

Preventing Violence with Diet, Exercise, Sleep, and Lifestyle Modification

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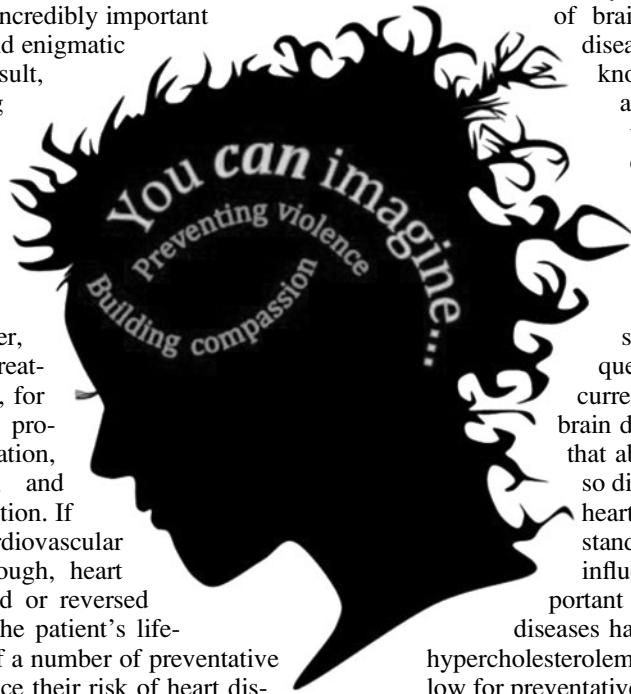
VIOLENCE, AS ALL BEHAVIORS, begins in the brain, an organ that remains profoundly enigmatic. Poor judgment, depression, poor decision making, risk taking, and altered perceptions of reality—all have a role in violent behaviors. But some of the behaviors that experts have observed in violent offenders are behaviors that are likely the result of poor brain health, and these behaviors can actually be modified or even eliminated with changes in diet, sleep, and/or lifestyle habits.

The brain, despite being an incredibly important organ, is extremely complex and enigmatic relative to other organs. As a result, our research and understanding of the disorders that affect the brain and cognitive function fall short of our understanding of diseases affecting other organs. Unfortunately, this means that the way we treat brain disorders is lacking relative to the way we treat other, better-understood diseases. Treatment of cardiovascular disease, for example, often involves three progressive steps: lifestyle modification, pharmacological intervention, and more invasive medical intervention. If the warning signs of a cardiovascular problem are caught early enough, heart disease can often be prevented or reversed through simple alterations to the patient's lifestyle. Most people are aware of a number of preventative measures they can take to reduce their risk of heart disease—quit smoking, drink alcohol in moderation, eat a healthy diet with plenty of fruits and vegetables, get out and move around, and actively reduce stress. In more critical cases, pharmaceuticals such as antihypertensives and statins may be indicated, and invasive intervention may become necessary (e.g., angioplasty and bypass surgery) if lifestyle modification and pharmaceutical interventions are not sufficient. This three-step method is followed in various forms for a number of other diseases such as diabetes, cancer, obesity, and more. However, when it comes to brain illness we fall entirely short. Despite the fact that the brain is just another

organ, just like the heart, liver, kidneys, and lungs, and can therefore be healthy or unhealthy, treatment of brain pathologies does not follow the same course. Instead, brain disorders are primarily diagnosed based solely on symptoms and syndromes and treated with pharmaceutical intervention, consequently bypassing the important lifestyle modification step.

We believe that skipping this step is a significant deficiency in our knowledge and treatment of brain disorders. In cardiovascular disease, we have a wide array of knowledge and ongoing research about how different foods and varying levels of activity impact cardiovascular health. This knowledge is easily available to be used in myriad ways to ameliorate heart conditions. Brain health, however, has only a limited amount of research to work with, and consequently lifestyle modification is not currently used as treatment for most brain disorders. However, if we realize that abnormalities in the brain are not so different from abnormalities in the heart, then we will see that understanding how our lifestyle choices influence our health is just as important in both organs. A number of diseases have early warning signs, such as hypercholesterolemia or hyperglycemia, which allow for preventative measures to be taken. Diseases affecting the brain are not as well understood, and therefore the warning signs are not as easily tested for or recognized. However, if patients were empowered with the knowledge that changing aspects of their daily routines, such as diet and exercise, could prevent brain-derived disorders such as depression and anxiety, we would see a path to preventing the onset of these brain health disorders and potentially effective interventions.

In order to have a significant impact, we need to change the way we think about brain disorders. Rather than viewing them as an intangible mystery (with the concomitant fear,



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stigma, and character judgments attached with the invisible), we need to think about them as a matter of dysfunctional brain chemistry, not as character flaws. A significant body of research has shown that disorders such as depression affect chemicals and structures in the brain, which are also influenced by diet, exercise, and other lifestyle choices. In essence we have to build bridges between the biochemical sciences and the behavioral science (e.g., inappropriate serotonin signaling is associated with depression). It is imperative that we come to a similar understanding of other brain diseases, such as violence. If we can reach the same level of understanding of the biochemical risk factors associated with violence, we will progress to treating or even preventing violence, along with other behavioral disorders, using lifestyle modification. The first step to changing how we treat violence is changing our understanding of it. If we can understand the neurophysiology of violence, along with the effects of diet, exercise, substance abuse, and sleep on the brain, then we will be well on our way to improving brain health and preventing violence through lifestyle modifications. We know that a healthy diet, exercise, sufficient sleep, and moderated substance use are beneficial to our physical health, but it is not yet common knowledge that these practices are extremely beneficial for our brain health as well.

Diet

In the last few years, there has been significant research done on what kinds of foods specifically correlate with changes in brain health. For example, dietary intake of folate, zinc, and magnesium was shown to lead to a decrease in depressive symptoms, and dietary long-chain omega-3 fatty acids were shown to be inversely related to anxiety disorders (Jacka et al. 2012, 2013). From these studies, we can infer that consuming foods such as dark-green vegetables, legumes, nuts, and whole grains can contribute to promoting a healthy brain. It is equally important to understand the foods that pose a risk to brain health and function. Diets high in refined sugar and saturated fat reduce neural plasticity and learning, and lead to low levels of brain-derived neurotrophic factor (BDNF), which correlates with depression (Molteni et al. 2002). The bottom line is that there is a growing body of evidence to support that the food we put in our bodies has a significant effect on our brain chemistry and resulting behaviors. Our brain health can directly benefit or suffer as a result of our dietary choices; thus, it is incumbent upon the individual to make choices that will allow for lower levels of stress-mediating factors and higher levels of beneficial neurotransmitters and hormones that influence mood and behavior. These changes to diet have the potential to influence behavior in a positive way, perhaps decreasing violent behaviors to self or others.

Physical Exercise

These same symptoms of anxiety, low BDNF, low cognitive function, and depressive symptoms can also be significantly decreased or eliminated as a result of consistent physical activity. There is extensive research to prove the benefits of exercise in several areas of brain health. These benefits range from academic performance, general cogni-

tion, and synaptic plasticity to protection from neurodegeneration and depression. Exercise has been shown to mobilize growth factor cascades, the central mechanism that mediates the benefits of cognition, neurogenesis, synaptic plasticity, and vascular function (Cotman et al. 2007). These benefits have proven to be neuroprotective, and can prevent or delay onset of neurodegenerative disorders. Not only does exercise prevent stress, but it can also reverse long-term effects of stress (Duman 2005). Similar effects can be seen in depressive symptoms. Women with depressive symptoms who participated in an exercise regimen for 8 weeks showed a significant decrease in depressive symptoms, and lower levels of cortisol and epinephrine (Nabkasorn et al. 2006). Physical activity thus plays an extremely important role in women's brain health in particular; one study demonstrated how aerobic activity aids in balancing hormones, and can significantly alleviate symptoms of premenstrual syndrome (Steege and Blumenthal 1993). Exercise is thus intimately associated with brain health and can affect mood, cognition, neurodegeneration, and behavior.

Sleep Habits

Several other components of our daily routines have potential consequences for brain health. For example, insufficient sleep leads to a whole host of problems in the brain. Sleep deprivation can lead to poor decision making and have a negative effect on mood. In some individuals, areas of the brain involved in executive function, such as the prefrontal cortex, are impaired by inadequate sleep (Durmer and Dinges 2005). Impaired decision making has the potential to lead to inappropriate behavior and potentially aggression.

Substance Abuse

Similar effects can result from activities such as smoking, alcohol abuse, and recreational drug use. These behaviors may have significant effects on the body and brain, which can lead to several brain disorders (Regier et al. 1990). Excessive use of alcohol or recreational drugs can lead to an altered perception of reality. This, along with decreased inhibitions, can result in more aggressive behavior. Excessive use of drugs over longer periods of time leads to even more negative consequences, frequently including acts of violence, to both oneself and others. These long-term effects can result in a lot of collateral damage. For example, cigarette smoke, including secondhand smoke, may have a link to increased violence, and has the potential to alter the genetic code, which can be passed on through both parents (Rao et al. 2015). Though it is well established that substance abuse poses a significant risk to cardiovascular health, it is important to understand the potential impact of these activities on cognitive, behavioral, and emotional health as well. While some habits will never benefit the brain, the old adage, "all things in moderation" is critical when it comes to health and particularly brain health.

Conclusions

There is a clear and, unfortunately, unmet need for research studying the link between diet, exercise, sleep, and

lifestyle habits, and violence. It is imperative that we identify revenue streams to financially support continued research into the links between lifestyle choices and brain health, particularly relating to violent behaviors. We certainly have an understanding of how exercise and diet influence disorders such as depression, and so a shift in our understanding with respect to violence is not a difficult one. Conceptualizing violence as a disease and researching it as such is the first step. A better understanding of the pathologies and dysfunctional pathways in the brain that lead to violence will empower us to identify the biochemical influences of diet, exercise, sleep, and daily habits. Establishing these connections will have a significant impact on reducing the stigma around brain health problems such as violence, and ultimately lead to an increased use of preventative measures such as lifestyle modification to decrease the prevalence of brain disease and the consequences associated with them.

Disclaimer

These are the views of Dr. Mary Ellen O'Toole and do not represent the views of the FBI.

References

- Cotman CW, Berchtold NC, Christie LA. (2007). Exercise builds brain health: key roles of growth factor cascades and inflammation. *Trends Neurosci.* 30, 464–472.
- Duman RS. (2005). Neurotrophic factors and regulation of mood: role of exercise, diet and metabolism. *Neurobiol Aging.* 26 Suppl 1, 88–93.
- Durmer JS, Dinges DF. (2005). Neurocognitive consequences of sleep deprivation. *Semin Neurol.* 25, 117–129.
- Jacka FN, Maes M, Pasco JA, et al. (2012). Nutrient intakes and the common mental disorders in women. *J Affect Disord.* 141, 79–85.
- Jacka FN, Pasco JA, Williams LJ, et al. (2013). Dietary intake of fish and PUFA, and clinical depressive and anxiety disorders in women. *Br J Nutr.* 109, 2059–2066.
- Molteni R, Barnard RJ, Ying Z, et al. (2002). A high-fat, refined sugar diet reduces hippocampal brain-derived neurotrophic factor, neuronal plasticity, and learning. *Neuroscience.* 112, 803–814.
- Nabkasorn C, Miyai N, Sootmongkol A, et al. (2006). Effects of physical exercise on depression, neuroendocrine stress hormones and physiological fitness in adolescent females with depressive symptoms. *Eur J Public Health.* 16, 179–184.
- Rao S, Shah N, Jawed N, et al. (2015). Nutritional and lifestyle risk behaviors and their association with mental health and violence among Pakistani adolescents: results from the National Survey of 4583 individuals. *BMC Public Health.* 15, 431–1762.
- Regier DA, Farmer ME, Rae DS, et al. (1990). Comorbidity of mental disorders with alcohol and other drug abuse. Results from the Epidemiologic Catchment Area. ECA) Study. *JAMA* 264, 2511–2518.
- Stege JF, Blumenthal JA. (1993). The effects of aerobic exercise on premenstrual symptoms in middle-aged women: a preliminary study. *J Psychosom Res.* 37, 127–133.

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