A Mathematical Framework to Augment Metrics of Small Intestinal Health

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Celiac disease is a hereditary autoimmune disease that affects approximately 1 in 133 Americans. After ingesting the protein gluten, a patient with celiac disease may experience a range of unpleasant symptoms while small intestinal villi, essential to nutrient absorption, are destroyed in an immune response. The only known treatment for this disease is a lifelong gluten-free diet and there is currently no drug treatment.

This preliminary work provides a mathematical framework to better understand the dynamics of cell populations in the small intestine after a single transient immune activation such as exposure to gluten in celiac disease. Using this construct, the modeled cell populations can be related to diagnostic methods for celiac disease. By investigating the timing of destruction and repair, the model will be able to analyze various theories behind the progression of this disease by capturing the dynamics of a healthy subject and a patient with celiac disease, including the effects of repeated immune activation. By doing so, we can suggest potential therapies to mitigate the negative effects of celiac disease without invasive procedures