BOOK
SCARED SICK — The Role of Childhood Trauma in Adult Disease, 2012
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Inside Excerpt
Could common diseases be reduced by an overlooked factor well within our control? Do genetics and aging actually play a smaller role than we think in triggering heart disease, diabetes, obesity, depression & addiction?
In Scared Sick, childhood expert and therapist Robin Karr-Morse and lawyer and strategist Meredith Wiley propose that chronic fear experienced in infancy and early childhood lies at the root of numerous diseases as well as emotional and behavioral pathologies in adults. Although it's commonly believed that by the time we become adults we forget the trauma we experience as babies and toddler, the authors demonstrate that these first months may set the course of our health for the rest of our lives.
Scared Sick reveals how our innate fight-or-flight system, which evolved as a protective response to acute life-threatening events, can unexpectedly become an agent of chronic illness and even mortality if overworked in the early stages of life. Provoked by conflict and trauma, the chemistry of fear quietly takes its toll on our organs and regulatory systems throughout our development—only to strike when we are fully grown.
Grounded in cutting edge science and over 35 years of clinical experience, Scared Sick offers a revolutionary view of the impact of childhood trauma on adult health.

In Scared Sick, “fear” is defined as our most fundamental emotional and physical response from a perceived threat, triggering the chain of physiological responses known as “fight/flight response”. Fear is recognizable in all animals, even in rodents. Rats freeze on the spot, immediately ceasing exploration and investigation. Humans are subtler, but not by much.
We hold our breath, our hearts race, both our blood pressure and muscle tone increase. We may break out in a cold sweat. In extreme cases, as when we have experienced abuse as children or we have grown up in the wake of disasters such as war, ethnic cleansing or famine, our brains become permanently wired for survival in a dangerous world. Ironically, the very defenses developed to protect us under dangerous circumstances may become a huge liability in later, less-threatening chapters of our lives, especially if these defenses are now triggered without conscious awareness or control.

So for example, the child who is constantly ridiculed or shamed or hit by an alcoholic parent and who develops extreme hypervigilance and readiness to fight at any provocation may appear aggressive, hostile, even paranoid in a less-threatening environment, like school.
Or a child rendered powerless in the face of adult aggression may appear frozen, depressed and abnormally passive, even self-destructive, with unfamiliar adults outside the home.

But without our adrenaline-driven alarm system, the flight or flight response—or more accurately, the fight-flight-freeze response—we would be in constant peril. When, for example, we see a snake in the grass or a swarm of yellow jackets coming for us, this is the system that enables input from the senses to instantaneously signal large muscles in the arms or legs to fight or flee, bypassing the normally slower route through the analytical brain. When there is no time for analysis, no time for deliberations concerning the perceived threat, our brain has an emergency route directly to the alarm centre, the amygdala, so that in a nanosecond our entire body is activated in fight or flight. Our brain is so good in this instantaneous preparation that associated sensual information—sighs, smells, sounds, recorded at the same time—can trigger fight or flight before we are consciously aware of the threat. But when we are helpless, like a small child in the face of a yelling assault by an adult, we can neither fight nor flee. In the wake of overwhelming fear, we enter a state known as freeze. In the animal kingdom, freeze imitates death, allowing an animal to escape a predator. For humans, freeze works differently. We become emotionally numb, removed from reality.

The problem is that fight-flight-freeze, which originally evolved to protect us in the face of an occasional acute physical danger—like an attack from a wild beast—has not adapted to the challenges of life in the twenty-first century. Acute physical threats are no longer our primary threats. In Western culture, for example, the need to hunt for our next meal has been replaced by the need to drive on crowded freeways to stores and offices, to make money to purchase necessities, and to interface with all kinds of people, often at a merciless pace set by the technologies that now rule our lives. Having evolved as hunter-gatherers in small mobile communities close to the land, we now find ourselves living mostly in densely populated areas in constant proximity to strangers, often with little connection to the natural environment. For most of us, challenges have shifted from immediate physical threats to chronic emotional ones. To the degree that the realities of modern living—including staggering advances in technology, increasing population density and drastic changes in our roles and relationships with other humans—have outpaced the adaptations of our internal physical systems, we experience what we call stress. To top it all off, we are the only species, as far as we know, that worries, projecting concerns into the future and ruminating on our fears, which keep the stress cycle running overtime.

Ephemeral sensations we call “feelings”---our emotions—fuel the stress response. In fact, our feelings, often disguised, repressed or denied, are in constant chemical communication with our brains—and consequently with all key systems in our bodies—about the status of our health and safety. When we experience a feeling of overwhelming fear, our bodies reflect critical changes in the systems designed to protect life.

We are often confused about the identity of negative feelings: “What is this sensation in my gut (or my shoulder or temples)?”. “Is this anger or frustration?” “Am I anxious or depressed, exhausted or sad?” What most of us know for sure when we are “stressed” is that we experience “dis-ease”. We know that we are not at ease, that we are uncomfortable; there is both clarity and irony in this term.

Most of us know the feeling of being moderately stressed, however overused and non-specific that term may be. “Being stressed” is commonly used to denote a vague, unpleasant sense of feeling off balance emotionally or physically. Originally an architectural or engineering term to describe the pressure on structures that might cause them to break, “stress” has become a generic term that we commonly use instead of specifically describing feelings as varied as frustration, exhaustion, anxiety, distraction, fear, embarrassment and anger. When we say we are “stressed out” we might mean that we are fighting with a partner, or feeling overwhelmed by work or kids or school, or exhausted by too may demands and too little time. Regardless of vague descriptions, the negative feelings are registering in our bodies—for better or worse—chemically and organically. Extreme stress is measurable in physical terms: degree of abdominal fat, waist-hip ratio, baseline blood pressure and measures of our overnight production of cortisol and adrenaline.

In Scared Sick, we use the term stressor in reference to an external event outside of our bodies that results in the negative emotions and accompanying physical sensations inside our bodies that we call “stress”. Not all stress is harmful. We experience some stress getting up in the morning, or going to school or work. For a child, receiving an immunization, going to the dentist, or getting a haircut are typical stressors with positive outcomes for the child. Some stress is essential—for example, scheduling and arriving on time for appointments, taking tests, or going for a physical examination. Researchers refer to this type of stress as positive stress.

Positive stress actually improves immune function and facilitates an effective response to more serious stressors in much the same way that short regular sprints prepare us for a marathon. It sharpens our attention and enables us to remember life-protecting information like a mistake in judgement that we don't want to repeat. It heightens acute sensual focus. Think of driving alone at night on an icy road. It is stress—the fight/flight response—that heightens our alertness, sharpens our senses, and speeds our responses to the sheen on the road or the slip of a tire that indicates danger. Brief episodes of stress are what our stress systems are designed for and may actually be better for us than no stress at all.

A secondary category of stress is tolerable stress. This is stress that could become harmful, like getting divorced, having a parent or partner die, or losing a job. The capacity to recover is what keeps tolerable stress from becoming more stress—or trauma. Under tolerable stress, we have access to the healing process through relationships with friends, family or professionals and practices like regular exercise, meditation, healthy eating, adequate sleep and personal time to regroup. Though we are still affected by stress, we are able to regain an internal balance or what we call homeostasis—a healthy balance within our central nervous, immune and endocrine systems that protect health. Being able to trust, to talk openly, to be heard empathetically, to physically release stress through dancing or running or swimming or drumming—these are the critical elements in preventing tolerable stress from turning into toxic stress.

Toxic stress is the problem. When it is strong, frequent or prolonged by emotional experiences that overwhelm homeostasis, toxic stress triggers the freeze response. In the grip of toxic stress, we don't fully regain our former equilibrium because the healing relationships and practices that may have worked with tolerable stress are nor inaccessible, insufficient or unsuccessful. If it continues and accumulates in our bodies, toxic stress dysregulates the systems that protect health, paving the way for disease.

Homeland Security — The HPA AXIS

We all know the feeling; our blood pressure and breathing increase to mount the battle, our muscles tighten so we can run faster, leap farther or hit harder, and our senses go on red alert so we can see and hear more acutely. And as soon as the danger passes, we return to normal—collapsing or breathing a sigh of relief.

This is the normal response when one form of stress or another triggers the HPA Axis; the relationship among the hypothalamus (H), the pituitary gland (P) and the adrenal glands (A) that produces finely tuned chemical messages that connect the central nervous system, endocrine and immune system.

HPA is the linchpin that activates the body's main defenses. Together, these 3 systems are the sentinels of health, functioning like internal radar. Constantly responsive to internal and external threats—from germs to terrorists—the systems of the HPA Axis marshall the troops to defeat the threat, then resume their posts.

Dr. Bruce McEwen, a professor in neuroendocrinology at Rockfeller University in New York and a prolific researcher on the subject, *views stress as any physical or emotional challenge to the major systems of the body*. He points out that the interactive nature of the three systems that comprise the HPA axis and their capacity to communicate and adjust to varying conditions have enabled humans to prevail through evolutionary challenges such as extreme climate changes, varying geographical terrains and variations in available food. These systems work like an integrated thermostat, sending chemical messages back and forth to maintain homeostasis in response to changing conditions—especially anything that is life threatening. Their job is to sustain life at all costs.

McEwen calls the HPA axis-driven process *allostasis*. This capacity to respond to a threat and return to *homeostasis* is essential. In healthy people, allostasis occurs almost automatically, frequently and expediently after normal stressors like running, chasing a call or climbing a set of stairs. Allostasis also kicks in under everyday emotional stresses, such as giving a report in school or taking a driver's test. Problems arise when intense stress comes at us so frequently that allostasis can't fully shut down the stress response, or when we need the activating energy of the stress response and allostasis doesn't shift into gear.

To imagine how allostasis works, picture a temperature gauge on the dashboard of a car. When the engine is functioning within the normal range for which it is designed, the needle stays in a green area, left of centre on the gauge. But if the engine overheats, the needle goes into the red area, right of centre on the gauge, indicating alarm. Our stress response system works similarly. When we are stressed, allostasis quickly sends our HPA into the "red zone". As soon as the stress has passed, allostasis sends our alarm system right back down into the "green zone", where it is meant to function.

But, if the stress response is stimulated over and over without much respite, toxic stress can wear this system down so that our HPA doesn't fully return to the green zone and stay there. With chronic overstimulation, the resting state of the HPA system gradually climbs to a higher and higher default, edging toward and then staying in the red zone. *Eventually it may remain there, never fully recovering its original balance.*

McEwen used the term "allostatic load" to refer to the wear and tear on the body from the overuse of allostasis and consequent dysregulation of affected systems. When stressful conditions continue and accumulate without repair over time—or even when we neglect healthy balancing practices, like getting adequate exercise—our allostatic load will ramp up. Those of us who live in a family where there is continual conflict or fear, in a violent neighbourhood, face economic challenges, live in a disaster zone or war zone—we are at risk for chronic stress, a reality recognized by health professionals and researchers for some time.

The surprising news is that people who experience low levels of constant annoyance everyday, such as frustrating, boring or demeaning jobs, are also at risk.

McEwen believes that chronic stress is toxic stress and that it causes problems with memory, premature aging and overstimulation of nerve cells. It often leads to the loss of tissue in key parts of the brain, especially the memory center, and to dysregulation of normally protective response systems, such as the immune response. Cortisol—the hormone produced by the adrenals, calms the system and enables it to return to homeostasis, signaling the immune system that all is well. Over time hyper-arousal may lead to a state of hypo-arousal (under-arousal) as adrenal glands become exhausted and cortisol decreases. When cortisol is depleted, overactive immune responses may attack normal processes and tissues, resulting in autoimmune conditions, various allergies or chronic fatigue syndrome.

Chronic stressors are likely the culprits at the root of many diseases. We are especially vulnerable to chronic negative emotions (fear, anger, shame, guilt, embarrassment, grief) when we are young, particularly if we were exposed to prenatal stress. And the gloomy news is that those of us exposed early become more—not less—vulnerable to the effects of chronic stress as we age, which in turn contributes to cognitive impairment and dementia. When high levels of stress, especially worry, continue into later life, they can cause shrinkage to the hippocampus in the aging brain, reducing memory and increasing the risk of Alzheimers. One Montreal study showed that the hippocampi of older people whose stress hormones rose over a 5-year period were 14% smaller than in people of the same age whose stress hormones were not elevated. The former group had difficulty remembering lists of words and paragraphs and negotiating mazes—symptoms predictive of increased risk of Alzheimer's and diabetes. While researchers have long known that trauma appears to contribute to the accumulation of the neurofibrillary tangles that are characteristic of Alzheimers, they now suspect that excessive HPA stimulation in everyday stress may contribute to the disease as well.

There is good reason, regardless of our age, to begin lowering stress levels, the advantages of doing so only continue to increase as we mature.

A Closer Look at Homeland Security

The central nervous system, the endocrine and immune systems communicate consistently with each other to maintain " Homeland Security"--- or homeostasis. But at moments of perceived threat, these same systems must respond almost instantaneously. In a nanosecond they coordinate carefully titrated biochemical changes and defenses through continuous feedback loops, share resources and energy with each other, and quickly borrow and pay back debts in an on-going dance to maintain life. It's unnecessary to remember all the terms or sequencing of this far from simple process. But pay attention to the key relationships, because it is the hijacking of these same ingeniously evolved relationships that paves the way to disease.

When you perceive a threat through one or more of your senses say, a dog bounding towards you, growling and snarling, his teeth bard, the sight and sound and even the smell of the dog comes in through your eyes and ears and nose to an area in the base of your brain called the locus coeruleus (the “Blue Center”). The locus coeruleus immediately alerts your limbic brain—especially the amygdala (the “olive”). It simultaneously secretes norepinephrine—an energizing and activating neurotransmitter—to increase attention and vigilance in your brain and body. In less time than it takes to blink, the limbic system performs an emotional analysis and memory review of the information. So if the growling dog runs past you toward another dog, or if, as it gets closer, you recognize the dog as familiar or friendly, in milliseconds the feedback to the locus coeruleus dampens the secretion of norepinephrine and the systems readying for “red alert” in your body immediately calm.

But if the limbic review confirms the threat, just as quickly, your autonomic (think automatic) nervous system will go into action. triggered by the amygdala, which functions like the brain's smoke detector. Joseph LeDoux at New York University refers to the amygdala as the “low road” because when immediate action is required, this tiny region of the brain bypasses the “higher” or cortical brain by directly signaling alarm through the lower brain structures to the body below the neck, commanding a life-saving emergency route. When there's no time for analysis, no time to linger in the grass and contemplate the color or speed of the oncoming dog, the amygdala provides the mechanism for urgent action. The “high road” through the cortical brain, the seat of reason and analysis, is, after all, for those times when we can sacrifice speed for analysis. The amygdala is also the center for emotionally ladin memories; it communicates immediately with the hippocampus (the “sea horse”), the center for declarative (conscious, verbal) memory, to update this bank of emotional experiences for future reference. Since the most fundamental goal of the brain is to sustain life, these steps are crucial, first to discern the threat, then respond to it, then record the associated variables for future protection.

Let's back up a step to look more closely at what is happening inside your brain and body to prepare you to meet this threat. Your nervous system is divided into two parts. Your *central nervous system* which consists of your brain and spinal cord and your *peripheral nervous system* which connects your central nervous system to your sensory organs, visceral organs and muscles, blood vessels and glands. Your peripheral nervous system in turn consists of two systems: the *somatic system* is conscious and you have control over it, while the *autonomic system* operates outside of your awareness. Itt is the autonomic system that is activated by the dog—especially if the dog turns out to be a very real threat.

In such an emergency, with almost no conscious thought on your part, the autonomic nervous system, having been activated by the chemical alarm sent from the locus croelus (in the brainstem) and the amygdala (in the limbic brain) takes command over the battle. This system coordinates defenses throughout the body by regulating the body's visceral organs and communicating through the nerve tissue running through the heart, the smooth muscles of the body and the glands—all of which are summoned to duty during the battle to preserve life.

At this point three branches of the autonomic system start working together synergistically, like divisions of an army deployed for war. The first of the three, the *enteric division*, which runs from the esophagus to the anus, shuts down all energy that would normally be directed to the digestive process. Gastrointestinal secretion and activity is postponed until further notice, and the sphincters contract. This is no time for digestion or elimination. Reproductive and sexual activity is similarly dampened. No time for that either! The enteric system sends messages to the brain about the sensations taking place in the gut, the heart and other organs, providing what Dr McEwen calls a set of microphones back to the brain so that it can "hear" what is going on in the body.

The amygdala will have discharged a second branch as well; the *sympathetic division* initiates the fight or flight response, beginning with a message to the hypothalamus in the brain. This is the first step in activating the HPA axis. The hypothalamus sends two sets of chemical messages that act simultaneously and in counterpoint with each other, one mobilizes the main defenses of the body for fight-or-flight, while the other keeps that mobilization in balance so that the body's other tasks, such as scanning for infection, are not weakened.

The first of these messages goes from the hypothalamus (H) to an area in the center of the adrenal glands (A) (which sit on top of the kidneys), triggering the production of *adrenaline* to instantly stimulate the cardiovascular and nervous systems. Now the heart, lungs and large muscle groups in the arms and legs are all activated; the stress response is fully underway. Heart rate and blood pressure increase to enable the mobilization of blood to the muscles to fight or run, bronchial passages widen to increase the flow of oxygen to all points needed, blood vessels constrict to slow bleeding, glands liquidate stored carbohydrates into blood sugar for energy, and pupils dilate. Even the immune system gets involved, white blood cells that fight infection attach themselves to the walls of the blood vessels, ready for departure to any point of injury.

At the same time that the *hypothalamus* is signaling the *adrenals*, it is also sending corticotropin-releasing hormone (CRH) to the *pituitary gland* (P), a small endocrine gland located in the bones at the base of the skull, near the hypothalamus. Once stimulated by CRH, the pituitary releases *adrenocorticotropic hormone* (ACTH), which stimulates the adrenal cortex (the outside layer of the glands) to produce *cortisol*, a hormone that provides a counterbalance to adrenaline. Cortisol— slower to develop and longer lasting in its effects than adrenaline— serves to control the stress response and calms the immune system's inflammatory response.

While life-preserving in response to acute stress, cortisol can play both constructive and destructive roles in several diseases if over- or under- stimulated. Without constant loops of communication between the body's systems, this emergency response can easily get out of balance. Overregulated or underregulated cycles can lead to disorders of arousal, thought and feeling and a malfunctioning immune system.

The third division of the autonomic system is deployed when the senses perceive that the war is won or almost won. This division, the *parasympathetic division*, counterbalances the sympathetic functions initiated during fight or flight. While the maneuvers of the sympathetic system activate the body for action, the parasympathetic division now gentles those same pathways. Known as the "*rest and digest:* system, the parasympathetic system, responding to cortisol, slows the heart rate, dilates blood vessels, reduces blood pressure, constricts the pupils, and stimulates the digestive, reproductive and genitourinary systems after the threat has passed. Under most circumstances, the parasympathetic system comes in only briefly to balance fight-flight. But when an event is overwhelming, the parasympathetic system may continue to be stimulated, activating the muscles of the bladder and rectum and causing involuntary emptying of these organs.

In a nutshell, the amygdala sits at the hub of an exquisitely tuned and coordinated emergency response system. In an instant, it can set off a body wide alarm, triggering powerful hormones that move the body into fight or flight. As the bloodstream is flooded with adrenaline, norepinephrine and cortisol, the heart begins to pound, the lungs pump, and the limbs get a strong shot of glucose. The non-emergency systems in the body— digestion and immunity— are shut down so that vital energy is directed to the task at hand. The stress hormones also create a sense of heightened attention in the brain, so that the urgent message from the amygdala is recorded by the hippocampus as "Don't forget!". Now, with this memory seared into the deepest recesses of your brain, you will never face a similar incident in the future without the "flash bulb" memory of this moment.

This, then, is the stress response. but what about trauma? With trauma, a marked intensity, either in the severity of the threat or in the internal bodily impact of the experience combines with *helplessness*— real or perceived. If we are helpless— as an infant or very young child invariably is— or if we think we are helpless, neither fighting nor fleeing is an option. In the face of extreme threat while feeling helpless, the only options are either to remain in a state of hyperarousal or, overwhelmed by terror, simply switch off, like an electrical appliance receiving too strong a current.

The "off" or "freeze" switch is thrown by the vagus nerve, which runs down the body from the brain stem, through the neck, to wrap around the heart and viscera. The dorsal vagal is responsible for functions as varied as heart rate and gastrointestinal peristalis, (the movement of waste through the intestines). In reptiles, the vagus nerve slows heart rate and breathing, enabling a creature to go without oxygen so it can dive deeply into water to escape predators or hibernate in winter. It regulates the heart, lungs and glands and controls the volume and width of blood vessels. In mammals the vagus nerve mediates the freeze response. When a mammal is unable to carry out fight or flight because it perceives itself to be helpless and hopeless, it collapses immobilized into a dorsal vagal state— the freeze response. In humans we call this state "trauma".

Remember that this is an autonomic— or automatic— response; it is not under our conscious control. This is the distinguishing trait of trauma. In trauma as opposed to stress, the parasympathetic system is called into play early, creating an insulated state that is nature's effort to buffer pain. Normally not activated in the stress response until after the threat has passed, trauma triggers the parasympathetic system to reduce heart rate and blood pressure and release endogenous opiates, nature's own calming and pain killing agents. A cardinal characteristic of trauma is that both the sympathetic and the parasympathetic systems are operating at the same time. We become both hyper-aroused and in a fog; our" thinking" or cortical brains are hardly available to us. We often find ourselves without words and suspended in time and space— frozen in a state of simultaneous arousal and disassociation.

In the animal world, this state is called *defeat*. Think of an opossum "playing possum", or any animal stunned when hit by a car. The animal looks dead, a response that may save the animal's life by duping a predator. In mammals that survive the freeze, however, there is an unconscious release of the energy that was mobilized before the freeze. Legs shake violently and claw the air, as if they were running, as they let go of the stored nervous energy. In humans this discharge rarely occurs, due to inhibition of the release of the cortical brain. This difference has huge implications for emotional trauma and its treatment.

Post traumatic stress disorder (PTSD) is emotional trauma in its most extreme form. Following the return of soldiers from both world wars, when it was known as “shell shock” or “battle fatigue”, and seen more recently in veterans from the wars in Vietnam, Iraq and Afghanistan, PTSD presents bizarre and often crippling symptoms. Victims vacillate between bouts of hyper arousal— when their capacity to cope is overcome by the tiniest challenges— to times of sitting blank and still, staring into space seemingly not there. Easily set off by loud sounds, they may startle excessively and experience panic or fits of rage. Frightening images and feelings intrude into victims' daily lives when least expect it and follow them to their beds, where these images and feelings are often most horrific, interrupting their sleep and taking possession of their dreams. Plagued by nightmares that erupt into violent screams and thrashing limbs, the brain of a PTSD victim is essentially trying to mobilize the frozen energy stored in response to trauma. These are the effects of chronic overwhelming fear on a fully developed adult brain. Imagine the impact on an infant brain when fear is the architect of its chemistry and structure from the beginning.

Particularly observed in very young children, especially girls, who are less likely than boys to either fight or flee, freezing is a response to helplessness in the face of being both hyper-aroused and cornered. Parasympathetic activation enables the individual to move from terror to a state of disassociation, thus disconnecting from a horrific reality. Following even one such experience, the young child's fight or flight response is reactivated by reminders or thoughts of the original event, including worrying or dreaming about it. These ruminations trigger the same cavalcade of internal responses as the original experience. If it occurs often enough, it may generalize so that even subtle reminders— just fragments of the original event— are enough to trigger the full HPA response, re-stimulating the child's sense of helplessness each time.

When chemical states of fear persist over time in early development, the chemistry of trauma can become permanently set. Such children will always be on red alert for signs of danger. HPA systems that are constantly being overstimulated by internal or external reminders pull a child's attention away from other forms of learning. These become the children who can't sit still in school because they are busy subliminally monitoring the environment for signs of danger rather than calmly listening to the teacher. They will often perceive even benign behaviors as hostile— and they are ready to respond. Or they become the kids who don't do what's asked because they simply aren't there. Teacher talk doesn't penetrate these little brains, which have tuned out and gone away to safe places inside themselves.

Because the memory of early trauma is frozen in the limbic brain of a young child as a somatic or emotional feeling, stored without words, it will most likely not be accessible either through language or rational thought when those abilities develop. Early trauma is often at the root of physical and behavioral symptoms that defy diagnosis. Our schools are filled with children misdiagnosed with attention deficit disorder (ADD), or attention deficit hyperactivity disorder (ADHD) whose problems stem from trauma, often related to child neglect or abuse. The symptoms look very similar— the child doesn't listen, doesn't focus, is up out of his seat, is restless, disturbs other children, or picks fights. He or she is irritable and tends to provoke or re-enact violence. 20 years ago, teachers reported that they had two or three of these children in their classroom. Now we hear that they have five or six or seven.

Negative emotions generate an ongoing stress response. Esther Sternberg, chief of the NIH section on Neuroendocrine Immunology and Behavior and author of *“The Balance Within”*, explains the liability of this overstimulation as “ dose effect— some is good, too much is bad”. The dose effect in biology Is likened to an inverted U-shaped curve. Graphing the effect of stress, we find that, as hormonal levels increase with acute stress, performance improves, forming the rising arm of the inverted-U. But if acute stress becomes chronic, performance declines, forming the descending arm of the inverted-U. Steinberg asserts that this is a basic principle in biology, applicable to our bodies in many ways, including our consumption of food and drugs.

So how do our emotions hijack our autonomic nervous system to facilitate our demise? Overuse of the stress response eventually undermines the very organs it is designed to protect. This happens without conscious awareness because the brain structures that handle survival evolved long before the *neocortex*, the seat of conscious awareness, and they easily override it. The linchpin is the amygdala. When overstimulated, the amygdala triggers a body wide emergency response at the expense of other vital systems, and because the episode is recorded in the hippocampus as an emergency, it isn't easily erased and forgotten— in fact quite the opposite. The hippocampus itself may be the site of extensive collateral damage if the system is activated too frequently and intensely.

Diseases of Stress

We know that negative emotions generated by stress can trigger immune responses similar to those generated by invading germs or bacteria. Emotions such as fear, anger, grief, shame and chronic frustration can stimulate an all-out immune defense with the same cascade of internal responses that the body deploys against physical pathogens, potentially dysregulating the HPA axis and facilitating disease. Keeping these systems on red alert can wear out heart muscles, arteries and veins, leading to many forms of heart disease and hypertension. Like overuse of a car's emergency brake, which is designed for sudden, brief threats, the overuse of fight or flight responses can cause immune functions to wear thin, leaving the body vulnerable to infections. Chronically overstimulated immune responses can cause the system to attack the organs, causing autoimmune diseases like lupus and psoriasis, or they may catalyze inflammation at various sites in the body, resulting in conditions such as osteoarthritis fibromyalgia or irritable bowel syndrome

ADDITIONAL RESOURCES

https://pmc.ncbi.nlm.nih.gov/articles/PMC4755437/ - **The critical importance of the fetal hypothalamus-pituitary-adrenal (HPA) axis**

https://www.frontiersin.org/journals/behavioral-neuroscience/articles/10.3389/fnbeh.2020.601939/full **The Hypothalamic-Pituitary-Adrenal Axis: Development, Programming Actions of Hormones, and Maternal-Fetal Interactions, *Frontiers in Behavioral Neuroscience***

https://pmc.ncbi.nlm.nih.gov/articles/PMC2657842/#sec4 **The Inverted "U-Shaped" Dose-Effect Relationships in Learning and Memory: Modulation of Arousal and Consolidation**