

Hormesis: A New Lens for Improved Health & Resilience

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OVERSTRESSED – OR UNDERSTRESSED?

What explains the recent pandemic rise in "diseases of civilization" like obesity, diabetes, cardiovascular disease, autoimmunity and cancer - conditions much less prevalent in ancestral populations?

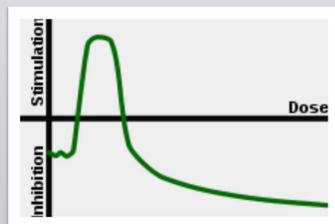
One common answer is that contemporary life is too stressful. The prescription is to minimize exposure to certain chemicals, foods, UV, or psychological stress. But stress is a double-edged sword. While chronic or excessive levels of stress can indeed cause illness, so can a "deficiency" of stress. Exposure to stress at the right intensity and frequency activates the body's natural defense and repair mechanisms, improving health and resilience. The harder life of our ancestors had benefits.

This poster presents the case for judicious application of progressive, intermittent stress to overcome conditions as diverse as obesity, addiction, depression, allergies and even myopia.

WHAT IS HORMESIS?

Hormesis is a biological phenomenon whereby a beneficial effect (improved health, stress tolerance, growth or longevity) results from exposure to low doses of an agent that is toxic or lethal at higher doses.

The LNT (linear no-threshold) model of conventional toxicology assumes that toxic effects are inhibitory *even at very low doses*. But many examples have been found of "hormetic" chemicals or stimuli with a "biphasic" or "inverted U" dose response curve, illustrated below. At low doses, the "toxic" or inhibitory agent actually becomes stimulatory or beneficial to the organism. [1]



Hormesis appears to work by activating endogenous defense and repair mechanisms found in all organisms, thereby improving resistance to stress and disease.

EXAMPLES OF HORMESIS

- Chemicals : alcohol, caffeine, curcumin
- Cold showers
- Sunlight
- Low dose radiation
- Resistance training
- Barefoot running
- Calorie restriction
- Allergen immunotherapy
- Anti-corrective lenses



Cold showers are awesome!

MECHANISMS AND APPLICATIONS OF HORMESIS

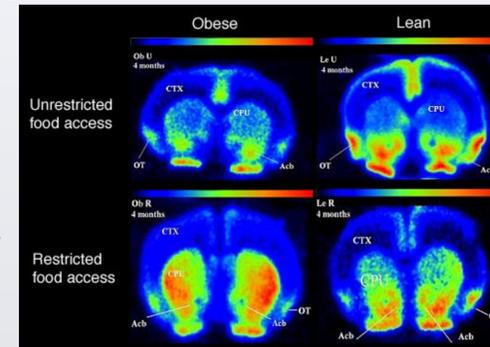
CALORIE RESTRICTION

Diets with calories reduced by 30-65% versus free feeding have been shown to extend lifetime and reduce degenerative disease in a wide variety of animals. [2]. What explains this? Several proposed mechanisms have been demonstrated:

Autophagy: A cellular "recycling" process. Calorie restriction dramatically lowers the concentrations of insulin, IGF-1 and growth hormone, activating enzymes that degrade damaged intracellular macromolecules and use them for energy.

Mitohormesis: A defense response initiated in the mitochondria. Calorie restriction turns on sirtuin genes that code for endogenous antioxidant enzymes and neurotrophic factors like BDNF, neutralizing reactive oxygen species (ROS), slowing the aging process, and protecting against neurodegenerative diseases like Alzheimer's.

Receptor upregulation. Brain scans in rats (right) show that after 3 months of restricted eating, D2 dopamine receptors in the brain are upregulated. [3]. This in effect lowers body fat "set point". Calorie restriction also upregulates GLUT-4 insulin receptors in muscle and liver.



Fasting and weight loss increase dopamine receptors [3]

Intermittent Fasting (IF). Fasting for 12-24 hours intervals per day produces similar health benefits as general calorie reduction, without activating a starvation response or risk loss of lean muscle. A "cycling" approach may optimize the secretion of (and sensitivity to) hormones such as insulin, leptin, ghrelin, cortisol, and thyroid hormones. For many, eating less frequently is easier than eating less at each meal; with time it naturally suppresses between-meal hunger. [4]

ALLERGEN IMMUNOTHERAPY

The allergy epidemic is frequently blamed on the profusion of pollutants and toxic man-made chemicals in modern industrial society. But historical studies indicate allergies have become pandemic as our environment has become cleaner.

The Hygiene Hypothesis holds that inadequate exposure to allergens in childhood may be depriving our adaptive immune system from developing properly, failing to develop normal tiers of IgG, IgA and IgM antibodies. The undertrained immune system tends to rely on the "emergency" IgE system, resulting in allergic response when confronted with normally harmless foreign bodies like pollen, dog hair, or peanuts. [5]

How to eliminate allergies. The conventional advice given to allergy sufferers is to avoid exposure to allergens and use antihistamines. Allergen immunotherapy takes the diametrically opposite approach: Patients are given tiny amounts of allergen in shots or sublingually. Exposure is then slowly increased in a systematic way. The emergency IgE response is thus dampened by stimulating production of an allergen specific IgG that blocks the IgE response and modulates the helper T cell response. Allergen immunotherapy has reversed allergies to peanuts and other foods in children. [6]

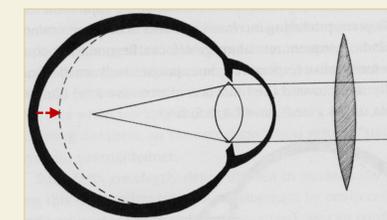
VISION IMPROVEMENT

Is myopia a result of nature or nurture? While certain populations may be genetically predisposed, studies show that nearsightedness is tied to environmental factors like increased schooling and close work. A multi-generational study of Eskimos revealed a statistically significant downshift in mean refractive state, from +1.8 diopters (hyperopic) in the older (unschooled) generation to -2.1 diopters (myopic) in the younger (schooled) generation. [7]

The Incremental Retinal Defocus Theory (IRDT) provides a plausible explanation for myopia induced by near work. [8] Effort by the retina to focus on near objects slows the rate of retinal neuromodulator proteoglycan synthesis in scleral tissues, causing axial elongation of the eye. Repeated cycles of "near work" induce axial growth that leads to permanent myopia. This has been further confirmed in studies of chicks and other animals in which axial elongation and myopia could be rapidly induced or reversed by respectively fitting them with plus or minus lenses.

How to reverse myopia. Conventional "correction" of myopia by fitting the eye with concave (minus) lenses provides short term relief, but at the cost of inducing progression of the underlying myopia. It is as futile as trying to "strengthen" a weak leg by prescribing crutches.

Anti-corrective lenses are the hormetic solution. Myopia is reduced by inducing a slight myopic defocus or "underaccommodation". This can be done using reduced prescription minus lenses for distance viewing, and using plus lenses (or the naked eye) to read text at the "blur point" - the maximum distance beyond which the printed word just begins to blur. [9]



Myopic defocus induced by a convex (+) lens on a myopic eye. From DeAngelis [7], p. 38.

THE BLOG: HORMETISM

Getting Stronger is a blog about the philosophy of **Hormetism**, based on the application of progressive, intermittent stress to overcome challenges and grow stronger physically, mentally and emotionally.

Some popular blog posts:

- "Cold showers"
- "Improve eyesight - and throw away your glasses"
- "Intermittent fasting for health and longevity"
- "Does insulin make you fat?"
- "Change your receptors, change your set point"
- "Obesity starts in the brain"
- "How to break through a plateau"
- "The paradox of barefoot running"
- "The case against antioxidants"
- "A cure for insomnia?"
- "Overcoming addiction"

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ABOUT THE AUTHOR

Todd Becker is the author of the blog "Getting Stronger", which combines his passion for scientific investigation with a practical desire to understand the root causes of health and disease.

Todd has degrees in chemical engineering and philosophy from Stanford University and Brown University. He works as a staff scientist for a biotechnology company in Palo Alto, where he leads project teams and holds more than 20 patents.

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