

Glutenology MasterClass: Module 7 – Recovering from Malnutrition

Biochemistry

- Biochemistry is equal to nutrition
 - The study of biochemistry is applied nutrition
- **Quote from the Textbook of Medical Physiology by Guyton:**
 - *Each of the 100 trillion cells in the human being is a living structure that can survive indefinitely and in most instances can even reproduce itself, provided it is surrounded by fluids containing appropriate nutrients*
- All of the known factors involving human health and wellness and disease are affected predominantly by nutrition
 - Nutrition plays a major role in the development and the processing of information and the progression towards disease
- **Nutrients** - these are the essential substances that allow your body to detoxify, repair, heal, grow, maintain cell function, create energy, and sustain life
 - **Classes of Nutrients:**
 - Carbohydrates
 - Fats
 - Proteins
 - Nucleic acids
 - Vitamins
 - Minerals
 - Water
 - These are the fundamental nutrients that are essential for body functions
 - **3 Other Nutrients:**
 1. Probiotics - these are the microbiome or the flora that lives inside of you
 - Many medications destroy the microbiome and damaging the microbiome cause damage to the ability of the body to produce vitamins
 - Many of the vitamins are made by your microbiomes, and it helps you digest the nutrients from the food
 2. Oxygen - you breathe oxygen in, and it is important in the cleanliness of the air
 3. Sunshine - this is classically not considered a nutrient
 - Sunshine and sunburning are different things
 - Sunshine helps the body produce melatonin and Vitamin D and vitamin D is an essential nutrient
 - Sunshine is critical to maintaining the nutritional quality of the human diet
- Even 1 nutritional deficiency can inhibit the healing process and can cause an outright disease
 - Examples:
 - Beri Beri - this is a disease caused by Vitamin B1 deficiency
 - Pellagra - this is a disease caused by Vitamin B3 deficiency
 - Scurvy - this is a disease caused by Vitamin C deficiency
 - **Milder Forms of Disease**
 - Hyperhomocysteinemia - elevations of homocysteine which increase the risk of the development of stroke and heart attack
 - This is caused by B12 (folate) and B6 deficiency
 - A nutritional deficiency can disrupt the body's ability to heal and repair itself but also can cause disease
- *Why do nutritional deficiencies develop?*
 - **Lack of Proper Intake**
 - This means the diet is too monotonous and there is no diversity in the diet and there are some nutritional gaps that can show up

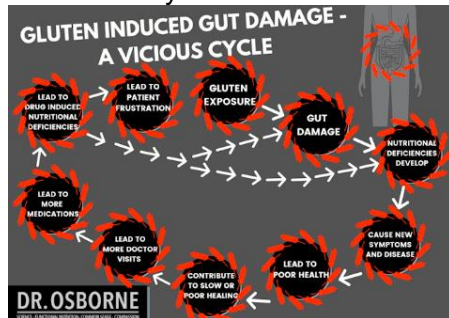
- This does not necessarily mean poor diet, but the lack of diversity in the diet where you are missing key nutrients and cause deficiency
- **Poor Food Choice**
 - This is common in today's industrialized countries where people are eating out of the process, packaged foods, and the food they are fortified by certain vitamins
 - Many of the food do not have adequate nutrients in them in the first place, which is why the government has mandated them to be fortified
 - In 1943, it was illegal to sell processed grain because they were so devoid of B vitamins
 - They were said to be responsible for killing about 8,000 people per year and why the food fortification program came into existence
- **Increased Requirements**
 - Baby, children, and adolescents are undergoing growth spurts and they require certain more nutrients to accommodate the growth spurts
 - **Examples:**
 - **Growth** - Adolescents are more likely to develop zinc deficiency as their body is growing because it aids in the growing process
 - **Pregnancies** - ladies and mother that has a baby growing inside of them require more nutritional power
 - They require more nutrient not just to sustain their health but to sustain the fetus within you
 - **Breastfeeding** - When you are breastfeeding you also require more nutrients because you are still feeding the baby
 - **Increase Exercise**
 - When you have an intense exercise program, the body will demand an increase in nutrients to heal and repair from the damage induced by the exercise
 - Exercise is a muscular trauma that requires nutrients for healing and repair, and regrowth of the tissue
 - **Trauma**
 - When you have a sprain, tissue damage, a broken bone, injury, or traumatic events that need an increased nutrient for healing and repair
 - **Chronic Inflammatory**
 - When you are suffering a chronic disease like diabetes, autoimmune disease, like celiac disease means increased inflammation
 - This would demand an increase in the body's nutritional status
 - Heightened inflammation will make the body demand more vitamin D
- **Increased Loss**
 - There are situations where the body are losing nutrients to a greater degree
 - Examples:
 - Kidney Disease
 - Burn Victim - nutrients can seep out of the burns especially proteins
 - Aggressive Skin inflammation - psoriasis or eczema lose proteins and nutrients more aggressively
 - There is also increased loss due to medication
 - Many medications directly inhibit vitamin or mineral absorption
 - Caffeine - this is a diuretic that causes a greater degree of water-soluble nutrient loss in the body
 - Alcohol - this can cause B vitamin loss
- **Malabsorption and Maldigestion**
 - Examples:

- **Celiac Disease** - the inflammatory damage caused in the villi causes malabsorption and maldigestion
 - **Gastritis** - Inflammation of the stomach which is a common cause of protein and mineral malnourishment
 - Crohn's Disease
 - Some medications damage the gut motility like antacids
 - Poor dentition or not having complete teeth where food is not being chewed effectively
 - This is altered physical digestion that causes malabsorption and malnutrition
- **Altered Metabolic Function**
 - This is related to drug use because there are medications that can alter the metabolic function
 - Toxic burdens like excessive exposure to gasoline
 - This can also be for people that have genetic SNP (single nucleotide polymorphism)
- **Surgical Procedures**
 - Those that have their stomach stapled or have undergone stomach bypass
 - Bypassing the stomach can have a long term deficit
 - Cholecystectomy - this is the removal of the gallbladder
 - The gallbladder secretes bile and it helps absorb fat
 - Intestinal resection
- **One study pointed out that *patients with non-celiac gluten deficiency are believed to react symptomatically to wheat components***
 - *They also have proposed low-grade inflammation in these patients and the study suggest that presence of altered gastrointestinal transit*
 - Gastroparesis - this is where the bowel is not moving properly, and the food is not being pushed properly
 - Gluten - this can also affect motility and cause issues

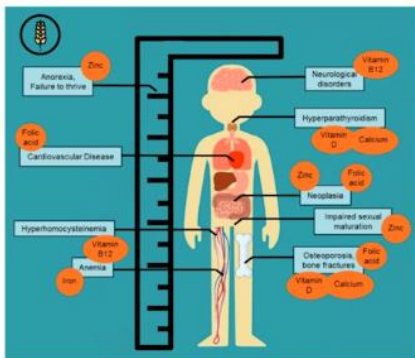
Nutritional Deficiency

- There are different stages on how nutritional deficiencies progress
 - **Early Stage Inadequacy** - there is no symptom manifesting and people are not struggling with issues
 - There is a decline in the internal biochemical body function
 - Examples:
 - Thyroid hormone is not converting correctly that can lead to fatigue
 - Selenium is essential for the body to digest appropriately but if you develop selenium deficiency it will not manifest at this stage
 - **Mid Stage** - this is a mild stage where mild symptoms are starting to develop
 - There is a continued decline in the internal biochemical functions which can be measured by doctors
 - This can last from weeks to months
 - **Advanced Stage** - obvious symptoms and physical signs start to develop along with the dysfunction
 - Example:
 - B12 deficiency - if this is not corrected immediately you can experience shortness of breath, fatigue and you can start to develop muscle weakness
 - **Full Blown Disease State** - this is where you get both physical and biochemical symptoms that can become debilitating
 - You are seeking out medical help in a big way and this disease can kill you
 - Scurvy, Beri Beri, Pellagra can kill you at late-stage disease
- **Deficiency is rarely investigated**
 - Most doctors poorly understand nutritional deficiencies, and many doctors do not investigate nutritional deficiencies because they are not trained adequately

- Nutritional deficiencies can cause symptoms and disease and can contribute to poor health
 - This can lead to drug-induced nutritional deficiencies wherein it leads to the patient being frustrated because when the drug causes nutritional symptoms, the patient is stuck on a cycle



- When you have gluten exposure > this causes gut damage > this leads to nutritional loss or nutritional deficiency > symptoms or progression of health issues > the patient seek advice > the doctors medicate the patients > many drugs have untoward effects on the GI tract > this leads to a massive cycle



- - This diagram is a synopsis of a major review by a journal published in Nutrients
 - This shows that nutrient deficiencies in adults and children with treated and untreated gluten issues and celiac disease still have a nutritional deficiency
 - This increase the risk of the development of diseases
- **A journal published by the Mayo Clinic Proceedings**
 - They found that albumin was low at 19.7%, copper was low was 6.4%, vitamin B12 was low in 5.3%, folate was low 3.6%, and 25-Hydroxy Vitamin D was low at 19%, Ferritin was low in 30.8%
 - This study was looking at serum levels of nutrients and using serum labs is less accurate than using lymphocyte proliferation
 - Even with lower accurate parameters, they still found nutritional deficiencies, and they conclude that micronutrient deficiency remains common in an adult with celiac disease despite a decrease in non-classic presentation
- **A journal published in Human Nutrition and Diet in 2013 entitled:**
 - ***Nutritional inadequacies of the gluten-free diet in both recently diagnosed long term patient with celiac disease***
 - They found that more than 1 in 10 newly diagnosed and experienced women had inadequate thiamin (Vitamin B1), folate (Vitamin B9), Vitamin A, magnesium, calcium, and iron
 - They also found that more than 1 in 10 newly diagnosed men had inadequate vitamin B1, folate, magnesium, calcium, and zinc intakes. Inadequate intake did not relate to the nutrient density of the Gluten-free diet

- Inadequacies of folate, calcium, and iron, and zinc occurred more frequently and was similar pre and post-diagnosis except for thiamin and Vitamin A which was inadequate after the gluten-free diet
- **A study published in 2019 entitled: *Micronutrients Dietary and Supplementation Advice for Celiac Patients on Long-term Gluten-free Diet with Good Compliance***
 - This is a review of 73 studies, and this showed deficiency was detected in up to 30% of subjects for vitamin B12
 - 30% of individuals on gluten-free diets with good compliance was still deficient in vitamin B12
 - 40% were deficient in iron
 - 20% were deficient in folic acid
 - 25% were deficient in vitamin D
 - 40% were deficient in zinc
 - 3.6% of children were deficient in calcium
 - 20% of children were deficient in magnesium
 - This study concluded that if integration with diet is not enough, starting with supplements may be the correct way, after evaluating the initial blood level to determine the right dosage of supplementation
 - These studies were using serum lab testing which is not the most accurate way to assess nutritional status
- **A journal published in the *American Journal of Gastroenterology* entitled: *Vitamin B12 Deficiency in Untreated Celiac Disease***
 - Iron and folate malabsorption is common in untreated celiac disease as the proximal small intestine is predominantly affected
 - B12 and iron are absorbed in the proximal small intestine, the area close to the stomach, it tends to be damaged in people with celiac disease
 - They concluded that vitamin B12 deficiency is common in untreated celiac disease, and concentrations should be measured routinely. Vitamin B12 concentrations normalize on a gluten-free diet alone, but symptomatic patients may require supplementation
 - The nutritional deficiency can be corrected by they do not always correct
- **A Multicenter Study published a journal entitled:**
 - *Evidence of Poor Vitamin Status in Celiac Patients on a Gluten-free Diet for 10 years*
 - The patient showed a higher total plasma homocysteine level than the general populations and this was indicative of poor vitamins status
 - Homocysteine is elevated when people have Vitamin B, folate, and vitamin B6 deficiency
 - The plasma level of folate and vitamin B6 were low in 37% and 20% of patients respectively
 - These were an indicator that either the damage to the gut is somehow permanent where they are not absorbing properly or either the gluten-free diet that the patient was following were not adequate in the nutrients to supply the nutrient that is needed
- **A journal published in *Nutrient* in 2013 entitled: *Vitamin and Mineral Deficiencies Are Highly Prevalent in Newly Diagnosed Celiac Disease Patients***



- The authors of this study found that 87% of newly diagnosed were deficient in at least one nutrient
 - 46% of the patient have an iron deficiency but only 32% have iron anemia that showed on the lab work
 - It is common with people who have gluten-free deficiency are malnourished
- *A journal about nutritional deficiency present regardless of the extent of gut damage or antibodies*
 - It showed that nutritional deficiency is present in the absence of gut damage and the production of antibody in the gut
 - They found that Vitamin D was the most commonly deficient in 70% of children and ferritin which is iron storage is suboptimal to optimal to 34.5% and zinc was suboptimal in 18.6% of children
 - They concluded that most children with celiac disease have vitamin D deficiency and the degree of micronutrient deficiencies does not correlate with the degree of villous atrophy or serum titers
 - You don't have to have the obvious markers and show that your gut is damaged to be nutritionally devoid
 - Some people associate the damage in the gut with nutritional deficiencies, and that if they do not have damage in the gut, they do not have to worry about their nutrition
- *A journal entitled: Gluten-free Diet and Nutrient Deficiencies, A Review*
 - This study is focusing on people following the gluten-free diet, and they found that the gluten-free diet was poor in fiber, and they found that this poor in vitamin B and folate and that it is poor in vitamin D, vitamin B12, and folate and they were low in iron, zinc, magnesium, and calcium
 - They found an inadequate macronutrient intake and was reported that it was related above all to focus on the avoidance of gluten
 - People were undereating because they were worried about getting gluten exposure and they did not eat enough calories
 - This study was done on people following a traditional gluten-free diet and they found that the diet was poor in nutrients and high in saturated fats and high in hydrogenated fats
 - They found that the individuals are eating far too much high glycemic, high carbohydrate processed foods
 - If you are following the traditional gluten-free diet, what you are getting is poor nutritionally dense foods
 - High calories in terms of carbohydrates but low overall calories in terms of proteins and other healthy micronutrients

- People who are avoiding gluten should be careful with their food choice because if they are not they will end up being deficient
- **A journal entitled: *Gluten-free Diet: The Gaps and Needs for a Healthier Diets***
 - At the time of diagnosis, they found that the following were quite common:
 - Iron deficiency
 - Calcium deficiency
 - Zinc deficiency
 - Vitamin B12, and folate deficiency
 - Vitamin A,D,E,K deficiency
 - Excessive fat intake
 - Secondary lactose intolerance
 - People with celiac disease, when their gut damage is destroyed so too are the cells that help produce the enzyme lactase
 - Lactase - the enzyme that breaks down the sugar in dairy called lactose
 - Nutritional Status during adherence to the traditional gluten-free diet tend to have:
 - Iron deficiency
 - Calcium, selenium, zinc, magnesium deficiency
 - Vitamin B12, folate, and low intake of vitamin C and vitamin D
 - They found that there is excessive fat intake
 - There is excess sugar intake in their diet
 - Controversial protein intake
 - They also have a low dietary fiber intake
- *The journal presented almost 90% of the people diagnosed with gluten issues are deficient in at least 1, and half is deficient in at least 2*
 - From different studies, it showed the nutrient in which people are mostly deficient are Iron, Vitamin D, Vitamin B12, Zinc, and omega-3 fatty acid
 - Nutritional deficiencies cause symptoms and disease that often lead to prescription medicine use

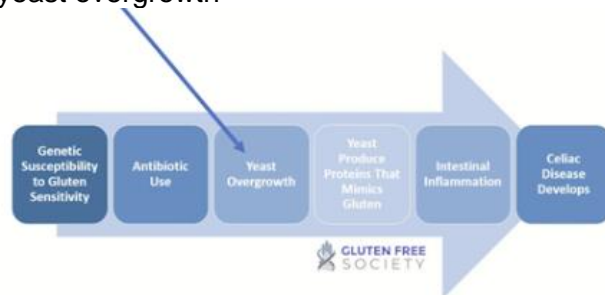
Medications

- Medications Used to Treat the Symptoms Caused by Gluten
 - Common medication prescribed for the treatment of gluten-induced or related disease cause vitamin and mineral deficiencies that can hinder the immune system

<div> <div>DRUG INDUCED NUTRITIONAL DEFICIENCIES</div> <div>  GLUTEN FREE SOCIETY </div> </div>				
Medication Type	Common Examples	Vitamins Depleted	Minerals Depleted	Antioxidants Hormones and Nutrients Depleted
BLOOD PRESSURE	Diuretics such as furosemide and Lasix	B1, B6, C	Magnesium, Calcium, Potassium, Zinc, Sodium	Coenzyme Q10
	Thiazides (HCT)		Magnesium, Potassium, Sodium	Coenzyme Q10, Melatonin
CHOLESTEROL	Beta Blockers	D		Coenzyme Q10
	Statins like Zocor, Lipitor, Crestor	B2, B6, B12, Folate		
DIABETES	Fibrates	A, D, E, K, Beta Carotene, B-12, Folate	Iron	
	Colcelestid, Questtran			
PAIN ANTI-INFLAMMATORY	Glucophage and Metformin	B-12, Folic Acid		Coenzyme Q10
	NSAIDS: Motrin, Naprosyn, Iodine, Aspirin	C, Folic Acid, B-12	Potassium, Iron, Magnesium	
HEARTBURN REFLUX	Steroids for pain, asthma, skin conditions, etc.	A, C, D, Folic Acid	Calcium, Magnesium, Potassium, Zinc	
	Prilosec, Prevacid, Aciphex, Nexium, Protonix	B12, Beta Carotene		Protein
HORMONE REPLACEMENT	Zantac, Acid, Pepcid, Tagamet, Tums, Rolaids	D, B12, Folic Acid	Calcium, Iron, Zinc	Protein
	Oral Contraceptives: Premarin, Vitamin, as well as estrogen containing Menopausal medications	B2, B3, B6, B12, C, Folic Acid	Magnesium, Zinc	Selenium

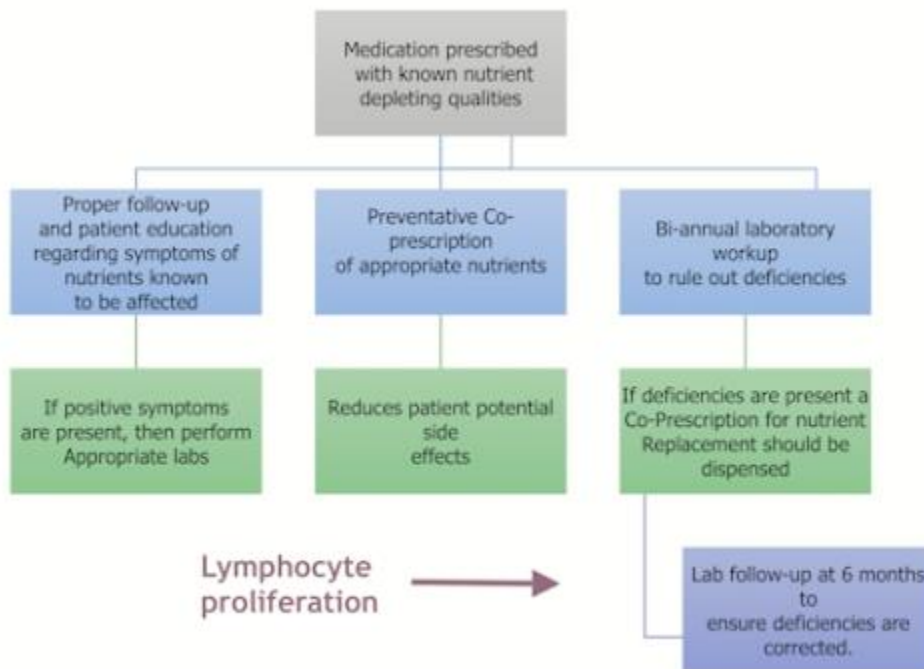
- - These are some of the most commonly prescribed medications

- Magnesium deficiency is a known cause of high blood pressure, and doctors do not measure if whether the patient or not has high magnesium and they prescribed a drug like diuretics
 - Diuretics are taken to lower the blood pressure but it causes magnesium deficiency
- **Antibiotics** - these can deplete vitamin K, B vitamins, and probiotics
 - 60% of vitamin K is made by your microbiome, and about 40% of your vitamin B (biotin) is made by the microbiome
 - When you wipe out your microbiome with an antibiotic, you are in essence inducing nutritional deficiencies by default by destroying and harming your natural microbiome or natural flora
 - One of the most common side-effects of chronic antibiotic use is that it can cause and perpetuate yeast overgrowth



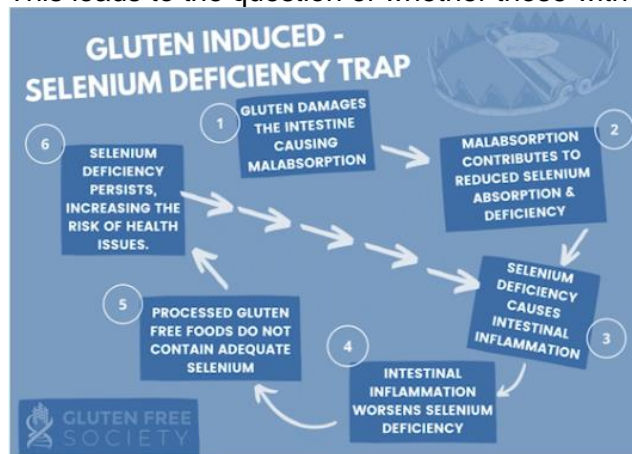
- - Yeast can produce a protein that can mimic gluten
- Research shows that probiotics as nutrients
 - Healthy gut flora is responsible for several functions, 1 of which is to help produce vitamins
 - Healthy gut flora aid you digest your food and help you break down food and the premise is that you can extrapolate the nutrients from the food that you are eating
 - Probiotics are an essential part of how the body is capable of digesting the nutrients from the food you eat
 - It can also perform immune cross-talk or the chemical messages that are transmitted by the gut flora and your gut immune system also known as the GALT
 - **GALT** - gastrointestinal associated lymphoid tissue
 - Some people experience leaky gut because of chronic antibiotic used that damage their bacterial immune cross-talk
 - They start to develop acquired allergies in food
 - A healthy microbiome is that it serves as the primary barrier for the GI tract
 - There are research studies that gluten can alter good bacteria and lowers the healthy species of bacteria that serve as a barrier
 - This leaves you exposed to the potential intestine permeability which is the leaky gut syndrome
- **A journal published in the Journal of Gastroenterology and Hepatology entitled: Infection, antibiotic exposure, and risk of celiac disease: A systematic review and meta-analysis**
 - There is evidence of a relationship between infection and the associated antibiotic exposure and the risk of celiac disease
 - They have concluded that exposure to early antibiotic appears to increase the odds of developing celiac disease suggesting that intestinal immune or microbiota dysbiosis may play a role in the pathogenesis of the celiac disease
- **Another study published in the Mayo Clinic Proceedings entitled: Association of infant antibiotic exposure with childhood health outcomes**
 - This measuring celiac disease outcome in which the risk of celiac disease in this study was increased in girls who received 1 or more antibiotic prescription and specifically penicillins

- They have concluded that they found an association between early-life antibiotic exposure and several distinct conditions with childhood-onset including celiac disease, asthma, and allergies



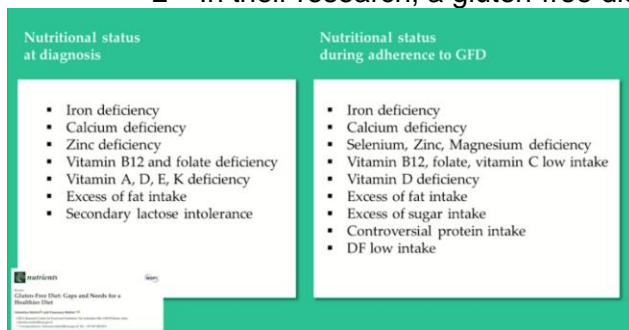
- - Medication that is prescribed and there is no known nutrient depleting qualities there are several things that need to happen
 - Proper follow-up and education around the patient needs to happen regarding the symptoms of the known nutritional deficiency
 - If there is a drug that can block CoQ10 the doctor should inform you that the deficiency symptoms of CoQ10 are an increase in blood pressure, increase in muscle pain, brain fog, fatigue, and neuropathy
 - The doctor should ask for your informed consent making you aware that it can cause depletion, and the depletion can lead to symptoms
 - As the patient, you are now educated if you still want to take the medications
 - If the doctor is prescribing you a drug that is known to deplete a nutrient, it might benefit you in taking nutritional supplements in a higher quantity
 - This is to prevent a nutritional deficiency from developing this can also reduce your risk of developing serious side effect of nutritional deficiency
 - A bi-annual laboratory workup to rule out nutritional deficiencies
 - This is to make sure that you are not creating a problem that can lead to other diseases or issues that you don't realize from the drug that is supposed to be treating you
 - **Lymphocyte proliferation** - this is a type of methodology that is one of the most effective and accurate ways to assess nutritional deficiencies
 - Using serum lab is better than having no information at all but there are a lot of inaccuracies in serum lab
- **Adequate Nutrition**
 - Eating real food and eliminating processed foods is important for adequate nutrition
 - A lot of processed food needs to be fortified because a lot of the nutrients that it initially contained was lost or destroyed
 - Adding synthetic vitamin does not make it whole food, it is just a fortified food

- Choosing organic as much as possible is one of the key fundamentals in maintaining nutritional status
- Pesticides can act as antibiotics and disrupt the microbiome and leading to malnutrition or other issues
- It is better to grow your food or go to a farmers market where you can ask the farmer if they are using pesticides
- Choose nutrient-dense foods, and one of the best ways to get nutrients in the diet is picking food with the greatest nutritional density
 - Examples:
 - Bone broth
 - Organ meats
 - Berries
 - Soups - this is when you cook vegetables
 - Many people think that if you cook food, it destroys the nutrient quality of the food, which it does not
 - It does nothing to the minerals and they cannot be destroyed by heat
 - Some B vitamins are unstable at heat but not all of them
 - Fermented vegetables - this is a great way to get good probiotics and the agents that live help you digest your food and create B vitamins
 - Consider following the *no grain, no pain diet*
 - This is a good start if you haven't had your doctor check you for other food allergen or advanced tests
 - This is a 30-day diet if you are just trying to start
- Avoid the Processed Gluten-free Food Aisle
 - Those adhering to the traditional gluten-free diet struggle to meet nutritional adequacy
 - This leads to the question of whether those with gluten sensitivity should supplement

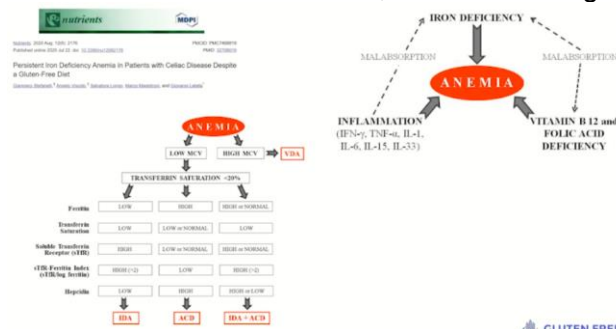


- - Gluten can damage the intestine leading to the potential of malabsorption
 - When the gluten damages the intestine, it is causing malabsorption and damages the villi that leads to severe malnourishment
 - Malabsorption contributes to reducing selenium absorption and the potential selenium deficiency
 - Selenium deficiency is known to cause intestinal inflammation
 - For the gut to start healing, absorbing, and digesting, the inflammation should be put out first
- A journal published in the **Scandinavian Journal of Gastroenterology** discusses homocysteine
 - Homocysteine - this can be measured in the blood and when it is elevated, it is indicative of Vitamin B deficiency

- **The journal was entitled:** *Homocysteine and related B-vitamin status in celiac disease: effects of gluten exclusion and histological recovery*
- The homocysteine concentrations were significantly higher and red cell and serum folate were significantly lower in untreated patients compared with controls
- **Their conclusion was:** *gluten exclusion in celiac disease improves folates status and normalizes homocysteine concentrations which reduces the risk of homocysteine-related disease may be another reason for aggressive diagnosis and treatment of celiac disease*
 - This is one of the reasons gluten can contribute to heart disease
 - In their research, a gluten-free diet was enough to correct the folate deficiency



- People who followed the traditional gluten-free diet tend to have similar deficiencies and the addition of excess fat, and excess sugar intake with low dietary fiber intake



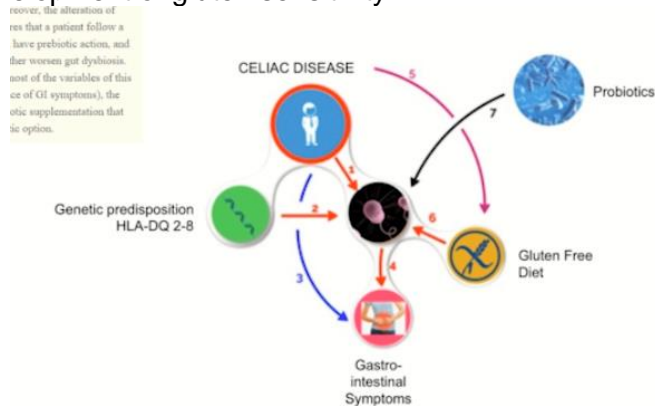
- **Persistent Iron-deficiency Anemia in Patient with Celiac Disease Despite a Gluten-Free Diet**
- This study shows that going gluten-free does not always correct the nutritional deficiency
- The iron-deficiency anemia can lead to a host of symptoms which can create, shortness of breath, fatigue, muscle pain, lethargy, brain fog, intolerance to exercise
- They found that iron deficiency was persistent even after the diet change occurs
- Not only are people present with gluten issues, consistently they are iron deficient, b12 and folate-deficient

● A journal published in Gastroenterology Clinics of North America

- **Their summary was:** *while indiscriminate use of multivitamins and mineral supplements in the general population is increasingly scrutinized as largely useless and sometimes potentially harmful*
 - Doctors think that supplementary use of vitamins and minerals is potentially harmful
 - Symptoms of toxicity of nutrients are extremely rare and they barely ever exist
 - Aspirin is taken over the counter and it kills 13,500 people annually even with its proper use
- *There is a population at risk such as those with chronic Inflammatory Bowel Disease (IBD) need to be monitored and compensated for nutritional and metabolic losses. Clear mechanistic links between vitamin and mineral deficiencies and the associated IBD pathology has been found for some nutrients and normalizing their systemic level has proven clinically beneficial*
 - Celiac disease is an example of IBD

- Key points:
 - *Vitamin and mineral deficiencies are common among IBD patients and warrant supplementation to restore recommended values*
 - *Those deficiencies likely contribute to the disease severity and associated co-morbidities*
 - *The development of other health issues is not directly associated with inflammatory disease*
 - *There is a need for more evidence-based approaches supported by well-designed clinical trials to document the optimal supplementation level and to assess the benefits of supplementation exceeding the recommended allowance*
- **A journal entitled:** *Ascorbate-dependent decrease of the mucosal immune-inflammatory response to gliadin in celiac disease patients*
 - **The conclusion of the study was:** *Vitamin C or ascorbate decreases the mucosal inflammatory response to gluten in an intestinal biopsy culture model*
 - *This study was not done in humans but it was done in a biopsy culture model and it showed that vitamin C reduced the inflammation caused by gluten*
 - *Vitamin C helps the patient recover at a higher speed*
- **A journal published in 1985 entitled:** *Serum Zinc Levels in Children with Celiac Disease*
 - *The author suggests that zinc concentration is measured in children with celiac disease and to add zinc supplementation in patients with diminished zinc values during 2-4 weeks because zinc deficiency could inhibit the recovery of the intestinal mucosa*
 - *If a patient is diagnosed with gluten issue and was zinc deficient at the time of diagnosis, the deficiency could inhibit their recovery*
 - *Conclusion: In newly diagnosed children with celiac disease, a significant lowness was established in vitamin D and A. The evaluation of Vitamin A and D levels will be helpful in the course of diagnosis in the patients*
- **A journal about vitamin E** *showed that the results of the current study demonstrated that vitamin E supplementation in treated patients with celiac disease reduced concentration of Nitric Oxide, which shows that it may have a beneficial effect on the oxidative imbalance*
 - **Treated patient with celiac disease** - this means people with a gluten-free diet
 - **Nitric Oxide** - this is an inflammatory gas that shows up when you measure the inflammation from the gut
 - *To the author's knowledge, this was the first study to assess the effect of vitamin E supplementation in treated patients with celiac disease. In the previous study, it was found that significantly reduced serum concentration of vitamin E in patients with celiac disease regardless of compliance with the diet*
 - *The authors have many studies and one of their studies showed that people with celiac disease tend to be vitamin E deficient if they were compliant with the diet*
- **A journal about people with celiac disease has also been vitamin D deficient**
 - *Vitamin D is a key modulator of inflammatory and immune mechanisms and the intestinal mucosa barrier*
 - *Vitamin D is an important element in keeping the gut sealed*
 - *In this regard, vitamin D has been considered as a factor that affects different conditions such as immune-mediated diseases. The new emerging role of vitamin D and its involvement in immune modulation has led it to be considered as a possible key factor involved in celiac disease onset*
- **A study published in the Annals of Medicine in 2013 about Appropriate Nutrient Supplementation in Celiac Disease**
 - **Key Points:**
 - *Reduced levels of iron, folate, vitamin B12, vitamin D, zinc, and magnesium are common in untreated celiac disease, and some of the deficiencies can persist even after removal of gluten from the diet*

- Nutrient deficiencies may be responsible for extraintestinal signs/symptoms of celiac disease
 - Assessment of nutrient status may help identify celiac disease patient who needs supplementation for preventing and/or treating clinical manifestations of the disease
- A journal published in **Nutrients** in 2018 have been identifying the mechanism of what contributes to the development of gluten sensitivity



- One of the factors in this diagram is probiotics and it is known that early use of antibiotics increases the risk for celiac disease
 - It is not just the antibiotic itself but it is what the antibiotic does which is it lowers good microflora
 - Probiotics play a role in the lining or the barrier function of the GI tract, in which gluten-sensitivity can develop more aggressively
 - Probiotic deficiency can accelerate the gluten sensitivity paradigm
- A journal published in 2015 entitled: *Administration of Bifidobacterium breve decreases the Production of TNF- α in Children with Celiac Disease*
 - **TNF- α** - This is an inflammatory chemical called Tumor necrosis factor-alpha
 - This was a double-blinded placebo-controlled trial with 49 children
 - Conclusion: Probiotic intervention with B. breve strains has shown a positive effect on decreasing the production of inflammation which is called the pro-inflammatory cytokine
 - Good Bifidobacteria were shown to reduce inflammation outcomes
- A journal published in **British Journals** in 2014 with a double-blind randomized controlled showed that B. longum could help improve the health status of celiac disease patient who tends to show alterations in gut microbiota composition and a biased immune response even in a gluten-free diet
- A journal published in the **Journals of Clinical Gastroenterology** in 2017 found that the beneficial symptomatic effect observed previously in patients with the celiac disease treated with B. infants may be related to the modulation of the innate immune system
 - Their results showed that a gluten-free diet decreases white blood cell counts in the intestine of celiac disease patients more effectively given this probiotic
 - However, this probiotic also reduced the white blood cell in the filtration of the duodenum
 - Probiotics can decrease the white blood cells called the macrophages, but a gluten-free diet does it even better
- A journal published in **Beneficial Microbes** in 2020 found that using Bifidobacterium infantis was previously shown to alleviate GI symptoms in newly diagnosed celiac disease patient consuming gluten
 - A high proportion of patient following a gluten-free diet experiences symptoms despite dietary compliance
 - The bifidobacteria improved specific celiac disease symptoms in a subset of highly symptomatic patients

- **A research study published in the Journal of Clinical Gastroenterology in 2013 in *Bifidobacteria Infantis***
 - Their results showed that those randomized to *B. infantis* experienced a significant improvement in Gastrointestinal Symptoms but they also experienced a decrease in serum macrophage inflammatory protein 1-beta
 - The conclusion of the study suggests that the bacteria *B. Infantis* may alleviate symptoms in untreated celiac disease. The probiotic produced some immunologic changes but did not modify abnormal intestinal permeability
 - You cannot just supplement your way out of a gut issue, and you need to do the diet, the supplements are just supplemental to that
- **A research study published in *Frontiers in Immunology* published in 2020 entitled: *Bacterial-based Strategies to Hydrolyze Gluten Peptides and Protect Intestinal Mucosa***
 - The authors were studying how to use probiotics to breakdown gluten proteins so that they are less toxic or less damaging to the GI tract
 - **Hydrolyze** - means to break down
 - *Probiotics are viable microorganisms thought to have a healthy effect on the host. The proteolytic mechanism of lactic acid bacteria comprises an extracellular serine protease*
 - **Proteolytic** - this means protein cutting
 - The lactic acid degrading bacteria contains elements that can degrade certain types of gluten-based proteins
 - *Probiotic supplementation is an attractive therapy because of its possible anti-inflammatory and immunomodulatory properties. Several studies have been performed to assess the effectiveness of various specific probiotics strain showing positive effects on immune-modulation restoring gut bacteria and decreasing immunogenic peptides*
- **What Labs to Run to Evaluate Your Nutritional Status?**
 - **Iodine Loading** - this is a special urine test that helps measure iodine
 - **25 OH D** - this is a blood test help to pick up the Vitamin D levels
 - **Iron Panel with Ferritin** - you would want your doctor to check your iron panel and check for the compound called Ferritin
 - **Complete Blood Count (CBC)** - you want to run a CBC including a chemical panel to screen information about your nutrition
 - **Homocysteine**
 - **Plasma Amino Acids** - this is to check if you're getting adequate quantities of essential bases of protein
 - **HS-CRP** - you want them to measure your C reactive protein which is markers for persistent inflammation
 - **Glucose, Insulin, Hemoglobin A1C (Hg1AC)** - this tells you about your nutrition and how your body is processing carbohydrates
 - **Lymphocyte Proliferation** - this is to measure whether or not your cells are storing adequate amounts of vitamins and minerals
 - This is to make sure that your cells are capable of replicating themselves
 - They are measuring your internal body storage in the last 6 months which gives you the idea of what food you are lacking and what needs supplementation
- **Summary**
 - Gluten causes nutritional deficiencies
 - Gluten causes inflammatory damage that leads to more nutritional deficiencies
 - Medicines used to treat gluten and nutrient deficiency-related symptoms cause nutritional deficiencies that exacerbate the problem
 - Research shows that removing gluten from the diet does not always correct the problem
 - Research shows that many long term gluten-induced damage need more nutrients for healing and repair

- **4 Supplements**

1. **High-Quality Multivitamin** - this has the predominant quantity of essential nutrients
 - You need to check the multivitamin because many have gluten fillers and are cross-contaminated with gluten
2. **Omega-3 Supplement** - this is usually not inclusive in multivitamins, and many people do not eat cold fish in their diet
 - This is 1 of the type 5 deficiencies
 - The recommended intake value is 2 grams per day of concentrated omega-3 which should contain EPA and DHA
3. **Probiotics** - make sure to take something worthwhile
 - Usually, the levels of probiotics are in CFU or colony-forming units but if the products sit on the shelf for months they will start to deteriorate
 - The 10 billion CFU that is shown in the label, by the time it gets to your house might be lesser
4. **Digestive Enzymes** - specifically gluten-free enzyme, which has shown to help break down gluten
 - This provides support if you have come across a product with gluten