although ACEs have been reported across all societal groups, evidence suggests that those in lower socioeconomic groups experience more ACEs than those in higher income areas. It is also becoming clear that ACEs occur in clusters, with studies showing that adults who report one ACE are far more likely to report more ACEs.

### The diversity of adversity and risk factors

While the commonly used categories of ACE encompass a lot of types of adversity, it should be borne in mind that this list is not exhaustive, and that adversity comes in many forms and may vary significantly in duration and intensity. It should also be recognized that an individual's response to an adverse experience can vary from person to person and protective factors as well as risk factors for ACEs should be considered. This balance between these opposing factors has perhaps recently come to the fore in the public eye through societal response to the COVID-19 global pandemic; evidenced in the notable increase in community spirit which has been seen across the nation when faced with the adversity of national lockdown and its challenging consequences.

A multitude of risk factors for ACEs have been identified. A 2018 report from the NHS Highlands Director of Public Health outlined a model of risk factors for ACE's based on a 2015 Report from the UCL Institute of Health Equity. This model aimed to illustrate the complex interplay between risk factors and included social/societal factors, household factors, family/parental factors and intergenerational factors (Figure 2). It suggests that in most cases it is not one single issue that puts a child at risk of an adverse experience but rather a complex and cumulative effect of these intertwined elements. It has been shown that children who experience ACEs are more likely themselves to perpetrate abuse and violence thus opening the way for continuation of the ACE cycle through generations. Therefore, careful consideration should be given to the intergenerational factors when considering early interventions to address adversity.

The effect of the environment in which the family lives as a risk factor for ACEs has also been explored and the concept of "A Pair of ACE's" was outlined in 2017 to illustrate this. This pair refers to Adverse Childhood Experiences and a second "ACE"-Adverse Community Environments. This model encompasses adverse experiences encountered at both the individual level of the child and also at an environmental or community level. This model proposes that when adversity is experienced at both of these levels that there is an increased risk of toxic stress from accumulated adversity. It illustrates the interplay of these two ACEs through the image of a tree; the adverse community environments forming the roots from which the adverse childhood experiences grow (https://publichealth.gwu.edu/sites/default/files/downloads/Redstone-Center/Resource%20Description_Pair%20of%20ACEs%20Tree.pdf). Of the adverse community environmental factors described, growing up in poverty has been shown to significantly increase the likelihood of ACEs. A concerning fact given the rise in child poverty and significant cuts in funding for family support services, in England over the decade from 2010 to 2020 reported by the most recent Marmot review.

As the majority of research into ACE has been carried out in high income countries, the World Health Organization (WHO) identified the need to raise the profile of ACE as a global issue of public health concern. They recognized the importance of international data, particularly from low- and middle-income countries, where the majority of children live worldwide. In an attempt to meet this need, in 2018 they developed the WHO Adverse



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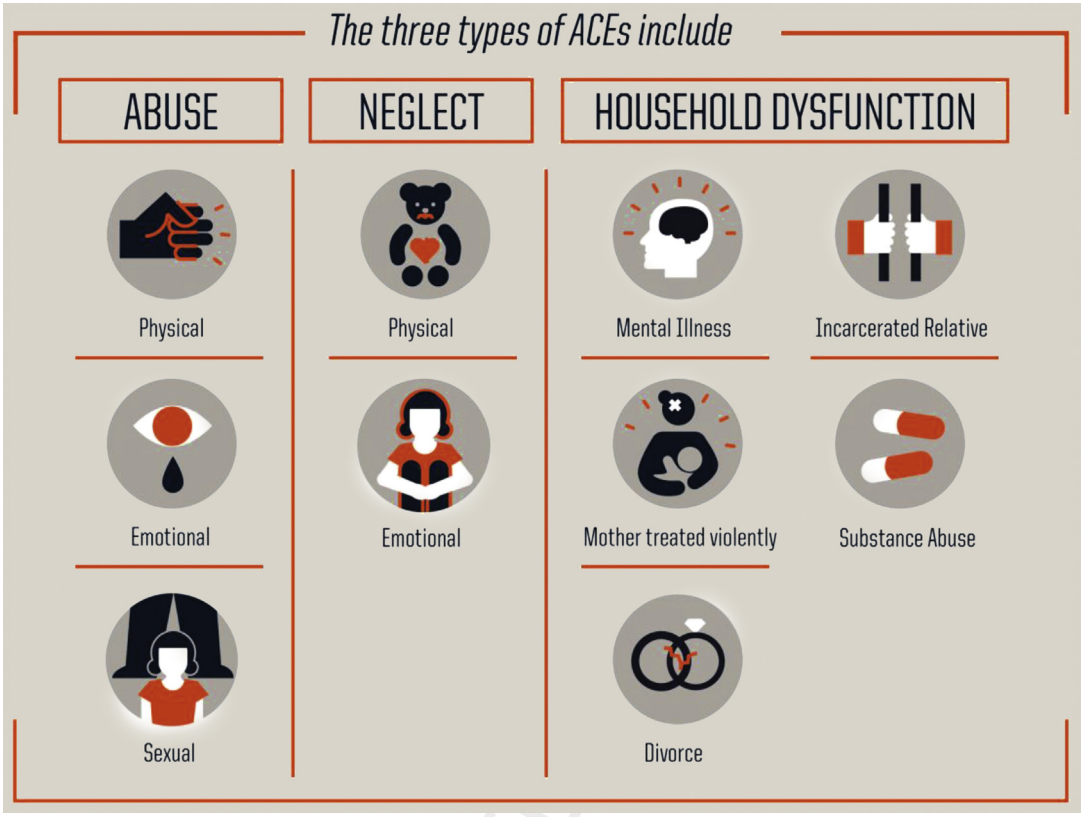


**Figure 1** The 10 categories of ACE. (Copyright 2013. Robert Wood Johnson Foundation. Used with permission from the Robert Wood Johnson Foundation).

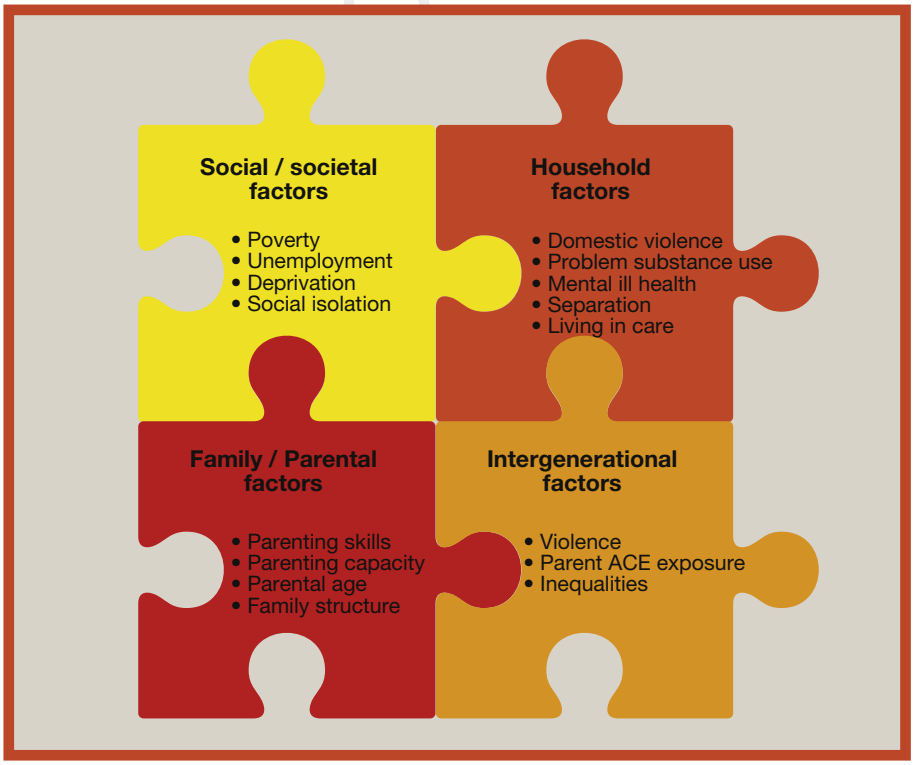


**Figure 2** From NHS Scotland 2018. The Annual Report of the Director of Public Health. Adverse Childhood Experiences, Resilience and Trauma Informed Care: A Public Health Approach to Understanding and Responding to Adversity. Source UCL Institute of Health Equality. https://www.nhshighland.scot.nhs.uk/Publications/Documents/DPH-Annual-Report-2018_(web-version).pdf Reproduced with kind permission of NHS Highland Public Health.



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Childhood Experiences Questionnaire (ACE-IQ). In addition to the typical ACE questions in other questionnaires, it also recognizes broader factors such as war, peer, community and collective violence as sources of childhood adversity. The WHO encourages the use of this questionnaire, emphasizing its potential value for advocating for investment and informing design of ACE prevention programmes. Although this WHO questionnaire has been developed it hasn't yet been utilized to its full potential in investigating ACEs globally; this has likely been exacerbated by changing healthcare priorities as a result of the pandemic.

## How do ACEs influence health and well-being?

The way in which ACEs can result in a negative effect on mental and physical health and well-being can be considered on two levels: physiological and behavioural. ACEs cause disruption in neurodevelopment which may lead to impaired cognition and social function which in turn can lead to health risk behaviours. Due to high levels of environmental stress, children who experience more adverse events are at higher risk of engaging in behaviour which may be harmful to health, such as drinking alcohol, smoking and antisocial behaviour. These behaviours can lead an individual on a pathway to poor adult health by increasing risk of a multitude of conditions such as cancer, lung and cardiovascular diseases. This trajectory has been illustrated by Public Health Wales and Blackburn and Darwen Local authority in the form of a progression pyramid (Figure 3). Exposure to one ACE doubles the likelihood of poor health in childhood and exposure to four or more ACEs triples this risk.

## Allostasis

From a physiological perspective, humans are designed to respond to their external environment as a mechanism to cope with stressful circumstances: a process of allostasis. When faced with a stressful or threatening situation the body responds by activating the sympathetic nervous system known as the 'fight or flight' response. This causes a number of physiological changes such as increasing heart rate and blood flow to the skeletal muscles. As part of this response, the hypothalamic-pituitary-adrenal (HPA) axis is also activated, releasing cortisol which triggers glucose production as an energy source for skeletal and cardiac muscle in preparation for the 'fight or flight' required to escape the threat. While this is an appropriate response should the stressful situation require escape from a predator, the same response is triggered whenever we perceive stress, regardless of the situation. The HPA response while beneficial in an emergency situation, can be problematic in the case of chronic or persistent stress. Following a stressful event, we usually have a recovery period which allows for a return to a healthy level of activation of these pathways. In the case of severe childhood stress, we may still be able to regulate effectively through the protective factors such as a parent or caregiver who helps regulate the response and builds the child's resilience. However, should the stressful situations be frequent or there are no protective factors to assist with recovery, it can lead to dysregulation of the pathways. It is this dysregulation which may have long term consequences on the function of the allostatic systems: the neurological, endocrine and immune systems. Damage caused by this dysregulation is most severe in young children through both direct effects and epigenetic genome modification.

The amygdala, pre-frontal cortex and hippocampus are the areas or the neurological system which are vulnerable to the toxic stress of ACEs. This can result in a variety of issues, including problems with concentration, memory, behaviour and learning, along with poor executive functioning. With regard to the endocrine system, ACEs may disrupt the circadian rhythm. This results in an increase in the level of cortisol production but with a decrease in diurnal variation. It can also eventually lead to glucocorticoid resistance over longer periods. From an immune perspective, chronic stress leads to chronic inflammation which in turn reduces cell mediated immunity which may increase risk of infection and cardiovascular risk.

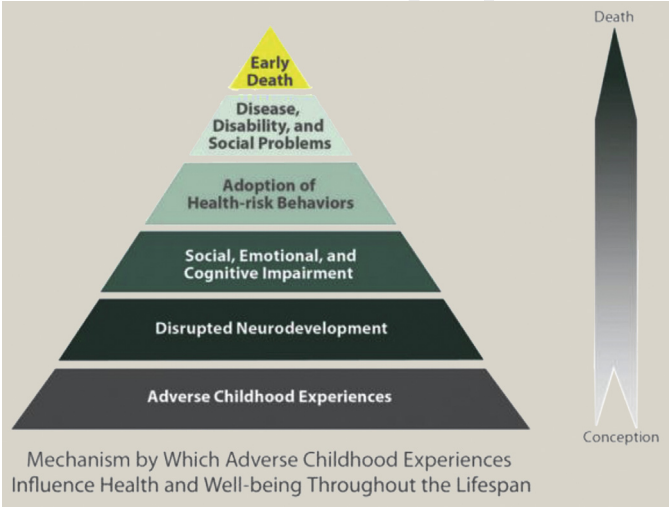


**Figure 3** The ACE pyramid model. https://www.cdc.gov/violenceprevention/acestudy/about.html.

### Epigenetics

While changes to the physiological pathways explain why individuals who suffer multiple ACEs are at much greater risk of both mental and physical ill health, the degree of impact of the adversity on their physiological development is difficult to predict. The nature and pervasiveness of the adversity experienced, the strength of an individual's resilience (which may be both genetic and environmental) along with other factors will determine the degree to which ACEs impact an individual. Epigenetics Q1 is an exciting area which gives a molecular basis for this gene environment interaction.

Epigenetics is the study of how factors including the environment, can change gene expression; genes are switched 'on' or 'off'. The resultant change in phenotype can be passed on from generation to generation despite no change in genetic code. Genes are activated or repressed by various mechanisms including histone protein modification or DNA methylation. Early exposure to adversity, maternal stress or anxiety can impact the degree to which methylation can occur which in turn leads to a change in genetic expression. This change can have long lasting effects on health and development. This was demonstrated in a 2008 study which showed that infants born to mothers with significant anxiety and depression in the third trimester had significantly higher rate of methylated genes which



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cause increased cortisol response to stress. By 3 months of age these infants had significantly higher levels of stress induced cortisol. A 2014 study showed that a cohort of adults who were exposed to child abuse had either over or under expression of 997 genes compared to controls. These patterns are not related to socioeconomic status and there is clearly much to learn about the biochemical mediators involved.

## Consequences of ACEs on adult health

ACEs have negative and lasting effects on both physical and mental health and increase the risk of health harming behaviours. Premature morbidity will not only have a direct adverse effect on the individual involved and their immediate family, but also have a knock-on effect for society through decreased economic productivity and increased burden on the healthcare system.

In Wales, having four or more ACEs doubled the likelihood of developing a chronic disease before the age of 69, with rates of chronic disease as high as you would expect to see in a person 10 years older but with no ACEs. Those with four or more ACEs were four times more likely to develop Type 2 diabetes and three times more likely to develop a respiratory or heart disease, compared to those who had not experienced any ACEs. A US study reported that those with six or more ACEs can die an alarming 20 years earlier than those without ACEs.

From a mental health perspective, there were significant differences reported in the 2015 Welsh survey between those with four or more ACEs and those without. The former group reported that they were three times more likely to never or rarely felt relaxed or close to other people and were six times more likely to never or rarely feel optimistic about the future or have felt useful. Health harming behaviours in the group with numerous ACEs where also significantly increased, ranging from a four-fold increase in likelihood of high-risk drinking, to 16 times more likely to have used crack or heroin and 20 times more likely to be incarcerated at some point in their lives.

The impact of ACEs on the healthcare system was also reported in the Welsh ACE study; those with four or more ACE were twice as likely to have visited the GP at least six times within the last year, and three times as likely to have visited A&E or stayed overnight in hospital.

## Economic argument for investment in early childhood and protecting individuals from the harmful effects of ACEs

The mounting evidence of the impact of ACEs on health, both through neuro/physiological changes, behaviour and epigenetics is impressive. There is also a growing body of evidence that investment in early intervention programmes has significant economic benefit.

The Marmot review 'Fair Society, Healthy Lives' 2010 estimated that health inequalities in the UK lead to an annual loss of £36–40 billion through lost taxes, welfare payments and costs to the NHS. Over 10 years later there has not been much progress in reducing this. In fact there has been a trend in the opposite direction, with evidence based interventions such as Sure Start facing severe funding cuts. Sure Start has been shown to reduce the health inequalities between areas of low and high deprivation, reducing hospital admissions significantly.

Investment in early childhood produces greater economic returns than later interventions (Figure 4). However it is common for societies to invest proportionately more in later childhood. The cost benefit of early intervention is often still a conservative estimate as most programmes don't calculate long term outcomes. Considering what we now know about ACEs investment that reduces ACEs in the perinatal and early infancy period will have cost benefits for decades to come.

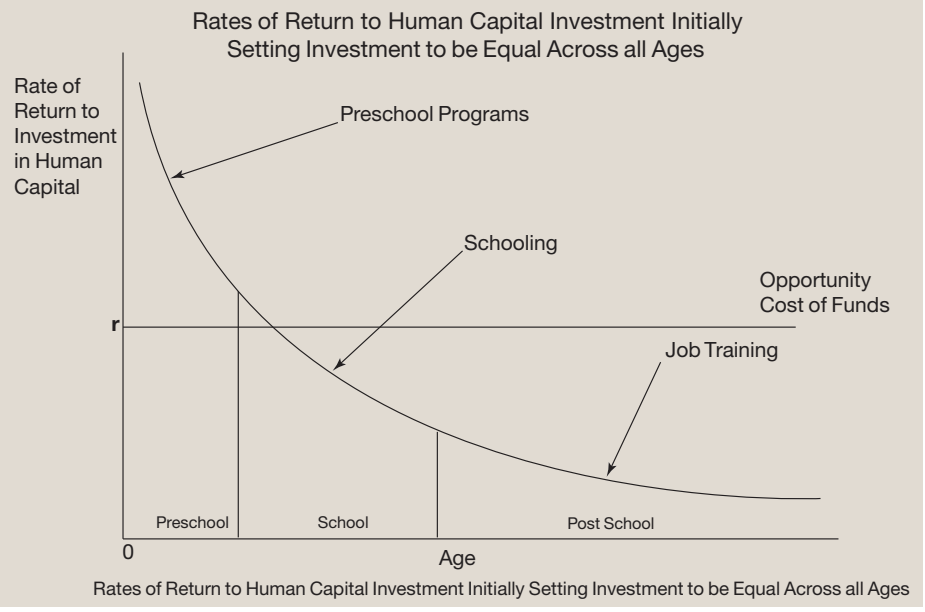


**Figure 4** Source: Carneiro P, Heckman J. Human capital policy 2003. https://www.nber.org/system/files/working_papers/w9495/w9495.pdf.



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Policy change is key to enable funding to be made available for programmes that will effectively reduce ACEs or mitigate the effects.

Effective intervention will target primary prevention of ACEs along with early recognition and intervention (secondary prevention). Certain programmes may target either one or both primary and secondary.

### Examples of intervention programmes

Over the last 5−10 years there has been a dramatic increase in the number of programmes local public health teams in the UK are running. A lot of these have focused on gathering data and raising awareness amongst professionals. Programmes and policies that promote safe, stable, nurturing relationships and environments for children to grow up in will both prevent ACEs occurring and limit the effect of the adversity if it does occur. We describe a number of these below.

The Family Nurse Partnership (FNP) is a primary prevention programme, developed in the USA to work intensively with young parents through pregnancy and early years. In the UK, in the areas where the programme exists, it is offered to first time mothers under the age of 20 years. The aim is to improve long term outcomes by impacting health behaviours of the mother and her partner and developing parenting skills that are responsive caring and competent. In the USA the programme has been proven to improve school readiness, reduce behavioural problems in the child and reduce child abuse and neglect.

Maternal Early Childhood Sustained Home Visiting is similar to the FNP program, with intensive health visiting input − at least 25 visits from the same health visitor applied to a much larger at risk population than FNP. There are some trial sites in England, however cost effectiveness for wider NHS implementation is yet to be shown despite good evidence for effectiveness in Australia.

Flying Start is a targeted early years' program provided by the Welsh government. It offers enhanced health visiting services, parenting support and language and communication development. It is focused on the most deprived areas in Wales.

A Better Start is an early intervention program run in selected deprived communities in England, funded by The Big Lottery Fund. The programme is for all families within the geographical area of the project from pregnancy until the child is 4 years old. It focuses on improving nutrition, speech and language, social and emotional development and systems change. It is a 10 year program with a robust evaluation system in place to assess impact.

WAVE trust is a UK based organization that campaigns for reduction of ACEs. Their 70/30 campaign aims for 70% reduction in ACEs by 2030. They also support partnerships that do preventative work such as the FNP.

Early Intervention Foundation is a research charity that promotes evidence based early intervention. They work with government to ensure evidence based intervention is implemented through policy change. Their Early Childhood Services Hub provides service providers with a central resource to utilize evidence base intervention programmes.

Liverpool CAMHS is an example of a local service that has developed a framework for training of staff around ACEs, both internal and external, and providing ACE informed interventions including promoting resilience in young people.

Public health Wales are developing ways of working across agencies to increase awareness of ACEs and their impact. One example is their work with the police, providing training to enable early recognition and intervention for families at risk. Helping families access services within the community early will build resilience through greater support and hopefully prevent further ACEs across generations.

There are many additional international programs which we are unable to cover within the limits of this article.

### Community and family resilience

There are a number of studies that document resilience but little is yet known about what provides resilience. A recent study critically examined the environmental factors that differentiate between healthy and unhealthy individuals who have been exposed to similar levels of adversity. This study compared two groups that had both received maltreatment as children, they showed that the group with ill health were significantly more likely to have had poor levels of social support. Social support included any form of external support, such as youth clubs, sports groups, a trusted individual to talk to. This gives weight to the idea that we can promote resilience by finding ways for the children at risk to be more socially integrated and have more opportunities. It would be beneficial for those commissioning services for children to be aware of this evidence. Investing in activities for children and improving their access to social support, may reduce healthcare needs later in life.

All adults who have a role in a child's life, whether as a family member, friend or professional should be aware of how their relationship with the child may provide resilience to counterbalance the negative effects of ACEs. Practitioners should find ways to promote those relationships that are providing resilience in the knowledge that such relationships are counter balancing chronic effects of adversity.

Mindfulness is a practice that teaches awareness of the present moment, non-reactivity, focus, attention and non-judgment. Teaching children and young people the practice of mindfulness has been shown to improve mental, physical and behavioural outcomes. There is no requirement for the history of the adversity to be explored and mindfulness is also beneficial to healthy populations. Therefore there is potential application of mindfulness being used for example in schools, to provide a means of resilience for those experiencing adversity, whilst being of some benefit to all. Teaching mindfulness to parents is another way to mitigate the effects of adversity and toxic stress on the child. If the parent can learn 'mindful' parenting that is more responsive to the child, the effect of the adversity will decrease. There are valuable resources available online such as YoungMinds and the app Headspace.

## Identification of those who have been subject to ACEs

A pilot study in Northwest of England tried to introduce routine enquiry for ACEs. This study found that most service providers were not comfortable with routine enquiry, but favoured targeted





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enquiry. This was multifactorial, but a major factor was service providers felt that they did not know what to do with the information.

There is a dilemma about delving deep into something that you may feel you don't know how to manage. The first step will always be raising awareness of ACEs amongst service providers, as a building block towards developing a framework for recognizing and mitigating the adverse effects of ACEs.

A study in 1998 (Read and Fraser) found that 82% of mental health patients disclosed trauma when asked compared to only 8% who volunteered the information without being asked. This suggests that we are unlikely to find out information about ACEs without asking. Normalizing the questions within the form of a questionnaire and providing information about ACEs and their importance may help.

## Conclusion

The evidence of the impact of early adversity is strong and growing rapidly. Taking steps in our local areas to raise awareness of this, consider ACEs when doing a holistic assessment of a patient/client and building links between the medical world and the community services that can help mitigate the effect is likely, based on the evidence, to have long lasting effects on health outcomes into adulthood. ◆

## FURTHER READING

Animated films explaining ACEs. http://www.aces.me.uk/in-wales/ http://www.aces.me.uk/in-england/.

Early Intervention Foundation https://www.eif.org.uk/.

Fair Society Healthy Lives and Marmot Review 10 years on http://www.instituteofhealthequity.org/.

NHS Scotland 2018. The Annual Report of the Director of Public Health. Adverse Childhood Experiences, Resilience and Trauma Informed Care: A Public Health Approach to Understanding and Responding to Adversity. https://www.nhshighland.scot.nhs.uk/Publications/Documents/DPH-Annual-Report-2018_(web-version).pdf.

Public Health Scotland Adverse Childhood Experiences in context report http://www.healthscotland.scot/media/2676/adverse-childhood-experiences-in-context-aug2019-english.pdf.

Public Health Wales Responding to ACEs. http://www.wales.nhs.uk/sitesplus/documents/888/RespondingToACEs_PHW2019_english%20%28002%29.pdf.

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