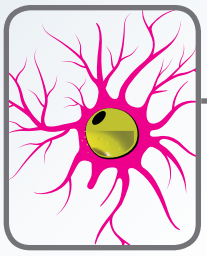


Understanding and addressing chronic stress during childhood

By Thomas A. Field & Michelle R. Ghoston

In this article, the second in a three-part series on neurological factors that affect child and adolescent development, we are focusing on the impact of chronic stress during the child and adolescent period.

Cortisol

Cortisol is a hormone secreted in the body that is associated with the body's mobilization of energy resources, especially in response to stressors in the environment. For example, cortisol increases blood sugar; enhances metabolism of carbohydrates, fats and proteins; and suppresses the immune system. All of these functions provide optimal conditions for individuals to conserve and use energy for important tasks such as responding to threats in their environment.

Cortisol levels naturally fluctuate throughout the day, with highest cortisol secretion taking place in the morning, slowly tapering off during the day, and increasing during the night, reaching peak level when we awake. Cortisol thus has an important role in preparing us to meet the demands of the day. It is related to diurnal rhythm because of its connection to energy use and alertness.

Cortisol is secreted in the body when the hypothalamus, a structure located in the limbic region of the brain, sends corticotropin-releasing factor to the pituitary gland. The pituitary gland is the master hormone gland of the body; it sends hormones to other glands that then release hormones. For example, in the case of cortisol, the pituitary gland sends adrenocorticotropic hormone (ACTH) to the adrenal cortex and medulla located above the kidneys, which then release cortisol and adrenaline. The interconnected structures involved in cortisol and adrenaline release are known as the hypothalamic-pituitary-adrenal (HPA) axis. Once the stressor has passed, the adrenal glands send a message back to the hypothalamus to discontinue the secretion of cortisol (i.e., downregulation) through a negative feedback loop. This upregulation and downregulation of cortisol, known as allostasis, helps the person to meet environmental demands.

Hypercortisolism and the metaplasticity hypothesis

When environmental stressors persist over long periods of time (i.e., chronic stress), this allostatic balance is disrupted. Chronically high levels of circulating cortisol cause damage to cells and reduce their ability to recover. For example, cortisol overactivates nerve cells (neurons) in the brain, causing them to degrade over time. In addition, cortisol causes chronic inflammation responses, and cytokines involved with immune responses can cross the blood-brain barrier, resulting in further overactivation and degradation of nerve cells. Cortisol also interferes with brain-derived neurotropic factor (BDNF) and glutamate release, reducing the development of new neurons and synapses.

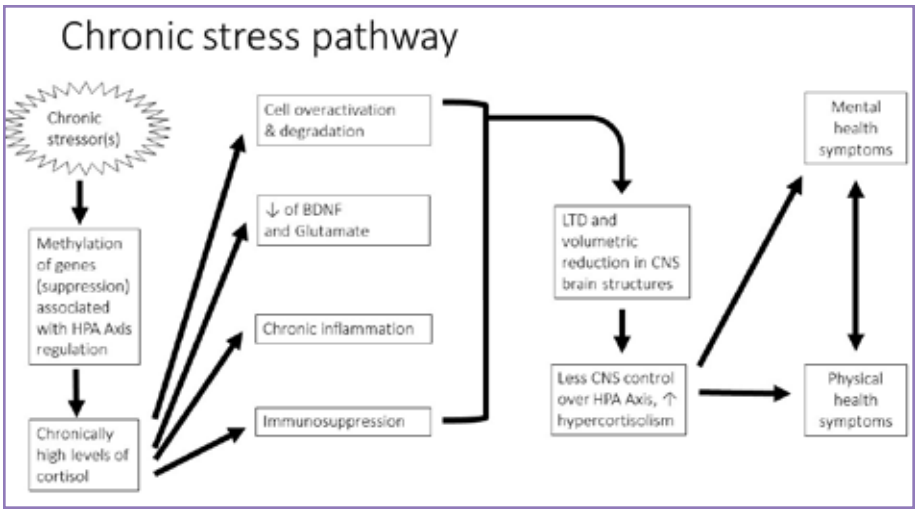
Ongoing, chronic high cortisol secretion causes long-term depression in central nervous system (CNS) brain structures. *Long-term depression* is a term used to describe longitudinal decreases in neuronal proliferation (i.e., the number of neurons). Volumetric decreases in hippocampal volume have been associated with chronically high levels of circulating cortisol, for example. These changes to brain structure weaken CNS control over the HPA axis and the negative feedback loop, further perpetuating chronically high levels of circulating cortisol.

Over time, epigenetic changes occur within cells so that methyl groups attach to gene sequences of DNA, tightening histone coils that silence (i.e., block) the expression of genes associated with the negative feedback system for turning off cortisol secretion. These changes cause permanent modifications to allostatic balance because the body becomes attenuated to high levels of circulating cortisol. Some researchers have termed this process *hypercortisolism*.

The *metaplasticity hypothesis* (as termed by Sarah Hulme and colleagues in 2013 and by Linnea Vose and Patric Stanton in 2017) describes changes to allostatic balance, epigenetics, and the associated volumetric declines in CNS brain structures. The graphic on page 9 depicts the process described.

The attenuation hypothesis

Longitudinal studies have found that chronic stress alters cortisol secretion over time. A research team led by Penelope Trickett conducted a 23-year longitudinal study that examined the impact of sexual abuse. The team reported its results in 2011. The study sample consisted of female children analyzed in two groups. The first group had experienced sexual abuse, whereas the second group had not. Approximately 50% of the participants were of African American descent. The



HPA = hypothalamic-pituitary-adrenal; BDNF = brain-derived neurotropic factor; LTD = long-term depression; CNS = central nervous system. (Adapted from Neuroscience-Informed Counseling With Children and Adolescents*, published by ACA.)*

study had a very high retention rate of 90%, which is difficult to achieve for longitudinal studies.

Participants were given an ovine corticotropin-releasing hormone (oCRH) to ascertain HPA axis regulatory systems years after disclosure of abuse. In early childhood, participants with abuse histories had increased ACTH responses to oCRH stimulation. Yet by early adulthood, participants with abuse histories had significantly reduced ACTH responses to oCRH stimulation.

In a study by members of the Trickett research team, Chad Shenk and colleagues proposed in 2010 that this asymmetrical response to oCRH suggested an attenuation and a breakdown of the HPA axis marked by blunted cortisol reactivity. The authors believed this supported Elizabeth Susman's 2006 attenuation hypothesis. Susman proposed that in cases of chronic stress, people at first experience increased cortisol secretion, followed by reduced cortisol secretion over time. Interestingly, Shenk and colleagues also reported that ACTH response differed by developmental age even among participants who had not been sexually abused, with ACTH secretion increasing during adolescence and gradually leveling off in early adulthood.

Reduced cortisol secretion is also problematic because cortisol is associated with the mobilization of energy resources (as described earlier). Researchers have found that lower morning cortisol levels are associated with impaired immune and cardiovascular functioning, rheumatoid arthritis, chronic fatigue syndrome and fibromyalgia.

Effects of chronic stress

A large body of research has consistently found that chronic stress during childhood has profound effects on the child's neurophysiological development. Chronic stress is differentiated from traumatic stress in two ways: 1) the stressor does not qualify as a traumatic event and 2) the stressor may persist over a longer period of time.

Examples of traumatic events include direct threats to a person's physical safety such as surviving a car accident, physical or sexual assault, a serious injury such as burns or injury from a dog attack, or living through bombings in a war-torn area. In contrast, examples of chronic stress include acculturative stress; bullying; experiences of discrimination, prejudice or marginalization; or living in poverty. In addition, adverse childhood experiences (ACEs) may be chronic and/or traumatic stressors. These include substance use, depression or suicide attempts by a household member; witnessing interpersonal/domestic violence toward caregivers; and imprisonment of a household member.

When persisting over long periods of time, these stressors can cause significant changes to the stress response system, with subsequent consequences to physical and mental health. In the large ACEs studies conducted in the 1990s, the experience of four or more major stressors as a child doubled or even tripled the risk of experiencing drug addiction, cancer, cardiovascular disease, depression, obesity, sexually transmitted infections or suicide attempts as an adult.

In the longitudinal study by Trickett and colleagues, female children with sexual abuse histories began pubertal development six to eight months earlier than did the comparison group of children without sexual abuse histories. Those with sexual abuse histories as children also had higher rates of preterm deliveries as adults and were four times more likely to experience suicidal ideation and self-injurious behavior.

Experts such as Bessel van der Kolk have conceptualized the impacts of chronic stress as developmental trauma and have proposed developmental trauma disorder as a new mental health diagnosis to capture the impact of these experiences on neurophysiological functioning.

HPA axis dysregulation caused by hypercortisolism also has a strong linkage with major depression. John Guerry and Paul Hastings in 2011 called the linkage between HPA axis dysregulation and major depression "the most consistent and robust biological finding in psychiatry to date." The authors claimed that an estimated 50% of depressive episodes can be linked to chronic stress and HPA hyperactivity. David Pagliaccio and colleagues reported in 2014 that chronic stress is a risk factor for first episodes of major depression in children. A research team led by Jussi Jokinen found in 2014 that methylation (i.e., silencing) of corticotropin-releasing hormone gene sequences was associated with suicide attempts in adolescents.

Cortisol also affects the development of fatty tissue. In the studies conducted by Trickett and colleagues, it was found that females with abuse histories had greater adipose tissue formation associated with higher rates of obesity.

To summarize, hypercortisolism is associated with increased risk for myriad health conditions that include major depression, chronic fatigue syndrome, fibromyalgia, impaired immune and cardiovascular functioning, rheumatoid arthritis and obesity.

Counseling implications

Counselors seeing children who have experienced chronic stress should work to strengthen these children's relationships with supportive caregivers. Bonding is associated with oxytocin release, which itself inhibits the release of ACTH by the pituitary gland and thus can downregulate the stress response of the HPA axis. Caregiver nurturance is therefore an important protective factor against chronic stress, and a child's request for physical affection and comfort should be understood to be a healthy and adaptive action. In clinical practice, we have observed that a child's request for nurturance because of neurophysiological activation is different from a child's request for nurturance as an avoidance response (e.g., attempting to avoid tasks such as attending school) because the ultimate goal is *moving toward* the caregiver rather than *moving away* from the nonpreferred task.

Counseling itself has a role in normalizing cortisol levels. For example, Fei-Hsiu Hsiao and colleagues in 2011 reported that participants who received both counseling and medication for major depression had significant changes to morning cortisol levels compared with those who received medication only. Similarly, Tsung-Tsair Yang and colleagues reported in 2009 that participants who received counseling and medication had reduced cortisol levels at night compared with participants who received medication only. These findings suggest that clinicians should continue to prize the importance of a trusting counseling relationship that provides a supportive space for clients to process their experiences. This in itself will help reduce cortisol secretion in children and adolescents.

Other authors have examined the specific effects of cortisol on counseling process and outcome. For example, Alicia Meuret and colleagues found that cortisol helped to explain why some participants benefited from exposure therapy for panic disorder and agoraphobia. Participants with elevated cortisol levels during exposure tasks and also during nonexposure tasks (e.g., daily activities) experienced the most clinical improvement. The authors proposed that cortisol was therefore linked to facilitated learning.

This reminds us that cortisol secretion is not the enemy. Some degree of cortisol secretion can actually be related to improved counseling outcomes. Cortisol secretion is not inherently problematic and is part of our normal (and predictable) adaptive response to events in our environment. Cortisol secretion becomes problematic only when it is perpetual and ongoing.

Therapeutic lifestyle changes

Counselors working with individuals who are experiencing the effects of chronically high levels of circulating cortisol should consider implementing therapeutic lifestyle changes into their practice. Adequate sleep and physical exercise seem to be particularly important interventions. Consider the following research findings.

Sleep: Adequate sleep duration and quality is associated with the maintenance of synapses and neurons. Sleep deprivation causes reduced numbers of neurons and synapses. Sleep is associated with critical functions such as HPA axis functioning and cortisol secretion, metabolic hormonal balance, executive functioning and memory/learning. According to the American Academy of Pediatrics, children ages 6 to 12 should get nine to 12 hours of sleep per night, whereas adolescents ages 13 to 18 need eight to 10 hours of sleep per night.

As most parents can attest, adequate sleep duration is a special area of concern for adolescents. Early school start times are part of the reason that many adolescents experience sleep deprivation. Researchers have reported that adolescents tend to have a circadian rhythm preference for later bedtimes and start times, caused by delayed nighttime release of melatonin. This has been observed in several countries around the world. Yet school start times generally remain early, forcing many adolescents into a state of sleep deprivation.

A research team led by Charles Basch reported in 2014 that a staggering 90% of adolescents were sleep deprived. Scott Carrell and colleagues reported in 2011 that adolescents performed better academically when high schools started later, even when controlling for socioeconomic status and mental health symptomology. Counselors may need to advocate for changes to school start times to further help adolescents establish better sleep routines.

Physical exercise: Andrew Venezia and colleagues reported in 2017 that a single bout of physical exercise can increase BDNF, which is associated with the creation of new neurons. This can help counteract long-term depression of cells caused by neural death and suppression of new neurons through reduced BDNF levels.

Further evidence supports the role of physical exercise in neural functioning. Kirk Erickson and colleagues reported in 2011 that physical exercise increased gray matter volume (i.e., newer neurons with unmyelinated axons) in the frontal lobe and hippocampus. Laura Chaddock-Heyman and colleagues reported that physical exercise also improved white matter integrity (i.e., older neurons with myelinated axons) in children.

Of course, physical exercise may not be possible for all children and adolescents, but counselors could work with children, adolescents and caregivers to identify an achievable and appropriate physical exercise routine. The Centers for Disease Control and Prevention recommends that all

children and adolescents engage in at least 60 minutes of physical exercise per day, with sessions of vigorous-intensity exercise at least three times per week.

Conclusion

Chronic stress from ACEs can have profound effects on child and adolescent development. Counselors should consider taking a holistic approach when working with children and adolescents who have experienced chronic stress. A trusting counseling relationship that provides a supportive space for clients to process their experiences seems to reduce cortisol secretion. Enhancing caregiver support and nurturance and integrating lifestyle assessment of sleep quality and physical exercise (when possible) might also help to reverse (or at least mitigate) the effects of hypercortisolism. Counselors should also advocate to change social systems and structures that create chronic stress for children.

To learn more about how neuroscience can inform child and adolescent counseling, check out our new text, *Neuroscience-Informed Counseling With Children and Adolescents*, published by the American Counseling Association. ❖

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Neuroscience-Informed Counseling With Children and Adolescents

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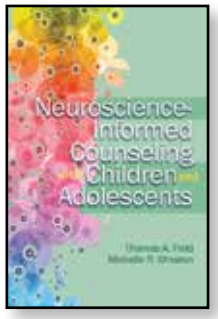

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