

OPINION PIECE

How Immune T-Cell Augmentation Can Help Prevent COVID-19: A Possible Nutritional Solution Using Ketogenic Lifestyle

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Opinion Piece

It is time we realize that food is a form of healthcare and promote a proper human dietary lifestyle. What is normal for one person may be poison for another. Being and getting healthy should not be predicated by any disease or infection that is out there. We human beings, who have been living with microbes in and on us, should not be afraid of the bug of the day. Whatever we do to survive as a human, depends on complex interactions of each one's immune system with their own environment and how their unique genetic system interacts with epigenetic mechanisms with food, being the biggest influence. The interaction between multiple factors (environment, lifestyle, genetic/epigenetics, microbiome, lipidology, and immunology) predispose or protect one from acute or chronic disease processes and nutrition is the most important stimulation human genes get influenced by. **(Figure 1)** The current mass medicine mindset helps with population-based theory generation, but the real solutions must be based on the N=1 personalized approach - if we have to fight the bug of the day. The dietary lifestyle one follows has a lot to do with the outcome of a disease process.

We have known for many years that people with metabolic syndrome and chronic diseases are the ones who suffer from complications of infections. This is observed when patients with different age groups get a viral infection. Patients affected by influenza

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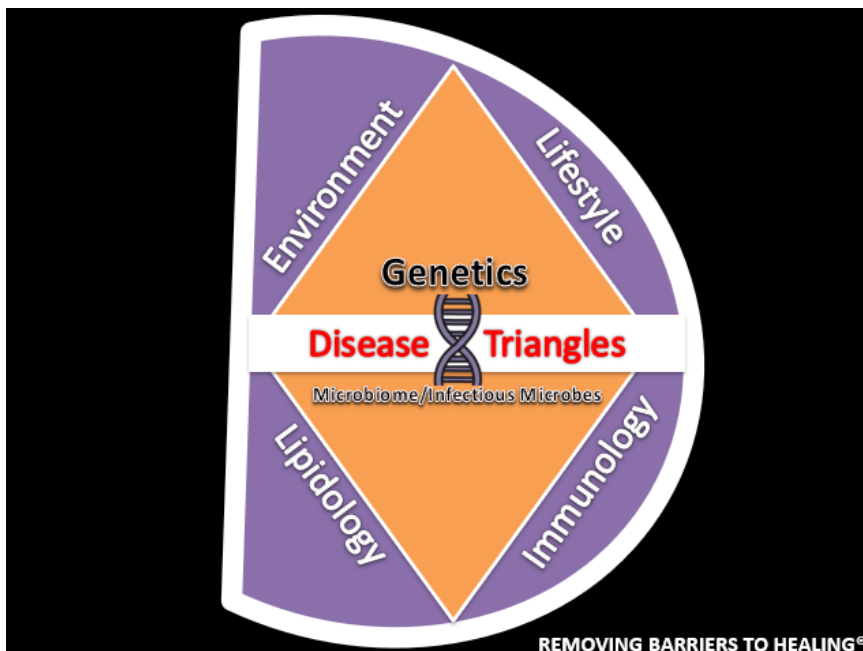


Figure 1. The Disease Triangles' factors: environment, lifestyle, lipidology, immunology, microbes/microbiome influence genetics and disease occurrence and outcomes.

have outcomes that are more lethal in association with morbid conditions of CAD, Diabetes, Obesity, Kidney diseases and immunodeficiency states. [1] Obesity leads to hyperinsulinemia, hyperleptinemia, and nutrient dysregulation. Systemic metabolic alterations of obesity directly affect immune responses to influenza via Hyperinsulinemia or hyperleptinemia that may lead to the metabolic dysregulation of T-cells, thus impairing their function in response to influenza. Hence, metabolic restoration of cellular immune cells may be critical to restoring their function and reduce the risk of influenza morbidity and mortality in obese individuals. [2] The current clinical picture emerging with epidemic coronavirus (COVID19/SARS-CoV 2) infection is consistent with an increase in fatality rate in those high-risk groups.

Reversal of metabolic syndrome and improving the metabolic function of the population would remarkably improve the overall survival of the population. [3] The rapid reversal of metabolic syndrome and improvement of the overall metabolic profile of the population is possible with low carb ketogenic nutrition. The elimination of chronic low-grade inflammation associated with metabolic syndrome that impairs the body's ability to mount an acute inflammatory response to combat viral infection would be reduced. [4]

Viral infections present a constant challenge to the host's immune system. Success or failure of the antiviral response is entrenched in cellular metabolism. Glycolysis, tricarboxylic acid cycle, pentose phosphate pathway, fatty acid oxidation (FAO), fatty acid synthesis and amino acid metabolism are the six key metabolic pathways that T-cells use. In T-cells, viruses interfere with the regulation of glucose uptake and down-stream metabolism to suit their own needs and to enhance the production of viral progeny. [5] Amino acids uptake and utilization are critical for T-cell development, homeostasis, activation, differentiation and induction of a long-lasting memory response. The regulation of cholesterol and fatty acid availability is crucial for T-cell function and a decrease in cholesterol availability limits proliferation. Several viruses are known to directly alter the lipid and fatty acid metabolism within the host cell for their own benefit. Metabolic changes are not only a response to cellular activation but can drive T-cell function, as well as regulate the progression of T-cell dysfunction and exhaustion. Augmenting Immunometabolism would help improve the function of the immune system. [3]

Increased glucose levels increase influenza A infection. Higher glucose concentrations induced a dose-specific increase in influenza infection. Altering glucose metabolism may be a potential new approach to inhibit influenza viral infection. [1] T-cells are a fundamental component of the adaptive immune response in the context of both acute and chronic viral infections. Seasonal influenza is a significant problem in healthcare and it mostly affects the elderly. The emerging coronavirus infections including SARS-CoV, MERS-CoV, and COVID-19 (SARS CoV-2) cause a number of T-cells in the blood to be severely reduced. [6] The acute phase of SARS in humans is associated with a severe reduction in the number of T-cells in the blood. Studies from patients who recovered from SARS suggest that the SARS-CoV-specific antibody response is short-lived. [7]

The studies in mice suggest that the T-cells are very important in viral clearance during SARS-CoV infection. Recent studies in Mice have shown significant protection against the influenza virus once the mice were placed on ketogenic diet (KD) triggering the release of gamma delta T-cells. KD increased the number of $\gamma\delta$ T-cells in the respiratory tract, and these $\gamma\delta$ T-cells were required to achieve the full protective effect of KD. [8]

At the time of writing this article in March 2020, there is no proven antiviral therapy for SARS CoV-2 infection and vaccine development may be a year away. [9] Recent studies in mice suggest the importance of T-cells in viral clearance during SARS-CoV infection. T-cell may play a crucial role in the clearance of SARS-CoV; there is therefore a need for detailed characterization of the T-cell response to SARS-CoV for the development of future vaccine candidates.

Finally, it is important to note that T-cells can play a protective and/or pathological role during viral infection and improving T-cell function and triggering the release of the T-cells via optimal nutrition that proactively helps this process. We are aware that metabolic syndrome reversal helps with the overall health of human beings along with the body's ability to mount the acute inflammatory response necessary to combat the viral infection. A ketogenic nutritional approach if taken up at the personal and community level, would reverse metabolic syndrome faster, likely improve T-cell function, and help stave off COVID-19 associated morbidity and mortality. Obviously further studies need to be done to see if this theory is helpful. If we have figured out how to protect ourselves from the "bad bugs" we ought to change our metabolic profile with an N=1 approach reversing metabolic syndrome and adding micronutrient augmentation with increased vitamin D and vitamin C supplementation would help immune cells function better against viruses. [10,11] There are many more viruses out there that are not detected, and there is discussion to identify all of them and devise vaccines and drugs as a solution. That is too costly and frustrating. We are going to see more and more pandemics in the future associated with more chaos. It's time for real introspection by using personalized solutions and tracking methods to improve health using a whole-person approach that helps one change the relationship with oneself!

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