

How Hormesis Works

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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? These conditions were much less prevalent in pre-modern societies.

One common answer is that contemporary life is too stressful. The prescription is to minimize exposure to certain chemicals, foods, UV, or psychological stress

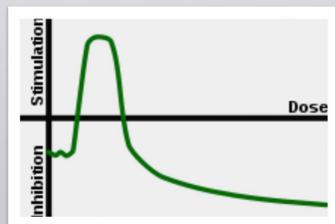
But stress is a double-edged sword. While chronic or excessive levels of stress can indeed cause illness, so can a deficiency of physical challenge. Exposure to stress at the right intensity and frequency - hormesis -- activates the body's natural defense, repair and adaptive mechanisms, improving health and resilience. The harder life of our ancestors was in fact protective.

This poster examines four different types of hormesis and their underlying biological processes

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, repair and adaptive processes found in all organisms, to improve resistance to stress and disease.

EXAMPLES OF HORMESIS

- Chemicals: alcohol, caffeine, curcumin
- Calorie restriction
- Cold showers
- Exercise
- Sunlight
- Barefoot running
- Allergen immunotherapy
- Anti-corrective lenses



Cold showers are awesome!

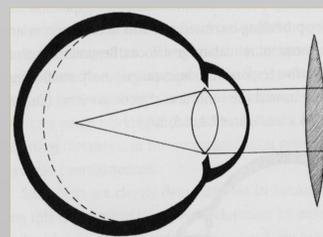
MECHANISMS OF HORMESIS

Biology of Hormesis

Hormesis is not a mysterious principle, but rather a fundamental and universal set of biological processes, found in all animals, plants and microbes. Hormesis operates at a biochemical level, and developed out of evolutionary necessity, allowing organisms to survive, adapt and even become more resilient in stressful and variable environments.

Hormesis operates at different **levels**. The chart below describe 4 main classes of hormesis.

Structural remodeling	Defense & repair	Metabolic adaptation	Psychological adaptation
PROCESSES			
Damage or strain induces release of anabolic hormones and modulators	Foreign substances , and organisms induce innate or adaptive immunity, detoxification, DNA repair	Metabolic challenge is sensed and regulated by hormones, enzymes, signaling proteins and transmitters, receptors	Challenge acts to reverse reward-driven cravings, addictions, and habits vis conditioning, receptor upregulation and neuroplasticity
EXAMPLES			
Bone strengthening from strain induces prostaglandin release and collagen synthesis	Exposure to allergens , ideally in childhood, "train" a moderate IgG and IgM adaptive immune response rather than allergic IgE response	Calorie restriction lowers insulin, leptin; increases PGC-1 α , BDNF dopamine, detoxifies via autophagy, activates REDD1, and inhibits mTOR and inflammation	Appetite control by retraining hormonal response and sensitivity (ghrelin, insulin, leptin), reducing hypothalamic inflammation
Muscle hypertrophy from micro-trauma and androgen induced protein synthesis	Toxins and oxidative stress from environment, exercise induce Nrf2 to upregulate endogenous antioxidant enzymes (SOD, glutathione,	Exercise activates PGC-1 α and irisin in the muscles, upregulates BDNF, thermogenesis, increases VO2 max, hemoglobin.	Overcoming depression and addiction by re-sensitizing dopamine D2, serotonin receptors
Calluses from dead keratinocytes and friction induced expression of adhesion molecules	Polyphenolic herbs and spices like curcumin, green tea, broccoli, upregulate the Nrf2 antioxidant system. Taking antioxidants suppresses this defense	Cold exposure , like exercise, stimulates the PGC-1 α cascade, irisin and thermogenesis and brown fat. It also improves mood!	Neuroplasticity remodels the brain to correct problems with vision, balance, pain, M.S. and Parkinson's
Myopia reversal results from defocus-induced differential release of neuromodulators, proteoglycan synthesis & axial length	DNA repair is activated by processes such as autophagy and the Nrf2 system	Hypoxia stimulates PGC-1 α , improves leptin signaling, represses mTOR, and stimulates thermogenesis & urge to exercise	Sleep restriction therapy acts to reverse insomnia by rebalancing of CRF and ACTH in the ascending arousal system



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"
- "Change your receptors, change your set point"
- "Obesity starts in the brain"
- "How to break through a plateau"
- "The case against antioxidants"
- "A cure for insomnia?"
- "Overcoming addiction"
- "Live longer!"
- "Is charred meat bad for you?"

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ABOUT THE AUTHOR

Todd Becker is a biotech scientist and 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's AHS16 podium presentation investigates why those who live at high altitudes tend to be less obese and live longer. Todd presented at previous AHS meetings in 2013 and 2014 on the ineffectiveness of many nutritional supplements and the reversibility of myopia through active focusing.

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