Therapeutic Diets

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42.1 Introduction

We so often hear the saying by Hippocrates, "Let food be thy medicine and medicine be thy food," but do we really pause to consider the meaning and relevance of his words? "Food as medicine" is using the functional characteristics of foods that allow the body to heal and function optimally. Medicine as our food is the idea that how we eat can be used on a daily basis, as a lifestyle or preventive medicine-type approach that will keep us well or prevent disease. This chapter will summarize and examine therapeutic diets from an integrative and functional perspective. We will describe dietary approaches used therapeutically by practitioners, the evidence for their use, the application, and any caveats or cautions for their use.

42.2 Defining "Therapeutic Diets"

The term "therapeutic diets" is defined by the Academy of Nutrition and Dietetics as "a diet intervention ordered by a healthcare practitioner as part of the treatment for a disease or clinical condition manifesting an altered nutritional status, to eliminate, decrease, or increase certain substances in the diet [1]." We will use this working definition of therapeutic diets within the context of nutrition approaches for integrative and functional medical nutrition therapy (IFMNT).

42.3 Traditional/Historical Perspective on Therapeutic Diets

In early civilizations, particularly of India and China, ancient traditions included dietary approaches to healing. These were some of the earliest documented accounts of using food as medicine. India's ancient healing paradigm, Ayurveda, is one of the oldest medical systems in the world. Its name is derived from Sanskrit words "life science" or "life knowledge." Ayurveda takes the approach to health with the belief that all aspects of an individual's lives are interconnected (humans, health, and the universe) [2]. Ayurveda also uses individual constitutions or "doshas" that characterize an individual's tendencies to disease and specific remedies, especially dietary recommendations.

Similarly, and slightly more recently, traditional Chinese medicine (TCM) is an ancient medical system that also uses therapeutic diets as part of its foundation to health. TCM is similar to Ayurveda in viewing human health as connected to the larger environment and universe as a whole [3].

42.4 Conventional Approaches to Therapeutic Diets (and the Nutrition Care Process)

Conventional nutritional approaches to therapeutic diets have included several categories of diet modifications, including nutrient modifications (i.e., macronutrients, micronutrients, fiber), texture or consistency modifications (mechanical soft, puree, etc.), food allergies and intolerance modifications, and additional feedings (snacks and oral supplements). Each of these is recommended based on assessment of the patient and recommendation by the doctor, another healthcare provider, and/or a registered dietitian.

42.5 Integrative and Functional Approaches to Therapeutic Diets (and the Nutrition Care Process)

IFMNT is a specific approach to medical nutrition therapy (MNT) that expands on the assessment portion of the nutrition care process (NCP). The NCP involves assessment, diagnosis (nutritional diagnosis), intervention, monitoring, and evaluation. An expanded assessment requires specific tools (including time) as a means to investigate core nutritional imbalances in patients. The IFMNT practitioner has the benefit of additional time with the patient, often spending 60–90 minutes for an initial consultation and close (often frequent) monitoring of interventions.

42.6 IFMNT Assessment Tools

Prior to an initial appointment, a patient completes paperwork that includes prompts about their goals, lifestyle barriers and challenges, health history, family history, social history, nutrition and diet histories, environmental exposures history, physical activity, dental history, symptoms, dietary supplementation and medication histories, and other backgrounds. During the initial consultation (often 60–90 minutes), the IFMNT practitioner will ask about any questions identified from the patient's initial intake forms. Through the interview, the IFMNT practitioner collects the patient's story (see ▶ Chap. 38 for more on the patient's story) and fills in any gaps left in the paperwork.

During the initial appointment, the IFMNT practitioner assesses more than just the patient's nutritional status and metabolism; she also assesses their readiness to change, self-efficacy, and level of feasibility to make necessary changes. The IFMNT practitioner will be able to help troubleshoot any of the patient's challenges to ensure that if the patient would like to make changes, they will be able to access the support they need to make them. Sometimes this involves family, friends, and their community to serve as caregivers or support systems (▶ Box. 42.1).

Box 42.1 IFMNT Tools

- Time
- The client's story and health timeline
- IFM Matrix
- IDU assessment tool
- Intake assessment form
- Health symptoms questionnaire
- Fats and oils questionnaire
- Nutrition physical exam
- Body composition measurement
- Laboratory testing (conventional and functional)
- Motivational interviewing and stages of change model

42.7 Commonly Used IFMNT Therapeutic Diets

There are countless "diets" widely promoted on the Internet and social media that may or may not be based on evidence and many that are conventionally accepted and used: carbohydrate counting for diabetic patients (often matching carbohydrate intake to insulin dosage) [4]; a "cardiac diet," which includes lowering total and saturated fat intake [5], sodium levels, and egg yolks; calorie counting for weight loss; and a general Mediterranean diet for heart health. These are generally well accepted in the conventional medical world but in a broad sense lack the nuance of each individual patient. The IFMNT approach to therapeutic diets is based on the foundational concept of evaluating the patient's nutrition status and implementing an intervention that is personalized to that individual.

42.7.1 Elimination Diets

Elimination diets (also called "exclusion diets") [6] are both a diagnostic tool to identify food adverse food reactions and a broad term for a systematic dietary approach to mitigate symptoms of adverse food reactions or to alter disease progression. At the extreme end, celiac disease and food allergies are conditions that necessitate the avoidance of certain foods to protect the patient from life-threatening illness. Less severe, but also on the spectrum of adverse food reactions, are food sensitivities and intolerances, which also warrant the elimination of certain foods (e.g., lactose or fructose intolerance or non-celiac gluten sensitivity); these have a less severe but still detrimental impact on one's health and often quality of life. Another category of conditions that may warrant an elimination diet are autoimmune diseases like rheumatoid arthritis [7] or Crohn's disease [8].

Although there has been skepticism of sensitivities to foods like wheat and gluten outside of overt celiac disease, evidence is emerging that there can be measurable physical changes in immune activation and cellular damage in people with wheat sensitivity without celiac disease [9]. Alessio Fasano [10] has contributed significantly to the evidence around characterization of non-celiac gluten sensitivity.

A PubMed search for "elimination diet" shows that most recent publications were specifically related to therapeutic use for eosinophilic esophagitis (EoE) [11–31]. When searching for "exclusion diet," one may find that most publications refer to inflammatory bowel diseases [6, 32–38]. Terminology of elimination diets seems to vary by diagnosis or area of research. Other conditions studied for the therapeutic use of elimination diets include irritable bowel syndrome (IBS) [39, 40], autism spectrum disorder [41–43], migraine headache [44], and others.

The elimination diet is often used by individuals who suspect they have food intolerances. Food intolerances are adverse food reactions that are not overt food allergies (mediated by immunoglobulin E (IgE)). Food intolerances involve an adverse reaction to food due to a lack of adequate amounts of an enzyme to digest the food (e.g., lactose intolerance is a deficiency of the enzyme lactase) [45]. Food sensitivities are a non-IgE, immune-mediated reaction to a food when ingested. These are often less severe reactions like adverse digestive symptoms (stomach pain, bloating, nausea, breathing problems, eczema, brain fog, etc.). Non-celiac gluten sensitivity is a condition characterized by adverse symptoms (fatigue, digestive problems, brain fog, etc.) caused by ingestion of gluten without having classic characteristics of celiac disease [10]. Although the mechanism is not fully understood, some hypothesize that the adverse reaction may be due to histamine intolerance [46]. Further, evidence suggests that the pathophysiology of celiac disease is related to a response by the adaptive immune system, while non-celiac gluten sensitivity is a reaction by the innate immune system [47]. This phenomenon has been measured via fecal assays suggesting an immune reaction to gluten/dairy [48].

People with IBS often try to eliminate certain foods (e.g., gluten and dairy) in an attempt to alleviate symptoms [40]. A low FODMAP diet is another version of an elimination diet with compelling evidence that it contributes to amelioration of IBS symptoms [49].

42.7.1.1 Implementation of an Elimination Diet

Elimination diets are often followed for 4–12 weeks (the time period foods are withdrawn) with additional time to systematically reintroduce foods back into the diet. To begin, a person avoids one or several foods for the specified time period. During that time, the individual keeps a diary of their dietary intake and symptoms (see Fig 42.1) to ensure that suspected foods are completely removed and there aren't any hidden sources of the food(s) remaining in the diet. Symptoms are recorded, along with the time and food eaten, to note any patterns in food ingestion with elicited symptoms. At the end of the period of elimination, each of the eliminated foods is reintroduced ("challenged") back into the diet, one-by-one, to determine which (if any) foods elicit symptoms. If the person has an adverse response to the food, they are to eliminate it again, wait for the symptom(s) to subside, and try another new food to assess tolerance. After all foods are reintroduced or "challenged" back into the diet, then the person can wait another period of time before trying to reintroduce any remaining foods again.

42.7.1.2 Types of Elimination Diets

There are many dietary approaches that aren't necessarily referred to as "elimination diets" but may fall within the general umbrella of the term: foods are eliminated with the expectation that symptoms or signs of disease or illness may improve. Examples of elimination diets include (1) the Paleolithic or ancestral diet (Paleo diet) [50], (2) a low FODMAP diet (fermentable oligo-di-monosaccharides

Fig 42.1 Diet and symptom diary

Date/ time	Location/ activity	Food or beverage consumed	Amount (cup, etc)	Mood and symptoms

Reviewed by _____ **Date/Time** _____

Table 42.1 Potential vulnerabilities

Eliminated food	Macronutrient vulnerabilities	Micronutrient and phytonutrient vulnerabilities
Gluten [54]	Fiber, carbohydrate	Iron, folate, calcium, selenium, magnesium, zinc, niacin, thiamin, riboflavin, vitamins A and D
Dairy	Protein, fat	Calcium, potassium, phosphorus, vitamin A, vitamin D, vitamin B12, riboflavin, niacin
Soy [55]	Fiber, protein	Calcium, B-vitamins, iron, zinc
Egg [56]	Protein, fat/cholesterol	Choline, retinol (vitamin A), vitamin E, thiamin (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6), folate (B9)
Nuts [57]	Mono- and polyunsaturated fatty acids, protein, fiber	Vitamins E and K, folate, magnesium, copper, potassium, selenium, carotenoids, antioxidants, phytosterols
Grains [58]	Fiber, carbohydrate	Folate, thiamin, iron, niacin, riboflavin, vitamin B6, zinc, sodium
Paleo (Free of grains, dairy, legumes) [50]	Fiber, carbohydrate	Folate, thiamin, iron, niacin, riboflavin, vitamin B6, vitamin B12, zinc, sodium, calcium, potassium, phosphorus, vitamins A and D
Low FODMAP [51]	Fiber, fat	Iodine, selenium
Specific carbohydrate diet [32] (study in pediatric population)	Fiber (due to rationale for the diet)	Vitamin D, calcium [32] (limited data and study in pediatric population)

and polyols): eliminating all categories of highly fermentable carbohydrates and reintroducing them back into the diet one FODMAP category at a time) [51], and (3) the specific carbohydrate diet [32]. Other approaches involve individualized elimination diets based on food sensitivity testing (IgG blood testing) to determine which foods to eliminate [52]. Even a low-histamine diet and a ketogenic diet (high fat, low carbohydrate) could be considered elimination diets, and they will be covered later in this chapter. Although there have been clinical trials on the implementation of elimination diets [53], there is still a lot to be learned about elimination diets and their indication and safe implementation.

42.7.1.3 Cautions for Elimination Diets

A major concern for the implementation of an elimination diet is the risk for nutritional deficiencies or insufficiencies, especially if followed for a long period of time. Table 42.1 summarizes the potential macro- and micronutrients that may be insufficient in someone following an elimination diet.

42.7.2 Low-Histamine Diet

A low-histamine diet is one of several specialized food patterns to assist patients with food sensitivities, food intolerances, and/or food allergies. Focusing on this specific diet is

warranted, as this is a therapeutic diet that is seemingly more and more common. Many integrative and functional nutrition practitioners are noticing an increase in patients needing support for histamine intolerance.

Histamine belongs to a family of biogenic amines that are classified into monoamines and polyamines. Monoamines are derived from one ammonia molecule, NH3, where one of the hydrogen molecules is dropped and replaced with another chemical structure. Polyamines have more than one NH3 starter group. Five commonly known monoamines are histamine, serotonin, dopamine, norepinephrine, and epinephrine [59]. Another trace monoamine is tyramine, which can be yet another cause of biogenic amine-related food intolerance. To understand histamine, it is helpful to understand genetic and biochemical possibilities. Several boxed genetic notes are provided for more in-depth understanding.

> Genetics Note 1: the enzyme histidine decarboxylase (HDC) is made from the HDC gene. Its purpose is to convert the amino acid histidine into histamine. In some individuals, genetic variants may cause an increase or decrease in the enzyme function possibly resulting in too much or too little histamine. Active Vit B6 or P-5-P is a required cofactor of HDC [60]. Some fish are high in microbes that are capable of producing HDC that, when consumed by some individuals who do not clear histamine well, can contribute to histamine overload [61].

Histamine is most recognized for its role in symptoms associated with classic allergy in IgE-mediated immune system activation: hives, tissue swelling, nasal congestion, asthma, headaches, oral allergy symptoms, and gastrointestinal complaints. However, histamine has many beneficial roles in human function including neurotransmission, gastric acid secretion, inflammation and immune system support, and smooth muscle tone [60].

Those with histamine intolerance may be affected by a variety of sudden onset and seemingly unexplainable symptoms such as flushing, hives, rapid heartbeat, profuse sweating, nosebleeds, car sickness, migraines, itchiness, and more. For a comprehensive lists of symptoms of histamine overload, see references listed below, especially the books by Jarisch and Lynch.

42.8 Where to Find Histamine

Histamine intolerance may actually be an imbalance between histamine production and accumulation and the ability to degrade histamine. The body is capable of making histamine and storing it in specialized immune cells called mast cells. Mast cells are sentinel cells found primarily in mucosal tissue that help initiate an inflammatory response when a threat is detected. Releasing histamine is important for immune function, unless the mast cells are overactive. This is a phenomenon known as mast cell activation disorder (MCAD) [62]. Because mast cells live in the mucosal lining of the gut, if the gut lining is inflamed for any reason, mast cells may become activated and/or have the opportunity to migrate from the mucosa system-wide due to leaky mucosal tight junctions [63].

Histamine load may also come from food, especially food subject to spoiling or degradation as microbes degrade the amino acid histidine in food with the HDC enzyme and make histamine. Foods rich in protein are culprits, but so are foods and beverages allowed to ferment, such as wine, sauerkraut, and kombucha. Foods high in protein will be degraded by microbes after cooking, raising histamine content. While refrigeration will slow histamine production, only freezing will stop histamine content from increasing [64].

Allergies to food and the environment are the more obvious sources of histamine production. IgE-type allergy testing may be warranted to reduce load [64]. Elimination of antigens and/or treatment for allergic-type hyper-response may be needed.

The stress response may increase histamine production [65]. Assisting patients with stress management is key in regulating histamine load.

Estrogens (both naturally occurring and estrogen-mimicking "xenoestrogens") also contribute to the histamine load [66]. Assessing patients for estrogen dominance and genetic risk for estrogen dominance may be helpful. Lifestyle and dietary interventions to reduce estrogen involve avoiding exposure to plastics or heating food in plastics. Increasing cruciferous food intake is also supportive to decrease estrogen.

Emerging evidence suggests that specific species of gastrointestinal microbes produce histamine. Examples are *Lactobacillus casei*, *Lactobacillus delbrueckii*, and *Lactobacillus bulgaricus*. Testing for small intestine bacterial overgrowth may be a diagnostic tool in determining if dysbiosis may be an underlying contributor. Certain microbes are known to assist with histamine degradation such as spore-based probiotics, *Lactobacillus plantarum*, *Lactobacillus rhamnosus*, and *Bifidobacterium longum* [63].

> Genetics Note 2: the enzyme catechol-O-methyltransferase (COMT) made by the gene of same name is important for estrogen degradation. Individuals who are homozygous positive for variants may have estrogen dominance and benefit from estrogen clearing support. SAMe (methylation ability), magnesium, and vitamin C are cofactors for COMT [67].

Based on the above-described reasons that histamine may accumulate and individual sensitivity to histamine, it is best to describe histamine intolerance as "histamine overload." When the body is unable to handle the load, histamine can build up and eventually "spill over" the tolerable limit for the individual and create a histamine response.

42.9 How Can We Support Histamine Overload?

1. Decrease the dietary load. Limit very high histamine foods: red wine, champagne, aged cheeses, cured meat and fish, bone broth and fish stock, vinegar and fermented foods such as sauerkraut, and chocolate. A more comprehensive list of high and moderately high histamine foods is available in the references. Patients may benefit from suggested meals and meal plans based on lower histamine foods.
2. Avoid fish high in histamine unless very fresh or fresh and flash frozen.
3. Avoid or limit eating leftovers. Freeze leftovers for future reheating and consumption.
4. Assess genes that may influence the ability to degrade histamine. See boxed notes for DAO and HNMT genetics.
5. Support with probiotics (mentioned above) that are known to degrade histamine.
6. Identify possible allergens and eliminate and/or refer for treatment.
7. Assess for gut inflammation and/or SIBO and support as needed
8. Support with nutrients and/or supplements known to support degradation of histamine such as selenium, quercetin, vitamin C, stinging nettle, EGCG (primary catechin in green tea), and the DAO enzyme [68, 69].
9. Collaborate with other healthcare providers who may be able to offer support with prescription antihistamines. Be aware that many antihistamines decrease stomach acid secretion that may result in low vitamin B12. Consider assessing for B12 deficiency.
10. Assist with stress management techniques.

Genetics Note 3: the enzyme diamine oxidase (DAO) is produced by the cells that line the gastrointestinal tract. DAO is a key enzyme that degrades dietary histamine in the extracellular space (especially the gastrointestinal tract). Individuals with significant genetic variants might be impaired at making adequate DAO. Even without genetic variants, a damaged gut lining may impair DAO production. DAO is available as a supplement that is recommended for use as 15 minutes prior to consuming high histamine foods. Vitamin B6 is a cofactor for DAO [68, 69].

Genetics Note 4: the enzyme histamine N-methyltransferase (HNMT) degrades histamine inside the cell. It is primarily concentrated in the liver. Individuals with significant genetic variations may benefit from additional cofactor support to help speed up HNMT which is SAMe [68, 69].

Genetics Note 5: the enzyme monoamine oxidase B (MAOB) provides an important step in the histamine degradation pathway. HNMT degrades histamine to N-methylhistamine, which then is further degraded by MAOB so the body can finally get rid of the histamine. If MAOB is not working well due to lack of cofactor and/or presence of genetic variants through feedback inhibition, HNMT slows down making histamine buildup. The easy fix is a trial of the cofactor vitamin B2 (riboflavin) as about 400 mg taken 2–5 times a week [68, 69].

42.9.1 Low-Carbohydrate High-Fat Diet

"There has been a dramatic resurgence of interest in the ketogenic diet during the past several years," as stated in a 1997 review article by Swink et al. [70]. This original study emphasized the utility of the KD in treating children with epilepsy starting in the 1920s, which then fell out of favor in the 1970s due to the invention of antiepileptic medications. The 1997 paper mentioned the return of interest in the KD in severe cases of pediatric epilepsy when medications did not work. The same research team published a follow-up review in 2007, *The ketogenic diet: one decade later*, where they acknowledged that this diet, with evidence of use as far back as 500 B.C., was maintaining its momentum after 10 years [71]. This food trend continues to thrive as numerous research teams are diving into its many health applications [70–78].

This summary of the KD will be referred to from this point on as the low-carb high-fat or low-carb healthy fat (LCHF) food pattern. Many health professionals are making the transition to using the term LCHF due to the negative and often misunderstood confusion between nutritional ketosis and diabetic ketoacidosis.

42.10 How Do Diabetic Ketoacidosis and Nutritional Ketosis Differ?

Diabetic ketoacidosis is an acute life-threatening condition usually only seen in type 1 diabetes and rarely in type 2 diabetes [79]. In diabetic ketoacidosis, there is too little insulin to control a sharp rise in glucose and ketones, a result of an acute (usually within 2–4 hours) onset of a catabolic state [80]. Other biomarkers include a pH less than 7.0, a bicarbonate less than 10 mEq/L, and an anion gap >15 mEq/L. Blood ketones are measured as beta-hydroxybutyrate with serum levels >8 mmol/L [80] or 15–25 mmol/L [72]. Notice that researchers do not agree on a standard level for beta-hydroxybutyrate, but the combination of the above markers is what is significant. This combined "perfect storm" can result in a critical threat warranting immediate medical treatment.

Nutritional ketosis is a mild form of ketosis where blood glucose is relatively low, blood pH remains within normal reference ranges, and blood ketone values usually are between 0.5 and 5 mmol/L [74]. Medically therapeutic ketosis for treating epilepsy ranges from 2.0 to 7.0 [81].

Table 42.2 Macronutrient percentages

Macronutrients as percent of total kcals	Standard American Diet [82]	Paleo diet [83]	Mild LCHF diet [72, 73]	Moderate LCHF diet [72, 73]	Medically therapeutic LCHF (epilepsy and Alzheimer's disease [70, 73]
Carbohydrate	50	22–40	20	10–15	7–8
Protein	15	19–35	20	15–20	12–13
Fat	35	28–47	65	70	79–80

42.11 What Is LCHF?

A LCHF food pattern is high in (healthy) fat, adequate or moderate in protein, and low in carbohydrates. Healthy fats are considered, in the context, to be fats derived from whole food sources (grass-fed meat and poultry, avocados, olives, cold-pressed oils, butter, etc.) versus fats derived from chemical and heat processing (seed and soy-based oils). This pattern is able to assist the human body in making ketone bodies for energy. The formation of ketones for energy occurs with fasting, prolonged exercise, and very low carb intake. Comparing the macronutrient percentages of LCHF variations with the standard American intake may be helpful as listed in Table 42.2. The Paleo diet was included for additional reference as this food pattern, which emphasizes a whole food approach to food intake, is often used as a reference template for LCHF.

42.12 What Are the Benefits of LCHF?

Scientists are rapidly studying many possible benefits of a LCHF food pattern. Research covers a wide range of hypotheses from effects on exercise performance to metabolic derangement to chronic disease. Here is a summary of some of the current findings.

42.12.1 Carbohydrate Restriction in Cancer Therapy

First, note that not all cancers are related to diet, such as those associated with virus, environmental exposures, age, and genetic mutations [74]. However, when these types of cancer are diagnosed and treated, diet can be an important factor in outcomes.

Some common cancers have been linked to dietary influences. These cancers include breast, colon, some lung, prostate, and gallbladder/biliary cancers and endometrial adenocarcinoma. These cancers are linked to hyperinsulinemia based on data from people with diabetes mellitus (DM) [84–86]. A therapeutic diet could be one that promotes lower insulin and may be helpful in cancer prevention. Dr. Dawn Lemanne is recommending a moderate carbohydrate restriction of about 100 grams of net carbohydrates per day in breast cancer and in stage III colon cancer in those with BMI >25 [74, 75]. The breast cancer recommendations come from the large WHEL (Women's Healthy Eating and Lifestyle) and WINS (Women's Interventional Nutrition Study) trials [87, 88]. A LCHF food pattern may also increase lifespan of those with glioblastoma and metastatic glioblastoma [77, 78].

In addition to insulin, other biomarkers may be considered. An observational study of 269,391 participants in Korea over 2 years between 2002 and 2005 found that all-cause mortality, including cancer, was lower in those with higher blood lipids [89]. Certainly clinical trials are needed to verify this, but studies such as this support possible benefits to higher lipids which can occur in some people following LCHF.

The LCHF food pattern may support starving cancer cells of glucose. The energy demand of cancer cells dependent on glucose for energy is about twenty times greater than normal cells. This altered energy utilization and increased demand is known as the Warburg effect [76].

When should LCHF be avoided in cancer? Genetic mutations such as the BRAF V600E mutation result in dietary fat-fueled tumor growth [90]. Note that some cancers are learning to use other sources of fuel such as protein, amino acids, and fats instead of glucose [91–93].

Rationale for benefits of a LCHF dietary pattern

1. Alzheimer's disease: LCHF resulting in mild to metabolically therapeutic level of ketone production is recommended by The Bredesen Protocol to End Alzheimer's for three reasons: (1) to provide an alternative energy source to brain cells, (2) to decrease neural inflammation, and (3) to increase brain-derived neurotrophic factor [73].
2. Cardiometabolic disease: LCHF may support reversing chronic diseases such as type 2 DM, blood lipid dysregulation, hypertension, obesity and overweight, and chronic inflammation and decrease the need for insulin in type 1 DM [72, 94].
3. LCHF has been shown to enhance athletic performance, especially in endurance athletes [95].
4. LCHF may simplify food intake as many find this food pattern more satiating with a reduction in cravings for carbohydrates and the need to eat frequently [72, 94].

42.13 Who Should Avoid LCHF?

Many people are finding benefit from increasing healthy fats while lowering carbohydrates. As more adopt this food pattern and research data accumulates, we may find additional

reasons to avoid LCHF, but at this time the only recommended avoidance is for starting this food pattern during pregnancy [72, 94]. The most important consideration when adopting LCHF is a slow acclimation and progression to LCHF to assist the body to adapt to using fat for fuel over carbohydrates to avoid possible flu-like symptoms and muscle cramps [96].

42.14 Intermittent Fasting

Intermittent fasting (IF) is the conscious choice to abstain from food for health-promoting reasons such as spiritual, cleansing, or detoxing or as a method to ameliorate a disease. IF is also referred to as time-restricted feeding or periodic fasting. This section will refer to IF but could mean any of the three above titles. Intermittent fasting is not starvation. Starvation is a state of forcefully being deprived of food such as lack of availability (war or famine) or withholding food. Note: anorexia nervosa is considered a form of purposeful food refusal involving complex emotional, social, mental, and nutrition-related factors. Appropriately, this discussion does not include anorexia nervosa.

Fasting has no set duration. It is a cycle of consuming food followed by an abstinence period from food. The concept of IF represents cyclical and pre-planned periods of fasting followed by appropriate food intake. This could be simply avoiding food intake between meals, i.e., avoiding snacking between a standard breakfast and lunch. Other examples of fasting cycles are overnight, alternate-day, or extended-day fasts. The modified, shorter versions of fasting are showing promise with many health benefits and are more appealing to the general population over extended fasts. IF can be eucaloric or hypocaloric and still result in positive outcomes. The variability in fasting regimens allows the healthcare professional to individualize the needs of patients. Many patients benefit from individualized guidance on how to implement a fasting protocol based on health goals and reason(s) for fasting. Understanding the basics of fasting will provide guidance for patient support.

42.15 Benefits of Intermittent Fasting

A 2017 review by Patterson et al. [97] found that IF supports weight loss, improves metabolic health markers, and may influence other aspects of health, such as improved sleep circadian rhythm and microbiome biology. Some of the metabolic health markers include lipids, such as lower total cholesterol, lower LDL cholesterol, improved HDL cholesterol, lower triglycerides, and improved blood glucose and insulin. A more recent review found that most evidence related to IF and weight loss and improved lipid profiles are observational and suggested the need for more clinical studies to confirm these initial findings [98].

Regarding weight loss, IF is supportive as a manageable method for caloric restriction, promoting adipose thermogenesis, and altering the gut microbiome to increase metabolism via influences on adipose tissue [99–101]. Stockman et al., in a 2018 review, summarized findings in animal models showing that IF may reduce oxidative stress, improve cognition, and slow down the aging process [102]. This same review found that while the human clinical trials are small (many with fewer than 300 participants), they are showing evidence of sustainable weight loss and improved insulin sensitivity.

IF between meals and overnight is a newer dietary therapy for digestive problems such as inflammatory bowel disease (IBD), irritable bowel syndrome (IBS), and small intestine bacterial overgrowth (SIBO). The author (TL) uses IF for 12 hours overnight and 4–5 hours between meals for bowel rest with good clinical and anecdotal success for these gastrointestinal (GI) conditions. This concept is based on the work of Mark Pimentel, MD, the director of the GI Motility Program and Laboratory at Cedars-Sinai. He has authored many papers, and his book, *A New IBS Solution*, describes the migrating motor complex (MMC) function in the gastrointestinal tract [103]. The MMC is a wavelike pulse that has been shown to sweep microbes and food debris out of the small intestine helping to prevent SIBO. He describes the MMC as pulsing naturally about every 90 minutes when food is not present. He has found that when the MMC runs 10–12 times every 24 hours, IBS/SIBO treatment is optimized. This can only occur during intermittent fasting states instead of the conventional ideal of eating three meals and two to three snacks each day. Additionally, bowel rest has traditionally been used for IBD conditions for the past 40 years as a method to decrease inflammation. IF is a method to provide rest intermittently with nutritious food intake [104, 105].

Prominent clinicians are using varying methods of IF to support treatment of some chronic diseases. One example is Dr. Jason Fung, MD, Canadian nephrologist and head of the Intensive Dietary Management program to support weight loss and type 2 diabetes reversal. He teaches both low-carbohydrate diets and IF to patients. Dr. Fung has written two books on his methods noted in the references. He is collecting data in his clinic and shares many clinical and anecdotal stories about his success using his protocols to reverse diabetes, a disease that conventional wisdom has touted as being progressive, insidious, and irreversible [94, 106]. Because Dr. Fung's IF methods are individualized to each patient, such as 12-hour overnight fasting, between-meal fasting, and/or alternate-day or extended-day fasting, refer to his books for further examples and application. He shares clinical assessments to ensure safe implementation of IF.

Dale Bredesen, MD, neurologist and founder of MPI Cognition, studies Alzheimer's and other neurodegenerative diseases. A key dietary aspect of his protocol is IF. Dr. Bredesen recommends a 12-hour overnight fast on a daily basis, but those with increased genetic risk are instructed to extend their fast more. Those with the ApoE 3/4 genetics for Alzheimer's risk use a minimum 14-hour overnight fast, and those with the ApoE 4/4 genetic variants for Alzheimer's risk are instructed to use a minimum overnight fast of 16 hours. The goal is to produce a state of mild nutritional ketosis to help fuel the brain, optimize brain mitochondrial function, and reduce neural inflammation [73].

Also noteworthy is the research by Valter Longo, PhD, Professor in Gerontology and Professor in Biological Science, University of Southern California. His clinical animal trials have yielded the following findings [107, 108]:

- IF is chemo protective because it protects normal cells from treatment side effects. When starved, normal cells slow division, which is protective during cancer treatment. However, when cancer cells are starved, they continue dividing because their growth switch is broken in the "on" position making them more vulnerable to treatment.
- IF sensitizes tumor cells to chemotherapy treatment.
- IF slows tumor growth even without chemotherapy.

In 2010, a group of ten volunteer patients requested that Dr. Longo use them in a human trial with a model used in his rodent trials. At the time, he refused, citing many concerns that included unlikely IRB approval. The group of patients said they would attempt his animal model fasting techniques on their own, and he was invited to take notes. The results of this volunteer study were published in 2012 with the following findings [109, 110]:

- Fasting was well tolerated with some mild lightheadedness and weakness (temporary).
- Fasting reduced fatigue.
- Fasting reduced overall weakness.
- Fasting resulted in fewer gastrointestinal side effects.
- No adverse effects on tumor volume or serum tumor markers were identified.
- The proposed mechanism is that fasting enhances leptin sensitivity and lowers insulin (a growth hormone).

Note: this study included ten volunteers with various malignancies. They fasted 48–140 hours prior to chemotherapy and for 5–56 hours following.

42.16 Concerns and Special Considerations for Intermittent Fasting

Concerns and considerations for IF vary depending on the model. These are summarized below based on Dr. Jason Fung's book and on the clinical experience and application of IF by the author (TL) [106]. A literature review did not reveal any specific scientific studies on possible harm with IF, although basic understanding of physiology, psychology, and biochemistry provides background to address concerns and considerations.

- Making drastic, significant changes: Many patients get enthusiastic about fasting, which can lead to discouragement and failure. Proper assessment for readiness and appropriate stage is important. Starting small, like fasting overnight for 12 hours and/or helping patients restructure meals to feel satiated (often with higher healthy fat and higher fiber options), will help with a between-meal fast.
- Electrolyte imbalances: Some patients may experience symptoms such as dizziness, headaches, and muscle cramps. Patients should be carefully monitored and provided with electrolyte replacement if warranted, along with plenty of water during any fast [106]. Be aware for extended fast, usually beyond 3 days, risk of refeeding syndrome is possible [111].
- Coach patients about managing feelings of hunger. Hunger tends to come in waves so strategies to assist through these sporadic periods are important. Some strategies include drinking a glass of water or a cup of green tea, taking a walk, or engaging in an activity that requires concentration; staying busy during the fasting period can be helpful.
- Many overeat when breaking a fast, especially longer fasts. Patients need to be guided in breaking a fast, such as planning a small snack to start with or pretend he/she never fasted and eat a normal meal.
- Advise patients that they should not make an announcement about their fast. Many people will think fasting is extreme and may not be supportive. Suggest that patients only share this with a few supportive people.
- Heartburn can be a problem when breaking a fast. This can be avoided by consuming smaller meals after fasting.
- Some patients may need to take medication during a fast. Dr. Fung suggests that while fasting patients can eat a few pieces of lettuce before swallowing medications [106].
- Patients on blood sugar-lowering medication need to carefully monitor blood glucose levels and seek assistance on altering medication doses during fasting, if needed.
- Patients with diagnosed eating disorders should not fast. Each situation needs to be assessed. For example, a mother of teenage girls may want to avoid fasting due to risk of influencing possible disordered eating in her children.

42.17 Different Methods of Intermittent Fasting

The studies of IF have been difficult to review due to varying models. Table 42.3 below summarizes the most commonly used fasting models. Some fasts encourage water-only fasting with electrolytes, as needed. Other models, especially when combined with a low-carb high-fat protocol, allow for consumption of fat such as MCT oil or cream and/or bone broth during the fast. Beverages such as coffee or tea with added cinnamon and/or added fat are acceptable according to some providers [106]. Another type of fast called the 5:2 fast suggests continuing normal dietary intake for 5 days out of the week; the other 2 days are fasting days that allow for intake of 0–600 kcals from protein, fat, and non-starchy vegetables. A primary goal of many fasting models is a compressed eating window (CEW). Because eating food (some foods more than others) creates an inflammatory response, a CEW is often recommended as a method to decrease inflammation [104, 105]. A CEW may also support gastrointestinal conditions mentioned above like IBD, IBS, and SIBO.

Table 42.3 Types of intermittent fasting

Type of intermittent fasting	Description
Time-restricted fasting	Compressed eating window such as 12:12 (fasting for 12 hours followed by food intake occurring during the next 12 hours). Other examples are 14:10, 16:8, 18:6, and 20:4
Time-restricted fasting for cancer prevention and treatment (breast, colon, and glioblastoma) [112]	13-hour overnight fast: not eating from 6 p.m. until 7 p.m. the following day
Time-restricted fasting for Alzheimer's prevention and/or reversal [73]	3/12–16: (3-hour fast between dinner and bedtime with an overnight fast of 12–16 hours depending on ApoE 4 genetics)
5:2 fast	Eat normal intake for 5 days during the week. For two consecutive or nonconsecutive days, eat 0–600 kcals of protein, fat, and non-starchy vegetables
Alternate-day fasting [106]	For alternating days during the week, fast for 20–24 hours such as Monday, Wednesday, and Friday. For example, eat dinner on Sunday night at 7 p.m. and avoid eating again until 5 p.m. on Monday[a]
Extended fasting [106]	Fasting for 2–14 days. Note: fasting beyond 3 days may increase risk of refeeding syndrome
Extended fasting as an adjunct to cancer treatment [112]	Fasting 24–48 hours prior to chemotherapy and for as long as possible after as applied by Dr. Dawn Lemmane based on research by Dr. Valter Longo

[a]Coffee or tea with added fat such as MCT oil or cream and/or bone broth is considered acceptable or as a strict water-only fast. Electrolytes are recommended during alternate-day and extended-day fasts [106]

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42.18 Summary and Conclusion

Therapeutic diets have been used for thousands of years for the purpose of promoting health and healing. The modern IFMNT approach involves applying the nutrition care process in order to personalize the therapeutic use of nutrition, food, and targeted supplements. The IFMNT practitioner should be aware of the nutritional vulnerabilities (potential nutrient deficiencies) of each individual diet and ensure that any dietary intervention provides adequate amounts of macronutrients, micronutrients, and phytonutrients, which can be achieved by foods and/or supplements.

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