

Effects of stress on the developing brain

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The recent [debate](#) in the popular press about “Tiger Mom” parenting is a timely sidebar to the exceptional progress occurring in research on development of the human brain and behavior: studies of infants and mothers are drawing a clear picture of the singular importance of early life experiences for the future adult.



In particular, we now know that early life abuse and neglect have adverse effects upon the developing brain and body that can result in poor self control and emotional regulation, impair cognitive development, and raise the risk of cardiovascular, metabolic and immune system diseases. Yet, new evidence shows that the sensitivity of the developing brain provides an opportunity for improving outcomes, and this is leading to efforts to improve consistency of supportive parental care.

STRESS EFFECTS ON THE BRAIN AND THE REST OF THE BODY

The brain is central to stress and adaptation because it perceives possible danger and determines behavioral responses, ranging from fighting or fleeing, to vigilance and anxiety. The brain also determines health damaging behaviors such as eating too much, smoking or drinking, and sleeping badly. Through the nervous system, the brain also regulates the body’s hormonal, immune and metabolic processes that can affect many body processes at once. In turn, the hormones responsible for stress, sex, and metabolism affect the brain; they can alter the structure of neurons and their connections, influence behavior and even change the hormonal processes themselves. For example, chronic stress can increase anxiety and decrease memory and cognitive flexibility. Fortunately, these changes in neuronal circuitry are reversible in a healthy, resilient brain.

Another stressor is obesity, today an epidemic leading to increased incidence of diabetes at all ages. Diabetes has damaging effects on the young as well as adult brain and the capacity to learn and remember in children; it also has been linked to increased risk for dementia later in life. Thus, counteractive measures, including diet and increased physical activity, are important for brain as well as for body health beginning in childhood as well as before and during pregnancy.

The social environment has enormous impact on the individual through the brain. Besides major life events, abuse and neglect, it is the ordinary day-to-day experiences in family, neighborhood, commuting and work, and school that affect brain and body function and promote those health damaging behaviors. Furthermore, socioeconomic status, which includes both income and education, is a [very strong predictor](#) of brain and body health, even when health behaviors and access to health care are factored out; and [perceptions of inequality](#) in cities, states and nations that have large differences between rich and poor have been linked to poorer physical and mental health.

MULTIPLE CONSEQUENCES OF EARLY LIFE STRESS

Brain development goes through sensitive periods during which stressors and nurturing experiences can have lasting effects, as was shown in the Center for Disease Control [Adverse Childhood Experiences Study](#) carried out on a middle class population in California. And a chart (see below) from a recent journal study showing the range of physical, behavioral and mental health disorders is a dramatic demonstration of the power of early life abuse and neglect to affect lifelong behavior and brain and body health. Yet abuse and neglect are the extreme, and so we must define the good and the bad among less obvious influences. Some information comes from animal models as well as studies on children.

ACE – health consequences

Table 1. Health and social problems and the ACE score

Problems from the baseline data	Outcomes associated with the ACE score
Prevalent diseases	Ischemic heart disease, cancer, chronic lung disease, skeletal fractures, sexually transmitted diseases, liver disease
Risk factors for common diseases/poor health	Smoking, alcohol abuse, promiscuity, obesity, illicit drug use, injection drug use, multiple somatic symptoms, poor self-rated health, high perceived risk of AIDS
Mental health	Depressive disorders, anxiety, hallucinations, panic reactions, sleep disturbances, memory disturbances, poor anger control

Sexual and reproductive health	Early age at first intercourse, sexual dissatisfaction, teen pregnancy, unintended pregnancy, teen paternity, fetal death
General health and social problems	High perceived stress, impaired job performance, relationship problems, marriage to an alcoholic, risk of perpetrating or being a victim of domestic violence, premature mortality in family members

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Animal models have taught us that stressing the mother in pregnancy can alter brain development in the offspring; and that prolonged separation of infant from mother impairs in the newborn other aspects of brain development and function. Furthermore, inconsistent maternal care and maternal anxiety, for example, from food insecurity, produce anxiety in offspring and contribute to the predisposition to diabetes, which itself has adverse effects on the brain.

In *one of the most striking examples*, an infant rat becomes attracted to odors from the mother early in life before the fear system is developed, and this attraction can occur even when the infant is abused. This paradoxical attraction of infant to the abusing mother allows the pup to survive, because mother is the only source of nutrition. Indeed, the presence of the mother suppresses development of a brain structure involved in fear and aversive learning. Translated into human terms, this phenomenon may help explain the behavior of individuals who are abused and neglected as children and yet who may choose a partner similar to an abusing parent.

Studies on children growing up in adversity have

added to the information gained from animal research. Chaos in the home and inconsistent parenting impairs development of self regulatory behaviors, which can lead to substance abuse, earlier onset of sexual activity, bad decision making and poor mood control. Abuse and neglect also lead to poor health, including poor cardiovascular control and increased inflammation that can have lifelong consequences (chart). Finally, lack of verbal stimulation in the home impairs *language development* while *stress and chaos* increase anxiety and impair self regulatory behaviors and lower self esteem.

PROTECTIVE EFFECTS OF PARENTAL CARE

Animal models reinforce the notion that strong maternal care is key to good emotional, social and cognitive development. Indeed, good maternal care can overcome some of adverse effects of prenatal stress. Maternal care has long-lasting and even trans-generational effects that are “epigenetic”, that is, a long lasting and sometimes heritable influence upon gene expression imposed by life experiences. Growing out of these animal model studies, there is now some evidence that epigenetic changes seen as a result of good vs. poor maternal care may also occur in normal vs. abused human subjects.

Particularly noteworthy is newer research suggesting how genetic differences influence the outcome of good or bad maternal care. Certain variants (alleles) of common genes increase vulnerability to abuse and neglect in childhood. However, these “reactive alleles” may also give rise to better outcomes in a nurturing environment. Individuals with those alleles have been termed “orchid children” whereas those with the less reactive allele are “dandelion children” and can do reasonably well in any environment.

Finally, research on animal models has shown that consistency as well as quality of parental care is important for successful cognitive and social development and that exposure to novelty against a backdrop of stable maternal care is key.

BREAKING CYCLES OF STRESS

Interventions to reduce adversity and thereby help improve brain and body wellness for children must focus on the family. Programs like Head Start have worked best when the family environment supports the child and the child comes home to a stable and understanding environment. The [Perry School Project](#) is an example of this combination and has shown a large return on investment not only in earnings and achievement for the individual but also for society in terms of less crime and less need for special education, welfare and greater income tax revenue. Programs like [Nurse-Family Partnership](#) provides social support and education for first time mothers and families, and the [Harlem Children’s Zone Baby College](#) provides this type of education in a class for expectant mothers and their partners. Yet we must not give up on those who have suffered the effects of adverse childhood experiences; interventions can help the individual compensate for early life stress, but they require considerable time and effort and further underscore the need for prevention.

CONCLUSION

So what about the Tiger Mom? Individual differences in brain development (especially in the prefrontal cortex which has such an important role in [top down control of behavior](#)) emphasize that the parenting style, strict or permissive, is much less predictive of outcome than providing a consistent and supportive environment. Indeed, consistency of supportive parental care provides a foundation on which exposure to novel experiences and setting limits to behavior (as in the Tiger Mom) can foster positive development, whereas chaos and unevenness within the family promotes poor self control and emotional regulation. Fortunately, there is plasticity in the developing and adult brain that can be guided by experiences.

For more information:

A rich source of information may be found on the website of National Scientific Council on the Developing Child:

<http://developingchild.harvard.edu/initiatives/council/>

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