The Weston A. Price Foundation

Understanding the Concussion Epidemic: The Importance of Nourishing the Brain

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When the film *Concussion* was released in late 2015, pundits noted that the topic of sports-related traumatic brain injuries (TBIs) had "gone Hollywood."[1] Although the movie focuses on National Football League stonewalling and obfuscation about football-related head trauma, it also taps into growing collective anxiety about the broader risks associated with sports-related
head injuries.[2] A national survey conducted with over fifteen hundred parents in 2014 found that 89 percent of parents worried about the risk of sports injuries for their children, and concussion and head injuries were the leading injury of concern.[3]

Parents' fears about head injuries are not unfounded. It is conservatively estimated that between 1.6 and 3.8 million concussions occur annually in the United States as a result of athletic involvement.[4,5] Moreover, the rate of sports-related concussions has been increasing, with one prospective study finding a 15.5 percent annual increase over an eleven-year period.[6]

As another indicator of this trend, emergency department visits for sports- and recreation-related TBIs among children and adolescents rose 62 percent from 2001 to 2009,[7,8] even though youth participation in sports has been steadily declining in recent years (Figure 1).[9,10] Improved detection of concussion cannot explain all of the increase.[4] It also should be noted that statistics on emergency department visits do not reflect other non-emergency department medical visits that are occasioned by sports-related concussions,[11] or the many concussed individuals who do not seek medical attention.

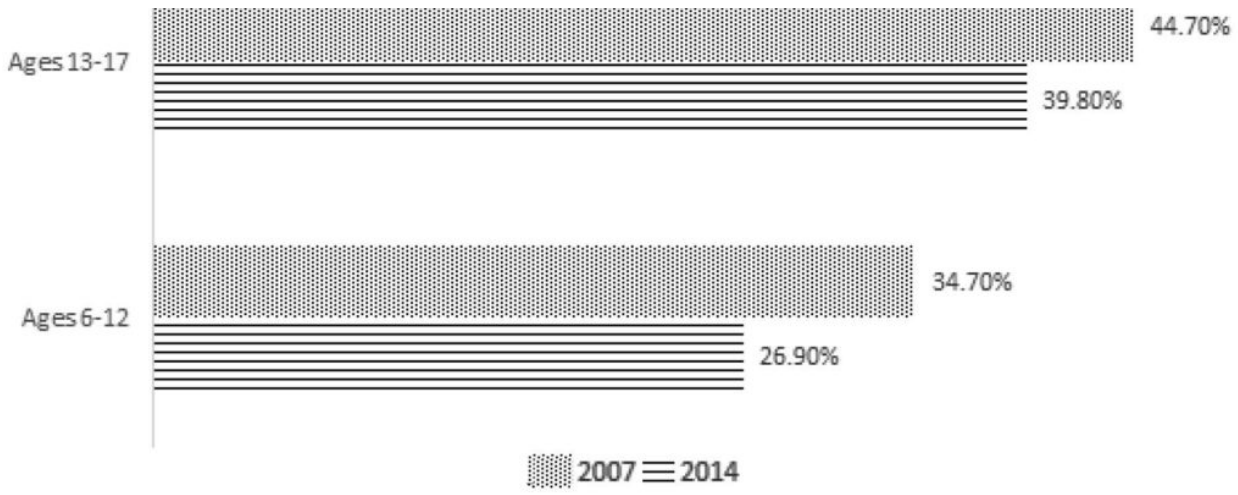
The Centers for Disease Control and Prevention (CDC) categorizes concussions as a "mild" form of TBI but acknowledges that all TBIs disrupt normal brain function.[12] Neurological surgeons caution that no concussion should be taken lightly.[13] In the short term, concussions may cause a range of physical, cognitive, behavioral and emotional signs and symptoms.[4] More disturbingly, researchers have found that some concussions can have downstream neurodegenerative effects, giving rise to "patterns of decline often associated with abnormal aging."[14] A 2014 study in *Surgical Neurology International* coined a term for this increasingly prevalent problem: "diminished brain resilience (DBR) syndrome."[11]

DIMINISHED BRAIN RESILIENCE

The authors of the 2014 study are Wendy Morley, nutrition specialist, and Stephanie Seneff, senior research scientist at MIT (and a frequent *Wise Traditions* contributor). The two authors make a compelling argument that our modern lifestyle and environmental toxins are the key culprits responsible for the alarming uptick in concussions and concussion-related neurological damage. A series of deeply interrelated environmental and lifestyle problems—pesticide and chemical toxicity, exposure to heavy metals such as aluminum, poor gut health, overconsumption of processed foods, nutritional deficiencies (especially during the formative years), and insufficient access to sunlight—are setting into motion a perfect storm of events that are making our brains less resilient to shocks and disturbances of all types.

According to Morley and Seneff, the human body's innate regulatory and healing mechanisms are ordinarily sufficient to "maintain homeostasis and enable physiological resilience."[11] When we are physiologically intact and healthy, intrinsic brain mechanisms typically allow us to recover spontaneously from uncomplicated single concussions within twenty-four to seventy-two hours. However, due to widespread exposure to environmental toxins, detrimental changes in the food supply and the loss of formerly protective lifestyle practices, few of us are lucky enough to have "unaltered physiology." Thus instead of producing a normal regenerative healing response, our impaired ability to recover quickly results in a "downward spiral of neurological demise."[11]

Figure 1. Percent of youth active three times a week in any sport activity (2007-2014)



Functional deficiencies and depletion of important brain nutrients are one of the key reasons for our increased susceptibility to brain injury and our compromised ability to heal. Common deficiencies include sulfur, magnesium, zinc, vitamin D, B vitamins and omega-3 essential fatty acids (EFAs)—especially docosahexaenoic acid (DHA). Each of these functional deficiencies has numerous downstream physiological consequences related to brain injury and diminished brain resilience (see partial list in Table 1).

GLUTAMATE TOXICITY

Glutamate is the brain's most abundant neurotransmitter, serving as a chemical messenger that relays signals between neurons. Glutamate is needed for learning and memory and as an important source of energy, and is involved in numerous aspects of normal brain function and "many different and interconnected processes."[15] However, glutamate is excitatory (brain-stimulating) as opposed to inhibitory (brain-calming), and it has somewhat of a split personality:

"Glutamate has to be present in the right concentrations in the right places for the right time. Both too much and too little glutamate is harmful. This implies that glutamate is both essential and highly toxic at the same time."[15]

The issues surrounding omega-3 deficiencies, brain injury and glutamate toxicity (see Table 1) are particularly interesting. As it happens, glutamate is released in large amounts after a TBI. While the brain has various mechanisms to restore glutamate homeostasis, neurodegenerative conditions and concussions impair glutamate clearance. The result—

excessive glutamate—then triggers a cascading series of damaging inflammatory effects. Thus, as the body tries to heal by releasing glutamate, it sets into motion a hyper-reactive excitatory response that damages the delicate neuronal tissue in the brain. These secondary effects turn out to be far more influential in determining the severity and outcome of concussion injury than the original mechanical forces involved in the concussion.

Neuroprotective omega-3 fatty acids can decrease the toxic effects of glutamate. However, because of the widespread deficiency of omega-3 fatty acids in the modern diet, this neuroprotective action may not be readily available to many concussion sufferers.

SULFATE AND SULFATE TRANSPORTERS

Insufficient supplies of sulfate to the brain—or more precisely the cerebrospinal fluid (CSF)—provide a central explanation for many neurological disorders.[16] (Sulfate is the oxidized form of sulfur.) Impaired sulfate supply is a factor, for example, in Alzheimer's disease, in part because adequate sulfate is needed to remove potentially neurotoxic waste products and prevent oxidative damage.[17] In the case of concussion, Morley and Seneff suggest that insufficient supplies of sulfate to the CSF (caused by environmental and lifestyle factors) leave the delicate neuronal tissues in the brain vulnerable to jarring.[11] When there is insufficient sulfate in the brain, the neuronal tissues produce a hyper-reactive inflammatory response in an attempt to regenerate the supplies of sulfate that neurons need, but this response is ultimately counterproductive.

TABLE 1. Functional nutritional deficiencies and their implications for brain injuries

DEFICIENCY OF:	RESULTS IN:
Sulfur	Impaired recycling of cellular debris and increased sensitivity to sudden impact
Magnesium	Lower seizure thresholds
Zinc	Increased protein misfolding comparable to that seen in Alzheimer's disease
Vitamin D	Increased likelihood of infectious agents in the brain
B vitamins	Glutathione depletion and increased oxidative stress
Omega-3 fatty acids	Increased glutamate toxicity

Adapted from Table 1 in Morley and Seneff, 2014.[11]

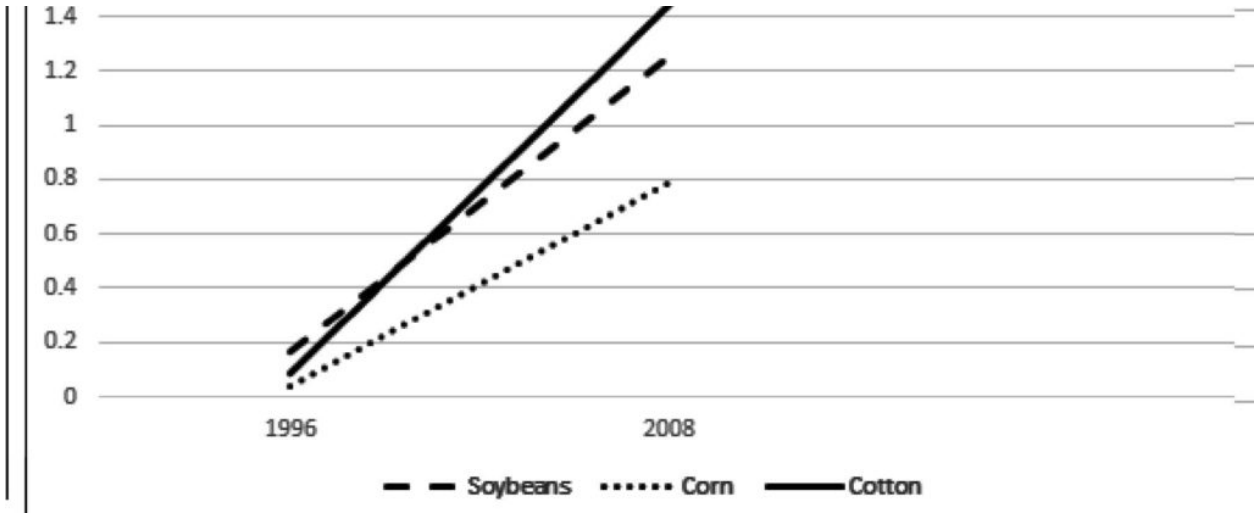
Sulfate depletion also impairs two important repair and clean-up mechanisms that are needed following brain injury, namely neuronal repair and recycling of cellular debris. Sulfate supplies in the CSF become inadequate when sulfate transporters are insufficient. Sulfate transporters include the monoamine neurotransmitters (melatonin, serotonin, dopamine and

norepinephrine), and sterols such as cholesterol, DHEA and vitamin D_3. The pineal gland (an endocrine gland in the center of the brain) plays a particularly important role in the sulfate transport process, synthesizing melatonin at night and delivering it to the CSF in the form of melatonin sulfate. Adequate sunlight during the day is essential to build up the supplies of sulfate needed to accomplish this nighttime transport process.18 Sun exposure is also a necessary (though not sufficient) condition to produce functional vitamin D3, another sulfate transporter. Interestingly, the brain centers responsible for producing serotonin, dopamine and norepinephrine are situated in close proximity to the pineal gland.

It is noteworthy that the omega-3 fatty acid DHA is also essential for the pineal gland to carry out sunlight-catalyzed sulfate synthesis. Morley and Seneff observe that DHA is "the most neuroprotective component of the omega-3 oils and makes up the most abundant fatty acid in neural membranes."[11] Although DHA normally should be present in substantial amounts in the pineal gland, omega-3 fatty acid deficiencies, as already mentioned, are at epidemic levels. A shortage of DHA, therefore, is problematic for sulfate synthesis as well as other protective and healing mechanisms.

THE ROLE OF GLYPHOSATE

Some interesting parallel trends have occurred over the same time period that sports-related concussions (and other forms of neurological-related damage) have been on the rise.[11] For Morley and Seneff, one of the most relevant and disturbing trends is the dramatic increase in use of glyphosate (the active ingredient of Monsanto's Roundup weed killer). Glyphosate is the most widely used herbicide in the world, with nearly a billion pounds of this toxin applied annually. In the U.S., according to the U.S. Department of Agriculture (USDA), glyphosate accounted for roughly 50 percent of total herbicide quantity as of 2008.[19]



Source: Fernandez-Cornejo et al., 2014..[19]

The escalating use of glyphosate has accompanied the wholesale adoption of genetically modified (GM) "Roundup-Ready" soy, corn, cotton and other GM crops (see Figure 2). From 1996 to 2008, there was a whopping 764 percent increase in millions of pounds of the amount of glyphosate applied to soy crops, as well as a 2167 percent increase in its use for corn crops and a 977 percent increase for cotton crops.[19] The USDA admits that the surge in glyphosate use has led to the development of glyphosate-resistant weed populations, prompting growers to apply other herbicides in conjunction with glyphosate and increasing the overall quantity of herbicides applied to GM crops.[19]

Over 80 percent of all processed foods in the standard North American diet contain GM ingredients, many from glyphosate-exposed crops. Glyphosate also has been detected in our water and air as well as in human urine samples. Of relevance to our modern-day problems with TBIs, according to Morley and Seneff, this explosive and cumulative increase in glyphosate exposure depletes sulfate supplies to the neural tissues. Sulfate depletion, in turn, leaves neural tissues "especially vulnerable to jostling through sudden impact" and impairs vital repair mechanisms.[11]

In addition to affecting sulfate supplies, glyphosate also disturbs at least three other critical processes. First, glyphosate interferes with the synthesis of the aromatic amino acids (tryptophan, phenylalanine and tyrosine), which are precursors to the monoamine neurotransmitters that serve as sulfate transporters. In the process, glyphosate binds to and

immobilizes micronutrients in plants, which carries over into nutrient deficiencies and diminished nutritional value in the glyphosate-exposed processed foods that we consume.

The second way that glyphosate alters our physiology is by disrupting all-important gut bacteria.16 It is common knowledge that beneficial gut bacteria perform many crucial biological functions. Glyphosate's interference with our gut flora allows opportunistic pathogens to gain the upper hand and produce toxic by-products such as formaldehyde. It also adversely affects the synthesis of the B vitamins that are essential for methylation; and glyphosate impairs glutathione (GSH) synthesis by depleting methionine. GSH is the brain's major antioxidant, and GSH depletion leads to neuronal degeneration.

Third, glyphosate interferes with the activity of the cytochrome P450 (CYP) enzymes in the liver.[16] CYP enzymes are important for vitamin D_3 activation, production of cholesterol sulfate and detoxification of drugs and toxins. Morley and Seneff suggest that glyphosate's suppression of CYP enzymes may explain the rampant vitamin D_3 deficiencies observed in this country. As already noted, vitamin D_3 is a sulfate transporter, and problems with sulfate transport are linked to insufficient sulfate supplies in the CSF.

GLYPHOSATE-ALUMINUM SYNERGY

Aluminum is a known neurotoxin[20] that bioaccumulates in the brain and can catalyze immunoexcitotoxicity. Glyphosate works synergistically with aluminum to cause harm, in part by promoting aluminum uptake.16 According to Morley and Seneff, glyphosate plausibly "facilitates the penetration of aluminum across the gut barrier"—and the fact that glyphosate disrupts beneficial gut bacteria further enhances aluminum penetration.[11] Aluminum's known physiological effects can also explain, independently of its interaction with glyphosate, the type of brain inflammation that is making it difficult for concussions to heal as nature intended.

TABLE 2. Amount of aluminum in vaccines, micrograms (mcg) per shot

VACCINE	BRAND NAME(S)	AMOUNT OF ALUMINUM (MICROGRAMS)
Diphtheria-tetanus-pertussis (DTaP)	Tripedia	170 mcg
DTaP	Daptacel	330 mcg
DTaP	Infanrix	625 mcg

Haemophilus influenza type b (Hib)	PedVaxHib	225 mcg
Hepatitis A	Havrix, Vaqta	250 mcg
Hepatitis B	Recombivax, Engerix B	250 mcg
Human papillomavirus (HPV)	Gardasil	225 mcg
Pneumococcus	Prevnar	125 mcg
DTaP + hepatitis B + polio combo	Pediarix	850 mcg
DTaP + Hib + polio combo	Pentacel	330 mcg

Source: Sears RW, n.d.[22]

There are many possible routes of exposure to aluminum, but for children, one of the most significant sources is the aluminum adjuvants contained in numerous vaccines. Adjuvants are substances added to produce a stronger immune response to the microbial antigens.[21] Table 2 lists the vaccines that contain aluminum adjuvants in the U.S., along with the amount of aluminum contained in each. As Dr. Robert Sears' pediatric website shows, newborns and infants who follow the current vaccine schedule receive 250 micrograms (mcg) of aluminum in the hepatitis B vaccine on the day of birth and another 250 mcg in the second hepatitis B shot at one month of age.[22] This is followed by anywhere from 295 to 1225 mcg of injected aluminum at the two-month appointment, repeated at the four-month and six-month follow-ups, producing a possible total of nearly 3,000 mcg by six months,[22] and 4,925 mcg by 18 months.[23] Investigators at the University of British Columbia have found a highly significant correlation between the number of aluminum-containing vaccines administered and the rate of autism spectrum disorders.[20] As the vaccine schedule continues to expand, so does children's cumulative exposure to neurotoxic aluminum.

Injection is a particularly toxic mode of exposure to aluminum. Injected aluminum enters the brain quickly and is slow to be excreted, with a half-life of about seven to eight years. Disturbingly, the children who are involved in organized team sports and are potentially at risk of concussion are exposed to additional injected aluminum in their preteen and teenage years through booster shots, even though the adjuvants that they received in early childhood and again at ages four to six have not yet left their bodies. Vaccine booster shots targeted at preteens that contain significant amounts of aluminum adjuvant include DTaP or Tdap,

Gardasil and the meningitis B vaccine recommended by the CDC in 2015 for teens between ages sixteen and twenty-four.[24] The Gardasil 9 vaccine approved by the FDA in late 2014 contains over twice as much aluminum (500 mcg) as the original Gardasil vaccine (225 mcg).

Teen lifestyles also feature other oral and topical aluminum exposures. These include aluminum-containing antiperspirants, sports drinks such as Gatorade (and other processed foods with aluminum-containing food dyes) and sunscreens, which have aluminum nanoparticles. Considering the synergistic relationship between aluminum and glyphosate, high consumption of junk and processed foods containing GM ingredients by teenagers is also cause for concern.

BUILDING STRONG SKULLS AND RESILIENT BRAINS

Morley and Seneff's wide-ranging article provides sobering evidence that environmental and lifestyle factors have given rise to the problem of diminished brain resilience syndrome—a problem with serious and potentially lifelong ramifications.[11] Moreover, DBR syndrome is only one component of a lengthy roster of neurological disorders that characterize our modern era and reflect diminished brain resilience, including, notably, Alzheimer's disease, but also other forms of dementia, Parkinson's disease and other disorders. Neurological disorders and deaths have increased disproportionately in the context of declining total mortality.[11] In 2010, for example, the U.S. ranked second among twenty-one high-income countries in deaths from neurological disorders, up from seventeenth place in 1991.[25] One in nine Americans (11 percent) has Alzheimer's disease (AD)—the sixth leading cause of death in the U.S.—and AD-related mortality rose by 68 percent between 2000 and 2010.[26]

In light of these dire trends, what are we to do? The first step is to ensure that mothers-to-be and growing children, especially, consume nourishing foods with the high levels of minerals (including good sources of calcium) and fat-soluble activators needed to support optimal skeletal development.[27] The fat-soluble activators—that is, the animal forms of vitamins A, D_3 and K_2—are essential for enabling the body to absorb and use minerals. As documented in Weston A. Price's masterpiece, *Nutrition and Physical Degeneration*, the quality of skeletal material is wholly dependent on adequate and appropriate nutrition that features these key components.[28] Price noted, for example, that "the excellent nutrition of the pre-Columbian Indians is indicated in the comparative thickness of the skulls" (page 100), and remarked on the superior skull development of other primitive groups, particularly those who made

abundant use of sea-animal life—noteworthy for its especially high content of minerals and fat-soluble activators (page 495). Examining a collection of ancient and modern skulls in Rome, Price found that whereas "only four skulls out of 4,000 [0.1 percent] belonging to the pre-Christian era…showed serious malformations, approximately 40 percent of the skulls…of

people who died in the last fifty years [in mental institutions] showed gross imperfections and abnormal formations." To endow modern-day children with the thick, strong skulls that Price once encountered and that surely represented protection against the adverse effects of concussion, modern parents-to-be and parents cannot afford to neglect sacred foods such as cod liver oil, raw milk and other raw dairy products from pastured cows and egg yolks from pastured chickens. For the more adventurous eaters, small fish such as anchovies and sardines, fish roe, liver and bone marrow are also excellent sources of minerals and fat-soluble activators.[27]

Unfortunately, it is impossible to eliminate fully our toxic exposure to pernicious substances such as glyphosate, but there is much that we can do to limit the damage that such toxins cause. In addition to eating the type of diet just described, we clearly should stay away from GM foods and ingredients, improve and maintain our gut health through regular consumption of fermented foods and avoidance of antibiotics, make sure that we consume adequate omega-3 fatty acids (seafood and organ meats are superb sources of DHA) and avoid sunscreen and sunglasses to ensure that we get enough sunlight to support sulfate synthesis and vitamin D_3 conversion. Avoiding aluminum exposure—and particularly injected aluminum—is also critical. More broadly, there is no doubt that we should all be working to encourage a societal shift away from the chemical- and toxin-dependent agricultural and medical practices that are diminishing brain resilience.

SIDEBARS

RECOVERING FROM CONCUSSION

The standard medical response to concussion has been to prescribe complete cognitive and physical rest (often in
a darkened room) to avoid reinjuring the brain. Typically, this means avoiding reading, screen time and exercise until full alleviation of symptoms.

Full rest in the first few days after injury is still considered critical. However, some physicians also have been developing a more proactive approach to treatment.[1] Instead of "waiting for the brain to right itself on its own," this approach draws on the concept of neuroplasticity, which recognizes the brain's ability to adapt. By carefully pinpointing the specific problems

that the individual is experiencing (such as vestibular system deficits, impaired vision or language problems) and prescribing exercises that are comparable to “physical therapy for the brain,” these physicians believe that it may be possible to encourage steadier improvement, although the approach still requires caution and fine-tuning.[1]

In addition to rest, administering alternating drops of fermented cod liver oil and high-vitamin butter oil under the
tongue can support the healing process. Cod liver oil is particularly helpful in reducing inflammation and promoting neuron repair. Homeopathic Arnica (or Aconite for the very fearful) in a 200C potency can also stimulate recovery if given shortly after the concussion, and other homeopathic remedies can be supportive over the longer term.[2]

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TRUE STORIES OF CONCUSSION

• A boy grew up eating a junk food diet and drinking large quantities of soda. One day, while waiting for his carpool, he fell off of a two-foot-high wall and hit his head, resulting in a concussion. The boy died the following day.

• Another boy was small and had difficulty gaining weight. His pediatrician recommended that he be allowed to eat
whatever he wanted, as long as he was consuming calories of any type, even candy. As a result, candy bars and other junk food were his mainstays. By his teenage years, he had had half a dozen repeat concussions and, despite a great love of athletics, was not allowed to play further sports, for his own safety.

• A third boy grew up eating a Weston A. Price style traditional foods diet. One winter, he lost control of his sled going down a steep hill and slammed head first into the side of his house. After a short rest, he was perfectly fine.

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