Environmental Health: Understanding and Enhancing Health from a Developmental Perspective

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INTRODUCTION
In discussing therapeutic options for autism, Harvard neurologist Martha Herbert, MD describes a whole-body perspective that considers the interconnections between cell, brain and body health. Because the environment plays a significant role in cell, brain and body health, understanding these biological relationships can be extremely helpful to developmental optometrists whose goal is to enhance the overall health and well-being of all patients, especially those with developmental delays and challenges.

Whole-body problems cause problems with cells, including those in the brain. Brain networks are built out of trillions of brain cells which cannot work well if the brain cells function poorly. Improving body health might have a trickle up effect: brain cells and brain networks receive more cellular energy to coordinate thinking, feeling, coordination, movement, etc. This results in improved health and well-being for all patients. For those with autism and other developmental disorders, the outcome can be an increase in neuro-typical behavior.

Health Begins in the Gut
One of the most exciting scientific findings in recent years is that health begins in the gut. Scientists are just beginning to understand the vital role of microorganisms (aka gut bugs) in training, modulating and evolving our immune systems in health and disease. The microbial community (termed microbiota) with which you share your body may contain as many as 100 trillion bacteria of a few hundred species. The genetic information from these microbial species is often referred to as the “2nd genome,” and unlike your original 46 chromosomes, it is possible to modify (perhaps even cultivate) your 2nd genome.

It is becoming increasingly clear that the environment is a key player in shaping the microbiota and body health, beginning at birth. Colonization of the gut begins during the birthing process when babies born vaginally are exposed to maternal microbes, while those born by Caesarean are deprived of this environmental advantage and do not acquire these “good” gut bugs. Breast-fed and bottle-fed babies differ as well. Breast milk contains sugars that feed good gut bugs, and their proliferation not only prevents less optimal bacterial species from gaining a foothold in the infant’s gut, but promotes healthy intestinal walls. Bottle-fed babies and those born by C-section have a higher incidence of allergy, asthma and other disorders of the immune system.

How ironic that a greater understanding of this positive relationship between human health and microbes has come at a time when humans have declared war on bacteria. The “western lifestyle” is awash in antimicrobial compounds. Children are frequently dosed with antibiotics; animals are given low doses of antibiotics to hasten their weight gain; bacteria are eradicated in order to increase the shelf life of processed foods; lettuce is washed in chlorine and hand sanitizers are used in every classroom.

The resultant decrease in both the quality and quantity of the bacterial species in the gut causes “leaky gut syndrome.” The microbiota maintains the health of the intestinal epithelium and its ability to form a barrier between food passing through the digestive system and the blood stream. When the epithelial barrier is not well-nourished, the gut becomes permeable. The immune system is called into action and the result is chronic inflammation.

Oxidative Stress
Free radicals are an unavoidable by-product of aerobic metabolism and the production of ATP. Healthy individuals have the anti-oxidant capacity to limit the damage to cell health, but oxidative stress may be increased by environmental factors. Exposure to radiation and toxins such as mercury, lead, pesticides and tobacco smoke are all associated with increased oxidative stress and decreased anti-oxidant capacity. The resultant damage to human cells may manifest as obvious disease such as cardiovascular disease, as well as many forms of cancer and auto-immune disease. The resultant damage to cells may also compromise “systems” functions, including the microbiome and the immune system. This can result in a vicious cycle of declining health. As systems and networks begin to malfunction, these systems attempt to compensate by increasing activity and increasing metabolic activity. The increase in ATP production only adds to the oxidative stress. Environmental exposures must be considered in order to break the cycle.

Epigenetics
Epigenetics can be defined as “the set of modifications to our genetic material that change the way genes are switched on or off, but which don’t alter the genes themselves.” Epigenetics helps to explain the relationship between a person’s genotype (the genetic makeup as defined by DNA) and phenotype (physical appearance and traits). Epigenetic regulation is an adaptive mechanism that allows cells to function under different conditions, including normal exposure to physiological substances such as hormones, or atypical exposure to substances such as environmental toxins. Epigenetic regulation facilitates adaptive changes and development from conception until death.

It is now known that epigenetic modifications or marks consist of chemical groups that are stuck onto DNA without changing the DNA. They sit on top of the genetic code and control the activation and deactivation of genes. These chemical markers are very susceptible to oxidative stress. It has been hypothesized that exposure to environmental toxins may increase oxidative stress to such an extent that epigenetic regulation is unable to respond optimally to the changing environment. Once again, the function of body systems is compromised and the result is decreased function and disease.

CONCLUSIONS
Three biological mechanisms have been described that all contribute to cell, brain and body health: leaky gut syndrome and chronic inflammation, oxidative stress, and epigenetic regulation. All three are intertwined and co-dependent. Leaky gut increases oxidative stress which inhibits appropriate epigenetic regulation.

All three are susceptible to environmental factors throughout the human lifespan. Developmental optometrists must educate patients and their families about optimizing cell, brain and body health by controlling environmental risk factors. In addition to providing printed materials and lists of web-based resources, optometrists should network with other “wellness professionals” to promote healthy lifestyles through co-sponsored activities such as book clubs, recipe swaps, and fruit/vegetable gardens.