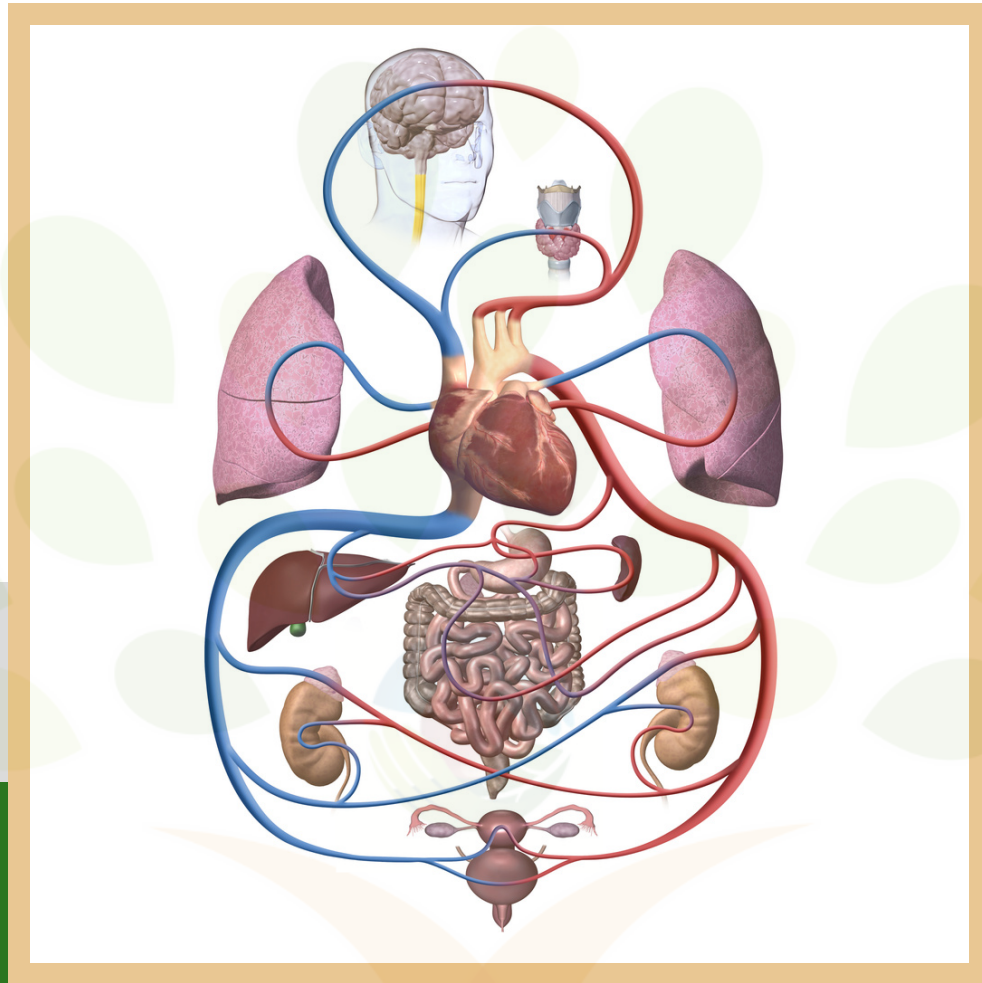


Nutrition + System Biology =
Better CARE



SYSTEMS BIOLOGY STARTER KIT

CINDY CARROLL, RDN, LDN, RN



WELCOME!



Nutrition Systems Biology Starter Kit

The field of nutrition is expanding... there are more players. Over the last decade, nutrition has become a competitive, saturated field of services with lots of lanes to practice in. These services employ and represent an array of fields including: health/medicine, research/education, food processing and manufacturing, cooking/culinary, agriculture, and many others.

Lots of folks are not just expressing an opinion about nutrition, but also giving out nutrition advice. Social media certainly has played a role in facilitating a platform for nearly anyone. Licensed professionals such as registered dietitians and registered nurses have been the traditional messengers, but many other people are hopping in the nutrition lane. Regardless of your nutrition philosophy or even the expansive knowledge you may have about food and its nutrients, unless your intent is to just look at that food that holds those wonderful nutrients, then your food and nutrition knowledge really only goes as far as the food itself—outside the body.

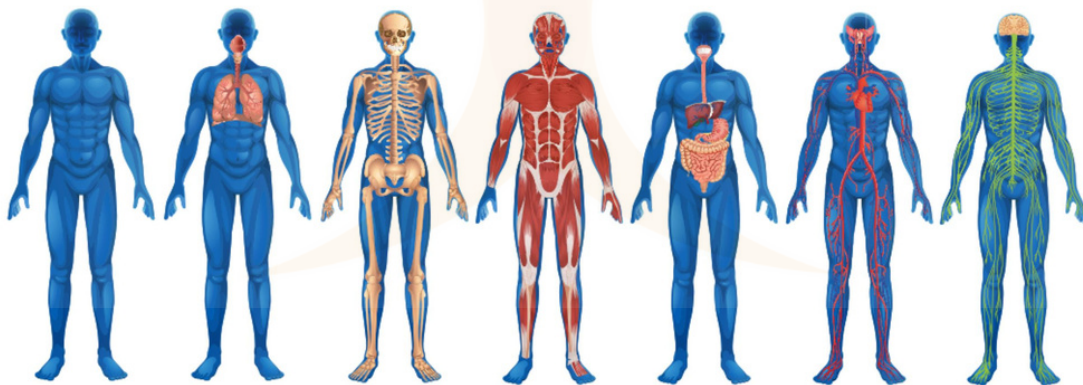
We must step inside the body to appreciate food. Nutritional biochemistry studies the interaction of nutrients at the cellular and molecular level, enormously important. But sometimes lost in the fray is all that happens between when food enters the mouth and before it gets to our cells. In other words, examining all of the organs and systems that support our cells. Without an understanding of anatomy and physiology and how the body's systems work together—systems biology, the value of food becomes quite limited.

Plain and simple, systems biology enables the cellular effects to occur.



SYSTEM BIOLOGY

Once food enters the mouth—it begins a journey, traveling through the GI tract, ultimately having both positive and negative systemic effects, virtually affecting every cell in the body. All of the systems in the body will in some way be affected by those nutrients. Having a strong foundation of the major systems of the body and how these systems communicate will enable you to have a much stronger frame of reference for your nutrition recommendations.



SYSTEM BIOLOGY

"THE WHOLE IS GREATER THAN THE SUM OF ITS PARTS."
ARISTOTLE



Aristotle, the greek philosopher and math wiz was one of the first people to use the phrase, “The whole is greater than the sum of its parts”, which essentially refers to **synergy**.

Synergy is the interaction of two or more of anything that produces a combined effect greater than the sum of their separate effects.

Interestingly, system biology is a mathematical and methodical approach to all biological systems, not just in humans. The net effect is far greater when individual systems are communicating and working together than when each is considered alone. Human system biology is innate synergy at work. Day in and day, out as your body plugs along and cells take part in thousands of interactions and reactions, synergy is a wonderful reminder that the whole is greater than the sum of its parts.

SYSTEM BIOLOGY



System biology is organized by systems of the body. Many medical specialties focus on a particular individual system: i.e. endocrinologists (endocrine system), cardiologists (heart/vessels), neurologists (nervous system) etc. This fragmented approach to medical care, providing we don't lose sight of the patient, is not system biology. Primary care practitioners are actually the closest to system biology in traditional medicine. Their care looks at the whole body. Functional medicine principles look to find the root cause of disease to help return the body to better function and system biology forms the framework to best achieve this practice.

Primary care practitioners are actually the closest to system biology specialists in traditional medicine.



SYSTEM BIOLOGY



What does nutrition have to do with systems biology?

Well, pretty much everything. I think many nutritionists intuitively know this. But still, nutrition guidelines and practice can be quite system limiting, meaning thinking only about the effects of food on one part of the body or one system. Nutrition affects every system in the body. This point can not be emphasized enough. Be careful of letting what might seem obvious, take a back seat in your care. Just to repeat again, nutrition affects every system in the body. This places nutritionists in a very influential position and you should be primed for this comprehensive approach.



Every cell, organ and system utilizes nutrients.

Each organ is connected via systems and each organ is affected by nutrients. Add to that, the gut microbiome utilizes nutrients. Genes are affected by nutrients. Understanding key anatomy and physiology principles of each system is a practical approach to better understanding system biology and nutrition's role.

HOW THE BODY PROTECTS ITSELF

Your body endures an infinite number of insults every day: smoking, stress, poor diet, inactivity, unlimited environmental hits and on and on. Yet, regardless of these numerous types of insults, your body has just three types of coping responses:

- **Inflammation**
- **Oxidation**
- **Immune response**

These responses occur daily to any number of benign or more harmful insults. When your body burden reaches your individual threshold, then these responses may go askew and disease occurs. The underlying presence of inflammation is a common thread with many chronic diseases. The inflammatory response is a multifactorial process that occurs acutely and chronically in the body. These three responses affect all systems in the body. Understanding how they develop and their effects has helped medicine understand how best to manage and treat various acute and chronic conditions.

Our genes, including snps (single nuclear polymorphisms) AND our gut microflora dictate the uniqueness of each person's response.

HOW MANY SYSTEMS IN THE HUMAN BODY?

The body contains twelve distinct systems whose functions are reflected in their name:

1. DIGESTIVE
2. CARDIOVASCULAR
3. IMMUNE
4. LYMPHATIC
5. ENDOCRINE
6. NERVOUS
7. Integumentary (skin, hair, nails)
8. Muscular
9. Reproductive
10. Respiratory
11. Skeletal
12. Urinary

All of the cells and organs of these systems have a blood supply and are affected by nutrients.



SYSTEM BIOLOGY

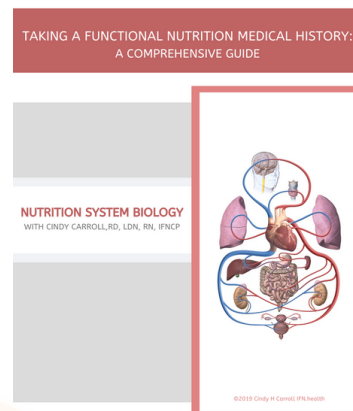
This System Biology Starter Kit will give you a brief review of five key systems and questions to consider in their relationship with nutrition recommendations. Also, assessing these five main systems will help your assessment of the other systems, including respiratory, musculoskeletal, and urinary/renal.

All nutrition recommendations should automatically consider a running check of these five systems:

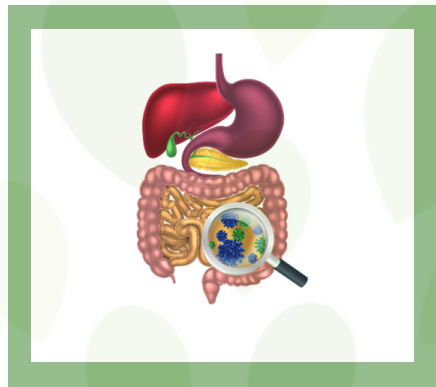
1. GI/DIGESTIVE
2. CARDIOVASCULAR
3. IMMUNE
4. HORMONE/ENDOCRINE
5. BRAIN/CNS



For how to best incorporate the major body systems into your medical history taking, please refer to **Taking A Functional Nutrition Medical History: A Comprehensive Guide**. It will take your patient care to the next level.



DIGESTIVE SYSTEM



The GI tract is the conduit system to the rest of the body. It just so happens to also be the main route by which food and nutrients enter our body to be digested and absorbed. Because of the following six key ingredients or characteristics of the GI tract, the health and integrity of the gut may well determine the health of the rest of the **body**.

A COMPREHENSIVE NUTRITION MEDICAL ASSESSMENT BEGINS IN THE GUT.

Four of these six characteristics reflect major systems of the body. Cardiovascular, Immune, Hormones and Nervous. The quality of our diet may be the difference between health and disease. After the skin, the gut is the first major barrier of protection. **See also Six Key Ingredients to Gut/Body Connection.**

1. Residence of gut microbiome.
2. Large presence of immune cells.
3. Permeable membrane with a functional purpose.
4. Access to the portal and splanchnic circulations.
5. Largest endocrine organ.
6. Enteric nervous system.

TIPS FOR ASSESSING THE GUT

Assessing function at each location of the GI tract helps to determine overall success in achieving GI health. Disturbances higher up in the GI have the potential to affect function below. Small and large intestines can have excessive permeability with the potential to affect the entire body. Also, consider the value of intermittent fasting and GI rest in between meals for optimal motility and function. Lastly, consider blood typing. Research is accruing regarding the association of blood type and the gut microbiome.

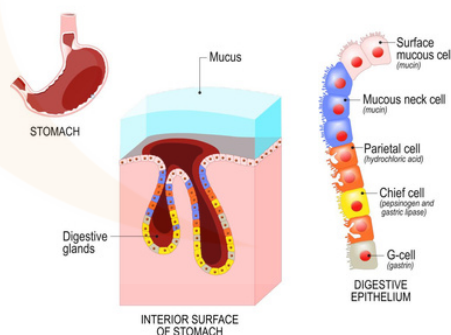
START AT THE MOUTH AND WORK YOUR WAY DOWN.

MOUTH (CEPHALIC PHASE)

Even before we eat, the brain is preparing the stomach. The parasympathetic nervous system (PSN) to vagus nerve releases acetylcholine (ACH), which binds to G cells in the stomach and stimulates the hormone, gastrin, which stimulates parietal cells to release small amounts of acid, setting the gastric motor to begin. Chew, chew, chew! Inadequate initial digestion makes it more difficult for the stomach and small intestine to do their job. Assess oral complications and fast eaters.



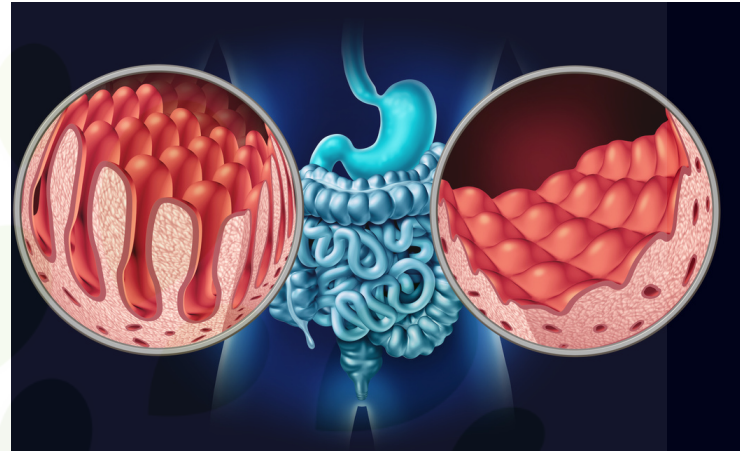
GASTRIC GLANDS



RULE OUT CELIAC DISEASE

This is one of the first steps in assessing a healthy gut. It's much easier to rule out celiac while someone is still eating gluten, then you can move on to other things. Celiac does not always present with GI symptoms. Untreated celiac disease leaves little leeway for achieving a healthy GI tract.

Possible tests: Total IgA, tTg for IgA/IgG and anti-DGP for IgA/IgG. Consider gene testing for HLA DQ2 + 8 and ultimately, multiple-site small intestinal biopsy.



ASSESS STOMACH FUNCTION

When food arrives, distension and mucosal irritation stimulate more ACH; more gastrin contributes to vigorous smooth muscle contractions as food is liquified. Also pepsinogen/pepsin are activated, aiding protein breakdown. Assess GERD, burping, H. pylori, MMC; gastric emptying and ULQ pain. Supporting stomach function also aids intestinal health. Consider probiotics, mucilage herbs and betaine HCL. No betaine HCL with H. Pylori.

Possible tests: Baking Soda test, H. pylori breath test or stool, quantitative PCR stool.

SMALL INTESTINE

Enterogastric reflex inhibits gastric emptying and along with the release of **cholecystokinin (CCK)** and **secretin** hormones, protect SI from excessive acid. CCK stimulates bile and pancreatic enzymes. Excessive permeability leads to systemic effects including insulin resistance, NAFLD, CVD. **Considerations:** ileocecal function + LRQ pain, SIBO, MMC, bloating, gas, other pain. Consider breath tests for SIBO or fructose malabsorption, sucrase isomaltase deficiency, urinary organic acid testing (OATS) for metabolites.

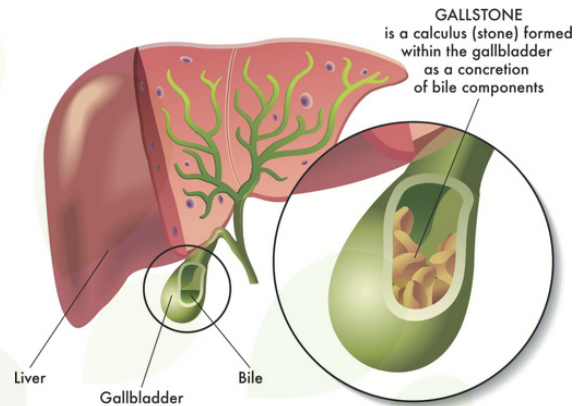


SIBO: Identify early! Can contribute to GERD and histamine intolerance and MCAS. SIBO often coexists with *H. pylori*. Check constipation, diarrhea, bloating, after meals that doesn't dissipate and may worsen by days end. Consider low fodmap and if improvement, then 3-hour hydrogen/methane breath test. MMC is a key component of SIBO. At a minimum, practice meal spacing and 12-hour night time fasting. **Consider checking serum LPS/antibodies.** LPS can increase CVD risk. Assess other CVD risk.

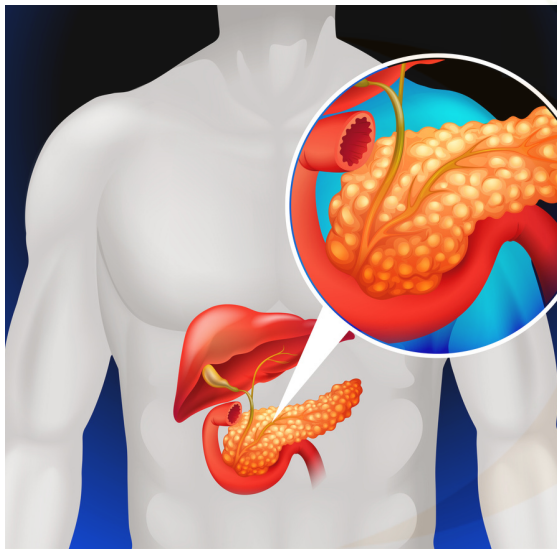
Treatment considerations: Anti-microbial herbs, prokinetics, DAO for histamine intolerance; dietary elimination as necessary, mixture of fibers for regular BMs.

GALL BLADDER

Check UR quad pain. Bile is anti-bacterial so assess for SIBO. SIBO can deconjugate bile and make it less effective. Broad spectrum AB can decrease two bile acids and increase C. diff. risk. Consider ox bile, artichoke, extract, curcumin, milk thistle. Caution with these herbs if gall stone blockages.



DON'T FORGET THE PANCREAS



Check for insulin resistance and blood glucose. Exocrine pancreatic insufficiency may coexist with endocrine issues. Assess macronutrient absorption (protein, carb, fat), steatorrhea.

Possible tests: Fasting insulin, fasting glucose, hemoglobin A1C, elastase, amylase and lipase.

Consider digestive enzymes and glucose lowering supportive herbs.

LARGE INTESTINE

Holds most of the gut microbiota and is the organ that completes stool formation. It's also the destination of probiotics and by products of prebiotic fermentation. Optimal production of SCFA protects intestinal barrier, as well as positive systemic effects. Assess function with Bristol chart, constipation/diarrhea, BM frequency, quality, pain, presence of blood, mucus or undigested food. Refer to GI MD for colonoscopy to rule out IBD and CA.

Possible testing: Quantitative PCR stool testing for major dysbiosis, i.e. C. diff, parasites, candida, others and calprotectin for inflammation.

Promote daily BMs as tolerated with adequate water, magnesium citrate, probiotics, meal spacing, psyllium, HGG, prebiotic foods, and herbal antimicrobials, if necessary.



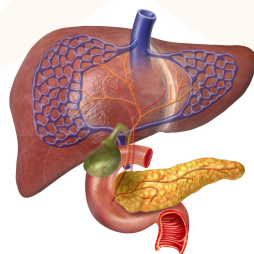
LIVER

Many functions in the body would not occur if not for the liver. It is involved with digestion and absorption of nutrients; macronutrient metabolism, including glucose management; bile and cholesterol production and the formation of numerous proteins, including enzymes responsible for detoxification. Together with the kidney, lungs and skin, the liver diligently works to filter our bodies from many toxins in our lifestyle. It provides a three phased, systematic means of detoxifying pretty much everything that passes through us, allowing elimination via kidneys/urine, bile and stool. Ammonia, a byproduct of nitrogen is detoxified by the liver's urea cycle.

Alcohol related and non-alcohol related fatty liver disease are the major pathologies to occur with the liver and are strongly related to diet and lifestyle.

Possible Tests: Liver function tests: AST (SGOT), ALT (SGPT), GGT, fasting glucose and insulin; liver ultrasound for fatty liver. Protecting the liver helps to protect pancreatic function so it doesn't have to bear so much load for glucose management.

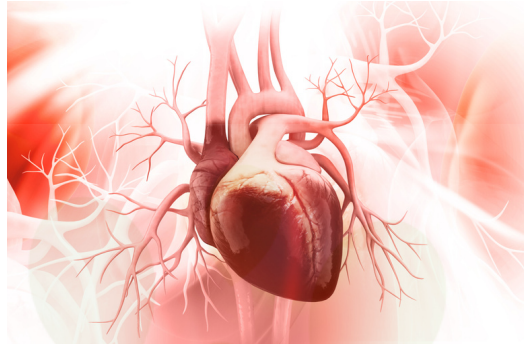
A number of gene variations "snps" are related to liver function. Changes in any single gene snp may not make any difference in function but epigenetic effects may occur when multiple gene snps are present.



KEY TIPS FOR YOUR DIGESTIVE NUTRITION ASSESSMENT

1. **To better assess nutrient adequacy, assess each organ function:** Mouth, stomach, small intestine, large intestine, liver, gallbladder, pancreas.
2. **Pancreas has dual functions** as endocrine and exocrine organ and the health of one affects the health of the other. Remember these functions are in the same organ.
3. **Pancreas (insulin/glucagon) and liver (IGF-1)** together play biggest role in glucose regulation.
4. **Gallbladder and bile acids key roles:** Anti-bacterial, fat digestion, appetite regulation, insulin sensitivity.
5. **Liver has key roles in detoxification through phase I, II, III;** Takes a more fat soluble molecule and transforms it to more water soluble to be excreted.
6. **Evaluate the entire GI tract to truly determine nutrient adequacy.** All nutrients: macronutrients (carbohydrates, proteins, fats) and micronutrients: (every vitamin, mineral and phytonutrients) are affected by the integrity of each GI organ, from mouth to anus.

CARDIOVASCULAR



The vast circulatory network of vessels stem from your brain to your toes. Each vessel contains an endothelial lining and receptors that communicate with the outside of the vessel.

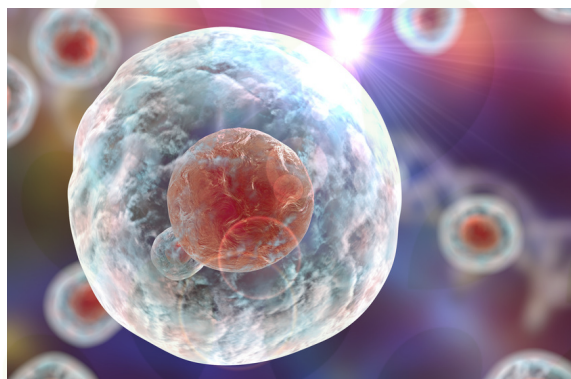
ENDOTHELIUM DYSFUNCTION IS AT THE HEART OF CVD, PERHAPS THE MOST IMPORTANT CONCEPT TO REMEMBER ABOUT CARDIOVASCULAR HEALTH.

Whatever affects that endothelial lining will affect heart health and potentially total body health. Vessels are the highway in the body that carry vital nutrients and toxins and are intimately connected to the gut. Historically, cardiovascular health has not been closely associated to GI health but that is changing. Research now shows, metabolic diseases and diabetes may have close ties to GI health and the gut microbiome. Also, research on the various forms of calorie restriction, intermittent fasting and the fasting mimicking diet (FMD) are collecting data on the benefits to vascular health. Some of mechanisms of the FMD are via the gut microbiome. Every organ and system has a vascular network and the health of the gut microbiome may influence its health.

KEY TIPS FOR YOUR CARDIOVASCULAR NUTRITION ASSESSMENT

1. The body's key protective responses: Inflammation, oxidation and immune response also apply to the cardiovascular system and in particular affects vascular function.
2. One of the six key ingredients of the GI tract is its vast circulatory network. In part, the gut microbiome and gut mucosal integrity can determine vascular integrity.
3. The vasculature is the main roadmap to all the other systems. Anything that damages the vessel lining, causing excessive or chronic inflammation is a potential culprit to the heart. Vascular integrity is related to these three CVD risks, which are all nutrient related.
 - **Hypertension**
 - **Hyperglycemia**
 - **Hyperlipidemia**
4. Re-evaluate the role of excessive insulin, and ratio of macronutrients with CVD: carbohydrates (too many and poor quality) and inadequate and poor quality fats, especially processed seed oils and unnecessarily restricting saturated fat.
5. Intermittent fasting and the fasting mimicking diet benefit cardiovascular health via a variety of mechanisms- (i.e. autophagy) and nutrient signaling pathways including IGF-1, mTOR, and a family of proteins called sirtuins. Sirtuins target proteins involved in DNA repair, stress resistance, reactive oxygen species (ROS), mitochondrial function.
5. Vitamin D behaves as an endocrine inhibitor of the renin-angiotensin system (RAS). Over activation of RAS can have detrimental effects on the cardiovascular system. The RAS path mediates the volume of ECF (blood plasma, lymph and interstitial fluid) and arterial vasoconstriction-hence blood pressure. Vitamin D induces ACE2, which limits the formation of angiotensin II, a vasoconstrictor. Angiotensin II has broad pathological effects including inflammation and fibrogenesis.

IMMUNE

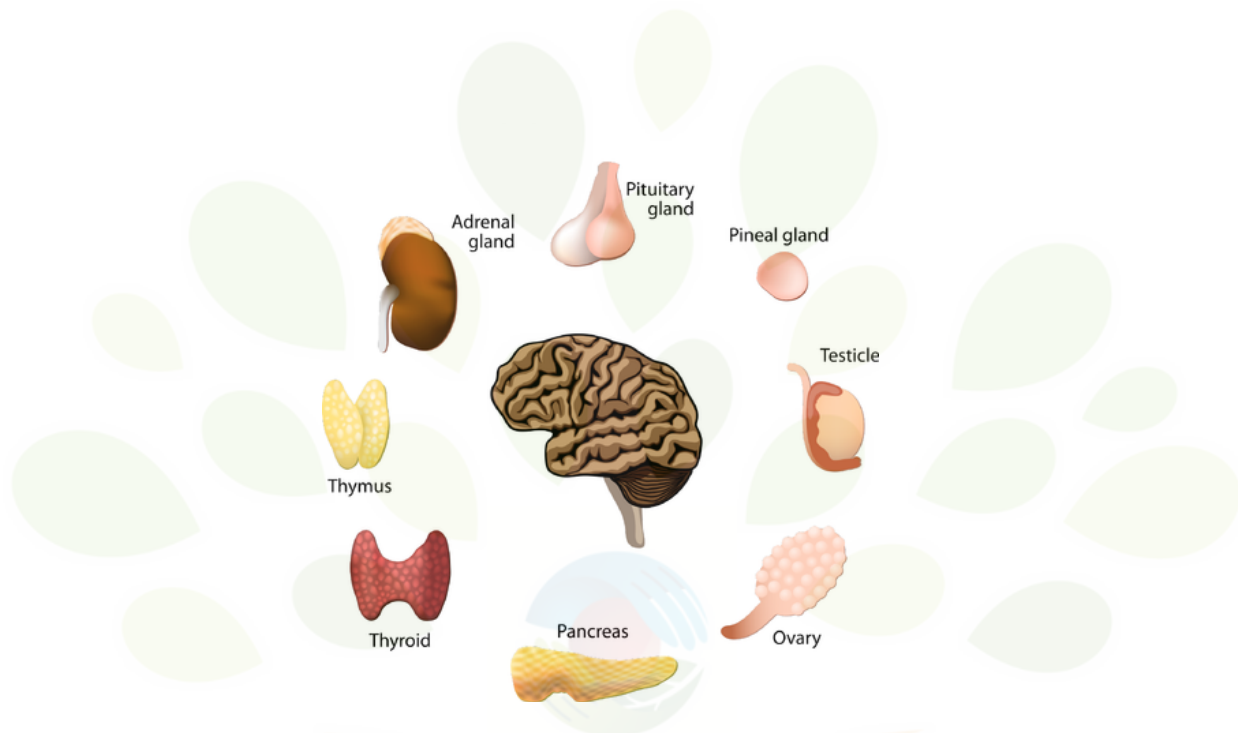


The immune system is the human body's defense response. It contains a network of cells, tissues and organs throughout the body to help the body stay healthy and prevent disease. It interfaces with all systems and the body gives many signs and symptoms (clues) that the immune system is responding. Although lymph nodes and immune cells are located throughout the body, the GI tract contains the most concentrated area of total immune cells in the body, estimated to be about 70%. The gut micro- biome, nutrients and food all influence the immune response.

KEY TIPS FOR YOUR IMMUNE NUTRITION ASSESSMENT

1. Immunity can be over responsive or under responsive.
2. Innate and adaptive immunity work separately and together to provide 24-hour surveillance. Recognize and understand the differences between these types of immunity and how they interact.
3. Neutrophils, macrophages, mast cells make up phagocytes and innate immunity and are first to respond.
4. Adaptive immunity includes both humoral (antigen/antibody B- lymphocytes) and cell mediated - (T-cell immunity)- part of memory immunity.
5. Food response can include both innate/adaptive immunity. Food (bioactives) interact with these proteins, as well as with the gut microbiome to modulate inflammation.
6. Cytokines are signaling cell proteins that are produced from a variety of WBC; they can be inflammatory or anti-inflammatory.
7. NFkB is a protein that controls transcription of DNA and cytokine production and is involved with triggering inflammation. There are many identified promoters and inhibitors, including lifestyle, dietary components and drugs that can be used to modulate this protein.
8. NRF2 is a signaling cell protein that regulates anti-inflammatory pathways. Several food components have been identified to upregulate NRF2, i.e. sulforaphane in cruciferous.

ENDOCRINE



Hormones are chemicals secreted by glands whose effects are seen throughout the entire body. The major hormones, including thyroid hormones, insulin and cortisol have receptors throughout the body and have bidirectional effects. The androgen hormones: testosterone and estrogen have a bidirectional interaction with other hormones. The gut microbiome may influence how estrogen is metabolized in the gut in certain estrogen sensitive women. Endotoxemia may affect both estrogen and testosterone. Insulin, one of the major hormones is influenced by the gut micro-biome leading to insulin resistance.

KEY TIPS FOR YOUR HORMONE NUTRITION ASSESSMENT

1. Stress is a major factor that influences the adrenal glands: cortisol and the catecholamines. Magnesium and vitamin C are in demand during times of stress.
2. Chronic elevated cortisol and catecholamines contribute to elevated blood glucose, weight gain and inflammation, lowering immune response.
3. Recognize lifestyle factors that contribute to daily stress. Daily lifestyle adjustments including nutrition can produce the biggest improvements in adrenal function.
4. Recognize the signs and symptoms of thyroid states that can change metabolism, primarily hypothyroidism or hyperthyroidism. Both affect nutrients and all other systems in the body: cholesterol, blood sugar regulation and immunity.
5. Understand the risks of low or high androgens in men and women and their relationship with changes to other hormones, i.e. insulin and cortisol.
6. Endogenous estrogen is eliminated via a healthy functioning GI tract, which includes the liver.
7. A reminder that vitamin D behaves as an endocrine inhibitor of the RAS, contributing to inhibition of angiotensin II; helping to lower blood pressure and inflammation.

BRAIN/NERVOUS



The three major components of the nervous system include:

- **Central Nervous System (CNS)**
- **Peripheral Nervous System (PNS)**
- **Enteric Nervous System (ENS)**

The value of nutrients and phytonutrients to the Brain and CNS has not truly been elucidated and appreciated until recently. It's important to get a basic grasp of anatomy to understand the nutrition connection.

CENTRAL NERVOUS SYSTEM (CNS)

The central nervous system (CNS) includes the brain and spinal cord. The brain and the spinal canal are an open system. In other words, the brain is encased in the skull and the spinal cord, with all of its nerves, is encased in the vertebrate. Cerebrospinal fluid circulates openly through the brain and spinal column. The CNS includes the majority of the nervous system. It integrates the received information and communicates this to all parts of the body.

PERIPHERAL NERVOUS SYSTEM (PNS)

The peripheral nervous system, (PNS) consists of the nerves outside the brain and spinal cord. The main function of the PNS is to connect the CNS to the limbs and organs, essentially serving as a conduit between the brain and spinal cord and the rest of the body. Unlike the CNS, the PNS in some ways is more vulnerable because it is not protected by the vertebrae or skull or by the blood-brain barrier, leaving it open to the multiple “hits” our body takes every day including, diet, environmental toxins and mechanical injuries. The peripheral nervous system includes the somatic nervous system (voluntary) and autonomic nervous system (largely, involuntary).

Historically, the CNS and PNS were not treated as being intimately connected to other systems or to the GI tract. But, enter the enteric nervous system. This knowledge has significantly changed how we think of the nervous system and system biology.

Enteric Nervous System (ENS)

The enteric nervous system is an independent but connected network of nerve fibers that innervate the gastrointestinal tract, pancreas and gallbladder affecting motility and secretion of neurotransmitters to the brain. The vagus nerve or the 10th cranial nerve, is the longest and most complex of the cranial nerves and part of the CNS. It extends from the brain down through the GI tract. There is a bidirectional information flow between the ENS and CNS and this connection has been coined, "the gut brain axis".

GUT MICROBIOTA AND THE ENTERIC NERVOUS SYSTEM

Gut microbes communicate to the CNS through at least three system pathways including: nervous, immune and endocrine/hormone signaling. The brain can affect the gut microbiota via the autonomic nervous system, influencing gut motility and gut permeability, as well as hormones that may directly influence microbial gene expression.

Changes in brain gut pathways are associated with the pathophysiology of IBS, metabolic syndromes, and several psychiatric and neurologic disorders. Gut bacteria produce “neurohormones, neurotransmitters and neuropeptides” that travel through the bloodstream and enter the brain via the blood brain barrier. These compounds influence appetite, inflammation and also vagal nerve stimulation.

The future of gut-brain connection will include: measuring various brain biomarkers including antibodies to the enteric nerve. Understanding how to protect the blood brain barrier is the new frontier in brain health. A compromised BBB may allow certain oral and gut pathogens to cross-reactive with proteins in the brain, increasing risk for conditions such as Alzheimer's.

The Gut Brain axis demonstrates system biology communication similar to the gut-cardiovascular connection.

KEY TIPS FOR YOUR BRAIN/NERVOUS NUTRITION ASSESSMENT

1. Recognize cognitive changes may stem from gut dysfunction. Assess gut health.
2. The vagus nerve and the communication of the gut may facilitate food sensitivities that may lead to cognitive changes.
3. The integrity of the Blood Brain Barrier is critical to brain health.
4. Healthy blood glucose is integral to brain health. Elevated blood sugars and glycated proteins are damaging to the brain's vasculature.
5. Recognize the role of individual nutrients, phytonutrients, probiotics and prebiotics in protecting the BBB.

Key Nutrients

Virtually all nutrients play a role in every system of the body. We could list every nutrient and just repeat with each system. However, some nutrients stand out. Here are a top list for each of the five systems. We can also list most of the B-vitamins as key nutrients for all systems since many convert food into energy and affect growth and development of cells. A few have other distinct roles, including RBC formation (B2), DNA prouction/repair (B3),

GI

- Amino acids: Glutamine
Arginine
- Fibers:soluble/insoluble
- Magnesium
- Vitamin A
- Vitamin B12
- Vitamin C
- Vitamin D
- Prebiotics
- Probiotics
- Selenium
- Zinc

Cardiovascular

- Fiber
- Omega 3 fatty acids
- Monounsaturatd fat
- L-Carnitine
- CoQ10/Ubiquinol
- Folate
- Riboflavin (Vitamin B2)
- Carotenoids: Lycopene
- Magnesium
- Plant Sterols
- Polyphenols: resveratrol,
anthocyanins, quercetin.

Key Nutrients

Immune

- Selenium
- Vitamin D
- Omega 3 Fatty Acids
- Protein
- Vitamin B12
- Iodine
- Fiber
- Flax
- Vitamin A
- Carotenoids
- Iron
- Zinc

Hormones

- Iodine
- Vitamin C
- Vitamin E
- Vitamin A
- Folate
- Vitamin B 5
(Pantothenic acid)
- Iron
- Selenium
- Zinc
- Protein
- Probiotics
- Prebiotics
- Flax

Brain/Nervous

- Alpha lipoic acid
- Choline
- Vitamins B6 and B12
- Folate
- Vitamin B1 (thiamine)
- Vitamin B3 (niacin)
- Vitamin B2 (riboflavin)
- Vitamin A
- Vitamin C
- Vitamin K
- Magnesium
- Vitamin E
- Amino Acids
- Polyphenols: resveratrol
- MCT
- Acetyl L carnitine

**THE WHOLE IS GREATER THAN THE SUM OF ITS PARTS.
NUTRITION IS A KEY COMPONENT OF ALL OF THE PARTS AND
ULTIMATELY THE WHOLE.**

Nutrition information becomes very limited if we are one dimensional with how we apply its effects throughout the body. Remember, food and its nutrients do not travel to just one system. They affect all systems. The magnitude of this information may sound overwhelming to consider all of the body's system. But, over time continue to learn and strengthen you knowledge about anatomy and physiology or structure and function of each system. Only then will nutrition guidelines truly be part of the whole body.

The Institute For Functional Nutrition



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