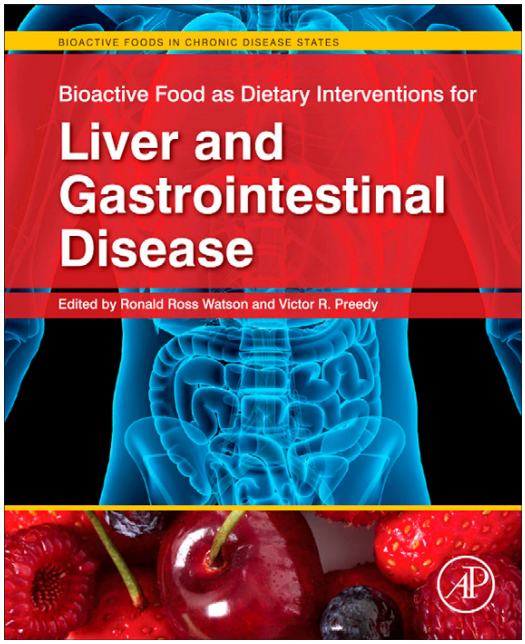




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CHAPTER 2

# Functional Assessment of Gastrointestinal Health

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Digestive illness is frequently a cause of or disposition to maldigestion-induced autoimmune conditions, as well as a factor in chronic degenerative disorders such as cancer and cardiovascular diseases. Worldwide, more than 1.5 million children die each year from diarrheal diseases (UNICEF/WHO, 2009).

In the United Kingdom Department of Health, digestive disorders affect one of every three people and are associated with one of every four surgeries (DoH, 2002/2003). In the United States, digestive health issues affect 60–70 million people at a direct annual cost of $97.8 billion (Everhart, 2008). The association between digestive disorders and health issues is reflected in conditions such as acute and delayed allergies, insulin resistance, and metabolic syndrome, as well as diabetes, an avoidable, costly, too common consequence. Furthermore, gut malfunction and pathogen overgrowth are the common underlying factors in numerous other chronic conditions, as discussed below.

## 1. PHYSIOLOGY OF DIGESTION

Digestion is a series of sophisticated metabolic processes that convert plant carbohydrates, proteins, fats, and other nutrients into building blocks that the body can utilize for nourishment, growth, and repair when toxin load and stress hormones permit. Healthy digestion produces molecular building blocks that support immune system tolerance and enable proactive repair. Multiple mechanisms exclude trap and neutralize larger molecules that can be bioactive and sometimes immunogenic. With cumulative stress, toxin exposure and nutritional deficits, maldigestion replaces eudigestion. The erosion of digestive defenses and the shift of immune responses from tolerant to hyper-reactive is a molecular expression of what people feel when they are chronically unwell although somewhat functional. In the 1960s, my gastroenterology professors were alarmed at the rapidly rising epidemic of epidemics related to the many expressions and comorbidities of maldigestion. Digestive metabolism involves chemical and mechanical functions that break down food so it can be assimilated, utilized, and eliminated efficiently, safely, and effectively. Essential nutrients released or manufactured by the body during this

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process must be derived in sufficient amounts to meet individual genetic, epigenetic, and sustainability needs for the body to grow, heal, and function well.

Digestion begins with the initial visual and gustatory contacts with food that tell the brain and then the body which digestive juices to secrete. The process of seeing the food to be eaten, tasting it, and smelling the aromas stimulates the release of saliva containing specific enzymes such as lipase (which begins the processing of fats) and amylase (which opens up and begins breaking down carbohydrates). This favors the locavore, 'slow food' approach.

The stomach exerts remarkable competence in mechanically churning diverse food mixtures. This process breaks up and acidifies the stomach contents (to create a mixture termed chyme), while adding the digestive enzyme pepsin to the stomach's contents. This exposes food molecules to enzymes and hydrochloric acid that hydrate, cleanse, and process carbohydrates and protein-rich foods. The resulting predigested chyme, the consistency of oatmeal, is passed from the stomach to the small intestine. When sufficient hydrochloric acid is present, biosensors are triggered to empty contents into the duodenum. If the chime is sufficiently acidified, bicarbonate and pancreatic digestive enzymes are then released. Adequate stomach acid is essential for healthy digestion. Blocking stomach acid production disposes one to maldigestion and its pervasive consequences.

Digestion occupies ~60% of the body's energy production and its consumption is devoted to digesting food. If the $20 \pm 10$ ft of intestines were unfolded to create a flat surface, the intestinal membrane surface covers an area the size of a tennis court, a remarkable 2500 $ft^2$ or 260 $m^2$ of surface area.

## 2. CLINICAL ISSUES IN DIGESTIVE HEALTH

The issues reviewed in this chapter impact or are comorbidities for numerous chronic health issues. Approximately a third of the gastrointestinal (GI) complaints seen are truly disabling, whereas 2/3rds are a part of an underlying chronic issue. We will also see how living the Alkaline Way™ restores digestive health.

### 2.1 Profile: Dysbiosis

Healthy flora are a major, increasingly appreciated aspect of health. The contents of the healthy human digestive tract typically contain at least 1800 different species of flora that in total number in the trillions. The presence of infection by a foreign pathogen or the overgrowth of any resident species is termed dysbiosis, which can result in poor health and a range of nondescript symptoms (Cani and Delzenne, 2010). Beneficial microflora minimize this type of imbalance. Healthy bugs in abundance crowd out bad bugs. Pathogenic organisms do not give out their toxins until crowd signaling confirms that they are present in high density.

### 2.1.1 Associated signs and symptoms

In a healthy human body, there are typically five to seven pounds of bacteria, of which more than 95% are anaerobes. Antibiotic therapy has been found to destroy both harmful and beneficial bacteria in the body (Charteris et al., 1998). When healthy flora is absent, food decomposition is slowed or incomplete, impairing digestion and reducing the level of nutrients available for absorption. Symptoms and diagnoses associated with compromised flora and dysbiosis include diarrhea, constipation, urinary tract infections, irritable bowel syndrome (IBS), irritable bowel disease (IBD), Crohn's disease, and even diabetes (Vaarala et al., 2008). Digestive health protects and promotes health. Digestive ill health is a comorbidity in almost all autoimmune, chronic, and degenerative illnesses.

### 2.1.2 Etiology

Multiple courses of antibiotics favor pathogenic bacterial overgrowth (Esposito et al., 2007; Majewski and McCallum, 2007), such as *Clostridium difficile*, and yeast overgrowth, such as the Candida species. In some cases, this promotes antibiotic-resistant strains of bacteria or other pathogens to which the individual is exposed and vulnerable. A diet high in sugars, milk, or meat products can also result in the overgrowth of various bacterial species with adverse effects on health (Jantchou et al., 2010). Harder to digest foods like cow dairy and grains become sources of digestive intolerance.

#### 2.1.2.1 Sidebar: initial probiotic research

In 1908, Nobel prize-winning scientist Elie Metchnikoff of the Pasteur Institute in Paris provided the first evidence that microorganisms may be responsible for the health-promoting effects of fermented milks. After observing that Bulgarian peasants live to ripe old ages, Metchnikoff became convinced that their health and longevity were linked to the beneficial microbes in the cultured milk they drank copiously. In his book, *The Prolongation of Life*, Metchnikoff suggests that disease-causing bacteria were minimized or eliminated by ingesting large amounts of Bulgarian kefir or yogurt, which contained beneficial bacteria later identified as *Lactobacillus bulgaricus*. These organisms are members of the bacterial species *Lactobacillus* – bacteria that produce lactic acid. *Bifidobacter* and *Streptococcus thermophilus* are other major beneficial probiotic organisms. We recommend 40–100 billion probiotic organisms taken daily between fermented foods and bioactive supplements.

### 2.1.3 Intervention: probiotic supplementation

Restoration of a healthy level of gut microflora helps promote the balance toward healthy and away from harmful microorganisms.

#### 2.1.3.1 Benefits of microflora

Beneficial microflora provide a surprisingly extensive range of protective functions in the body. Probiotic organisms decompose food in both the small and large intestines to liberate nutrients to be assimilated and utilized for energy and repair.

**2.1.3.1.1 Production of digestive enzymes by microflora** Probiotic bacteria normally found in a healthy gut support the production of essential enzymes, which increases the availability of nutrients as food is more efficiently and completely broken down (Chapman et al., 2011). For example, the enzyme lactase, produced by lactic acid bacteria, improves digestion, metabolism, and absorption of milk sugar (lactose). Heyman (2000) found that these bacteria also facilitate the action of intestinal lactase, improving overall digestion by reducing symptoms such as diarrhea.

**2.1.3.1.2 Reduced lipid levels** A variety of studies have shown that healthy probiotics at adequate levels can improve overall health, increasing metabolic breakdown of certain lipid or lipophilic substances and reducing toxins, binding toxins to prebiotic fiber that are contained in bile (Vaarala, 2008). This is important, for example, in fat emulsification that occurs in the upper area of the small intestine (duodenum), where fats are mixed with bile during digestion. Improved lipid metabolism also reduces the reuptake of cholesterol and fatty acid products, and this has been associated with a 5–17% reduction in serum cholesterol after just 1 month of daily consumption of viable probiotic organisms in the 10–20 billion organism/day (colony-forming units, CFU) range (Jackson et al., 1999).

**2.1.3.1.3 Inhibition of pathogens** One of the major beneficial effects of probiotics is the suppression of harmful microorganisms (Fuller and Gibson, 1997). When the microflora are significantly depleted, there is heightened risk for intestinal conditions such as viral gastroenteritis (Biller et al., 1995). Research by Campieri and Gionchetti (1999) suggests that when there are sufficient numbers of healthy probiotics in the gut, the risk of inflammatory bowel disease/syndrome (IBD/IBS), is substantially reduced. Conditions such as IBD and IBS, ulcerative colitis, and regional enteritis (Campieri and Gionchetti, 1999) have been reversed in individuals who have developed these symptoms through the use of probiotics as part of comprehensive care. Recent research also reports probiotic mixtures beneficial in the treatment of diarrhea, gut microbiota modulation, and *Helicobacter pylori* infection, as well as atopic disease and respiratory tract infections (Chapman et al., 2011). In our experience, an ounce of prebiotic and probiotic supplementation is worth a pound of digestive diseases cures.

### 2.1.3.2 Probiotic dosage

When flora are killed off by taking antibiotics, or from xenotoxins or distress, beneficial bacteria levels can be restored with probiotic supplements. Current clinical recommendations suggest a maintenance intake of 10–50 billion bacteria daily from a variety of mixed cultures. We prefer multiple strains of human implantable acidophilus, bifidobacter, and healthy *S. thermophilus*.

**2.1.3.2.1 Preventive applications** When one is traveling, under stress, or recovering from illness or disease, or post antibiotic consumption, the ideal dosage is a

probiotic culture that contains 20–100 billion viable probiotic organisms consumed daily for 2–3 months to restore digestive competence. Products are currently available on the market that provide as many as 200 billion count in a single dose.

**2.1.3.2.2 Therapeutic interventions** Probiotics are recommended in cases of bacterial and yeast infection or overgrowth (Gionchetta and Campieri, 2000). To address these forms of dysbiosis, many researchers now advocate antibiotic/probiotic combinations of 20–200 billion CFU mixed flora for conditions such as constipation, diarrhea, urinary tract infections, and infective endocarditis (Charteris et al., 1998).

**2.1.3.2.3 Medical probiotics** Probiotics harvested in the log phase for optimum growth and viability of CFU are recommended. Multiple strains, typically containing nine to ten different strains, are more effective in repopulating the gut. The level of supplementation is based on the severity of the patient condition, their response, and other factors determined by the physician. Typical replenishment needs are intakes of 20–100 billion organisms/day for 2–3 months; 5–10 billion per day for maintenance.

## 2.2 Profile: Hyperpermiability (Leaky Gut Syndrome)

A condition described as intestinal permeability or 'leaky gut' results whenever the lining of the small intestine leaks its contents into the intestinal lymphatics and then the bloodstream (Solly et al., 2001). When the body is under stress or in shock or nutritional deficit, pores that line the GI tract open wide and release metabolic and microbial toxins from the gut. These toxins are then passed on to the liver (Cariello et al., 2010), the lymphatic system, the bloodstream, and the immune system and distributed throughout the body and vasculatures. Leakage from the gut can also occur in conditions such as Crohn's disease, with the deterioration of tissue in the intestinal wall. Intestinal surfaces are also susceptible to erosion from mechanical action, toxins, and the products of pathogenic bacteria.

### *2.2.1 Associated signs and symptoms*

Leaky gut is implicated in chronic conditions with a broad range of clinical symptoms (Liu et al., 2005); many include a direct inflammatory component such as IBS, or toxic reactions, such as certain types of migraines. Leaky gut has also been implicated in both Type 1 and Type 2 diabetes (Secondulfo et al., 1999; Visser et al., 2009). Hyperpermeability is also implicated in skin conditions due to inflammation (recognized as repair deficit) and may reflect the intake of foods that induce delayed allergic reactions presenting as eczema, psoriasis or any other autoimmune condition. When digestion is incomplete, digestive remnants accumulate in the GI tract and increase inflammation (repair deficit). This cause atrophy and subsequently enteropathy.

Leaky gut also occurs whenever the body goes into shock in response to injury, surgery, or severe illness.

Hyperpermeability can result *from* any number of insults to the body:

- Alcohol abuse
- Food poisoning, parasitic infections, bacterial overgrowth
- Full range of GI conditions, including gastritis, colitis, and Crohn's disease
- Eating disorders (particularly anorexia)
- Shock, trauma, burns, or surgery
- Cancer and chemotherapy
- Chronic hepatitis, pancreatitis
- NSAIDS and certain other medications
- Rheumatoid arthritis
- Xenotoxins (toxic metals, persistent organic pollutants, solvents, endocrine disruptors)
- Distress

When the immune system detects oversized food molecules in the bloodstream, these molecules are targeted as foreign 'invaders'. This results in one or more delayed immune reaction that release powerful and potentially damaging cytokines and other amplifiers.

### 2.2.2 Intervention: recycled glutamine supplementation

Leaky gut syndrome and damaged mucosa are usually associated with glutamine deficiency. These conditions have been reversed through glutamine supplementation (Byrne et al., 1995). Glutamine and butyrate are the principal fuels that energize the intestinal lining cells. Generally speaking, digestion and normal metabolic function of the intestines are dependent on adequate amounts of glutamine, abundant in health and conditionally essential with respect to stress. The effects of glutamine have also shown to maintain the integrity of the gut barrier structure and decrease intestinal cell wall damage (Wu et al., 2006).

Through the action of glutamine on the kidneys, the body controls pH balance and eliminates acids. Research indicates that glutamine can effectively enhance bowel function in people with short bowel syndrome and other GI conditions involving extensive intestinal surgery, including transplantation (Byrne et al., 1995). Providing L-glutamine and pyridoxal-alpha-ketoglutarate in combination provides clinically an enhancement of glutamine uptake presumably through recycling. This approach allows full glutamine dosing without the risk of glutamate buildup.

## 2.3 Profile: Allergic Reactions as a Cause and Effect of Leaky Gut

Research and clinical experience indicate that allergies and intestinal hyperpermeability are linked (Yamaguchi et al., 2006). In an age of increasingly personalized medicine, LRA by ELISA/ACT tests provide insight into individual acquired delayed or late phase allergies. Comprehensive programs have been tested and found to significantly improve outcomes (Jaffe, 1998, 2006). Either of these conditions can serve as a cause or an effect. While it may be useful to identify the initial cause, such as gluten sensitivity, in practical clinical terms, it is not always possible to determine which factor is the cause and which is

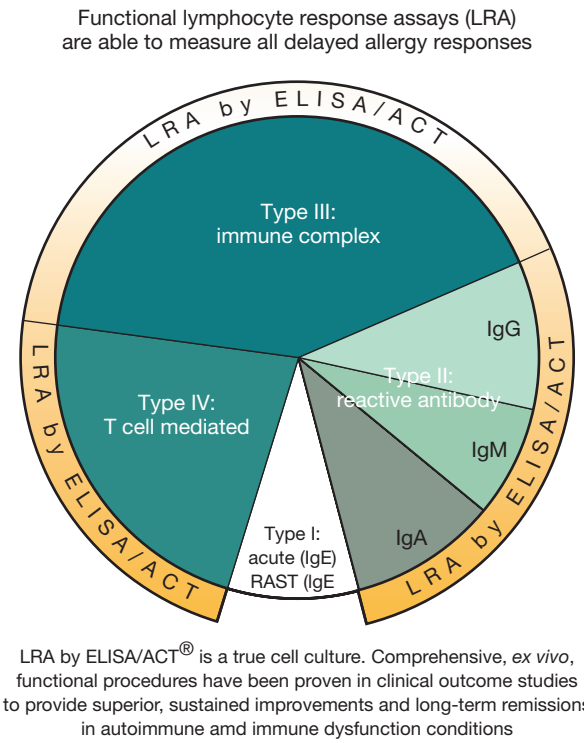


**Figure 2.1** Lymphocyte response assays.

the effect. Consequently, it is generally advisable to treat both conditions at the same time.

### *2.3.1 Hyperpermeability as a cause of reactivity*

The likelihood of developing antigen reactivity and food sensitivities is exceptionally high in anyone already experiencing leaky gut from any cause. In the case of food reactions, 80% of food reactions are *not* IgE-type reactions. Rather, they are delayed reactions caused by IgA, IgG, or IgM. Consequently, a comprehensive food assessment is vital, given the frequency of delayed reaction. An IgE screen alone will not usually pick up delayed reactions (Figure 2.1).

### *2.3.2 Allergies as a cause of hyperpermeability*

Consumption of antigenically reactive foods can trigger hyperpermeability, often within a matter of minutes. In addition, it is common for patients to consume more than one reactive foods in their daily diet. This causes a constant state of antigenic stimulation and burdens immune responses. Chronic inflammation and immune reactivity occurs when immune tolerance is lost. Leaky gut has been associated with a wide range of chronic

disorders, e.g., arthritis ( joint and connective tissue disorders), asthma, eczema, psoriasis, vascular diseases and diabetes, as well as anxiety, depression, learning disabilities, and some dementias. To manage these conditions effectively, it is essential to address the relationship between delayed food allergies, nutritional distress, and leaky gut.

## 2.4 Profile: Maldigestion and Enteropathy

Maldigestion is one of the underappreciated causes of illness that is increasingly common in industrial society. The causes are elusive because of the long lag from antigen exposure to symptomatic expression.

### *2.4.1 Comorbidities*

Prevalent symptoms of impaired or incomplete digestion include weight management issues, adult failure to thrive, lack of restorative sleep, skin disorders, and allergies. Impaired digestive function can result from any number of functional disorders, including low levels of essential stomach acid (hypochlorhydria), insufficient pancreatic digestive enzymes, and bile salt deficiency. Disorders of the liver, kidneys, and pancreas can all result from, or contribute to, maldigestion.

### *2.4.2 Cause and Consequences*

#### 2.4.2.1 Low enzyme levels

When pancreatic enzyme levels decrease, the cause is usually functional hypochlorhydria. Symptoms such as bloating, heartburn, constipation, diarrhea, insomnia, muscle aches, pain, and skin conditions that occur when the skin is used as an accessory ouster of excretes. Causal factors include an abundance of processed food in the diet and overuse of medications such as antibiotics and painkillers.

Enzyme insufficiencies can be caused by genetic conditions or low levels of probiotics, which result in a lack of the enzymes needed for digestion. Two potential solutions include the supplementation of probiotics (described in the section 'Profile: Maldigestion and Enteropathy') and enzymes (Domínguez-Muñoz et al., 2005). We find implantable probiotics, unprocessed dietary fiber a whole food-based immunocompatible diet to restore digestive and detox competence that in turn restores neuro-hormonal balance of the immune system.

#### 2.4.2.2 Poorly timed gastric emptying

Early or delayed gastric emptying are additional signs of incomplete digestion. These disturbances in the naturally orchestrated processes of digestion compromise the nutrition available to the body (see the Section 'Profile: Maldigestion and Enteropathy' for a discussion of interventions).

#### 2.4.2.3 Surgical restructuring of the GI tract

Surgery can induce maldigestion if portions of the large or small bowel are removed or if the stomach is reconstructed. In some cases, these structural changes are deliberate, for example, in cases of bariatric weight loss in which surgery is intended to limit digestion. All metabolic management approaches should be performed before surgery is evaluated.

#### 2.4.2.4 Malabsorption

Chronically poor digestion can lead to malabsorption. The individual does not obtain sufficient nutrients from the diet and therefore experiences health problems as a result. Increase in intake of prebiotics (40–100 g/day) and replenishment of probiotics (40–100 billion/day) and essential nutrients for healthy digestion, such as recycled glutamine, is recommended.

#### 2.4.2.5 Enteropathy

Loss of digestive competence can occur as a result of atrophy, a lack of essential nutrients, or excess toxins such as heavy metals, biocides, and hormone disrupters. Repair nutrients described above are recommended for a year or two it typically takes to restore and re-build digestive competence after enteropathy.

## 2.5 Transit Time

The speed at which digested food moves through the GI tract is described as the transit time. This time is the interval between food consumption and the elimination of digested waste.

### *2.5.1 Associated signs and symptoms*

A number of factors affect transit time, including diarrhea, constipation, and metabolic toxicity. Even with different sections of the GI tract, the time required for food to move through the digestive process is significantly affected by the composition of the meal passing through. Fats, for example, speed up muscle contraction and peristalsis. Transit time is also influenced by factors such as psychological stress, gender, and reproductive status (Riccardi and Rivellese, 1991).

#### 2.5.1.1 Delayed transit time

The longer the transit time, the greater the potential for putrefaction and the development of dysbiosis. When this occurs, unhealthy waste products are frequently reabsorbed and interfere with proper metabolism or with the overgrowth of specific types of bacteria such as *Helicobacter pylori, Clostridium* or species of *Escherichia coli* (associated with high concentrations of meat products in the bowel). The result is predisposition toward intestinal or systemic illnesses or their exacerbation.

**Table 2.1** Transit Time Evaluation: Charcoal Dosages

| Dosage according to weight | |
|---|---|
| <150 lbs | 6 capsules |
| 150–200 lbs | 8 capsules |
| 200–250 lbs | 10 capsules |
| >250 lbs | 12 capsules |

#### 2.5.1.2 Rapid transit time

Very short transit times may not provide adequate opportunity to digest and assimilate the food consumed. Symptoms and response are always individual and appropriate for discussion with a health professional. It is recommended that transit time be rechecked twice a month until healthy bowel movements and normalized transit time are achieved.

### *2.5.2 Evaluation: self-test for transit time*

Although various methods have been suggested to track transit time, a simple protocol can be used using charcoal capsules. (Charcoal is also sometimes utilized for symptomatic relief of intestinal gas.) This protocol involves taking 1.5–6 g of charcoal with 8 oz. of water on a specific occasion and recording the time of consumption. Choose a high-quality brand of activated charcoal capsules. For the most accurate results, the capsules are ingested just after a bowel movement. The ideal dosage is based on body weight (see Table 2.1).

#### 2.5.2.1 Observations

The first step is to note and record the time at which the charcoal is taken. This marks the beginning of the transit-time test. Patients are encouraged to observe the consistency of their stool and note anything unusual or different about the quality, texture, color, or composition of bowel movements.

#### 2.5.2.2 Transit time test interpretation

Twelve to eighteen hours is considered a healthy transit time. Unfortunately, many Americans have a 36–144 h transit time or longer. Slow transit time allows the production and absorption of various toxins produced within the body – xenotoxins that are absorbed from the chyme and stool directly into the bloodstream.

The longer the transit time, the greater the possibility that putrefaction can occur (with the overgrowth of either commensal bacteria or pathogenic species), leading to unhealthy waste products that are too often reabsorbed and interfere with proper metabolism. The result is predisposition toward chronic intestinal or systemic illness, or the amplification of existing conditions.

On the other hand, very short transit times may not provide adequate time to digest and assimilate the food consumed. It is recommended that the transit time be rechecked twice a month until a healthy transit time is achieved.

### *2.5.3 Interventions*

Initial interventions for maladapted transit time are relatively basic and can be implemented by patients through simple changes in lifestyle.

#### 2.5.3.1 Dietary fiber

The Standard American Diet is fiber deficient, typically including less than 7 g $day^{-1}$. Low dietary fiber intake requires the body to work harder to push waste along. One of the best ways to support an optimal transit time of 12–18 h is to increase fiber content in the diet. Good fiber intake also provides considerable benefit to gut health and contributes to a healthy microflora population. Additional benefits of fiber include

- prevention of the development of pathogens in the intestine and their adherence to the gut wall;
- improved blood cholesterol levels;
- improved vitamin activation;
- better absorption and elimination of toxins such as heavy metals;
- enhanced mental clarity and reduced brain fog;
- lower carbohydrate content and therefore healthier induction of glucose into the bloodstream;
- reduced body weight and lower body mass index (Murakami et al., 2007).

Fiber provides a cleansing function to sweep pathogens away from the intestinal tract – fewer pathogens means that fewer immune defenses are required, resulting in lower levels of inflammation in the body.

On the most basic level, fiber promotes good elimination. The ideal goal is intake of 40–100 g of total soluble and insoluble fiber throughout the day, with a balance of 80% soluble fiber and 20% insoluble fiber to support healthy digestion. For example, on a diet that provides about 30 g fiber daily, 7–14 g of additional fiber is indicated. Supplementation with 15–30 g from multiple forms of unprocessed fiber is recommended, selecting a source that contains no stimulants, artificial sweeteners, or flavors.

#### 2.5.3.2 Exercise and physical activity

Core body strength is a function of breath and stretch. With the practice of abdominal breathing, stress is reduced and core body strength is enhanced. Twenty minutes a day of gentle stretching complements the breath in maintaining visceral, core connective tissue, and musculoskeletal health. Walking as a source of spontaneous, pleasant irregular movement can be enhanced by the practice of Trager movement education, Feldenkrais technique, Alexander

work, or such classic approaches as hatha yoga. In the system preferred by the individual, a gentle appreciation for improved flexibility, resilience, comfort, and tolerance is suggested.

## 3. SYSTEMIC INFLUENCES ON GI HEALTH

Seventy percent of the body's immune system lies along the digestive tract (the Peyers patches housed here are also known as Gut Associated Lymphoid Tissue (GALT)). In a healthy person, the food is broken down completely and is never immunogenic. However, malabsorption, takes a toll on the immune system. A poorly functioning digestive system has lost ability to turn food that is consumed into a form the body can use. Poor digestion creates the same predicament as poor nutrition – a lack of nutrients to support immune response and physiologic function.

Today, loss of tolerance and homeostasis accounts for an estimated one third of all chronic disease. Yet, research and clinical experience have shown that healing can be stimulated and repair induced with the protocol described here: identifying and then avoiding offending substances, following an alkalinizing diet, and individualizing supplementation. This concept has been extensively tested in controlled outcome studies on insulin resistance and diabetes, in cases of IBS and chronic fatigue syndrome. Clinical outcome studies suggest that autoimmune conditions respond to this comprehensive clinical approach over 80% of the time through application of lower risk, lower cost, safer, and yet more effective personalized integrative therapies known as The Alkaline Way.

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