

Grade A heavy whipping cream

The butterfat content of the cream should be either 36% or 40%. The label on the carton may not show these percentages. Buy cream that matches the labels below. Your dietitian will calculate meals with the type of cream that you are able to locate. Check the freshness date on the cream before buying it. Avoid creams containing polysorbate or ingredients ending in -ose. Let the dairy manager of your grocery store know that you will be buying the cream regularly so that they may order additional.

For 36% Cream

Nutrition Facts

Serving size: 1/2 fluid ounce (15mL)

Amount per serving

Calories: 50
Calories from fat: 50
Total fat: 5g
Total carbohydrate: 0 (or 1g)
Protein: 0g

For 40% Cream

Nutrition Facts

Serving size: 1/2 fluid ounce (15mL)

Amount per serving

Calories: 60
Calories from fat: 55
Total fat: 6g
Total carbohydrate: 0 (or 1g)
Protein: 0g

Making cream fun to drink and eat

Note: Use only the amount of cream allotted on your child's meal.

For recipes with whipped cream, weigh the cream after it has been whipped.

- Mix the cream with water to make it taste more like milk.
- Mix the cream with 5 drops of pure vanilla or chocolate extract. Thin this mixture with water or diet caffeine-free club soda.
- Make a "cream soda" by mixing the cream with diet caffeine-free diet sodas such as root beer.
- Mix whipped cream and a few drops of pure extract and sweetener. Eat with a spoon.
- Freeze whipped cream; flavor with pure extract and allowed sweetener.
- Mix whipped cream with allotted fruit (chopped). Eat with a spoon.
- Make "hot chocolate" by adding unsweetened baking chocolate (must be calculated) or pure chocolate extract (free food). Heat until warm.
- Make sherbet by whipping cream into sugar-free Jell-O™ (must be calculated) that is just about gelled. Serve frozen.
- Make eggnog with cream (from a calculated recipe). Eggnog can be microwaved or frozen.
- Add sour cream to whipped cream (from a calculated recipe). Add chopped fruit. Tastes like yogurt.

Fruit and vegetable list

Fruit or juice: fresh, frozen or canned without sugar. Do not use dried fruit.

10% (Use amount prescribed)

Applesauce (unsweetened)
Apricot
Blackberries
Cantaloupe
Grapefruit (pink, red, white)
Guava
Honeydew melon
Kiwi
Mango
Nectarine
Orange
Papaya
Peaches
Pineapple
Raspberries
Strawberries
Tangerine
Watermelon

15% (Use 2/3 amount prescribed)

Apple (with skin)
Blueberries
Cherries (sweet or sour)
Grapes
Pears
Plums



Vegetables: fresh, canned, or frozen. Measure raw **(R)** or cooked **(C)** as specified.

Group A (Use twice amount specified)		Group B (Use amount specified)	
Asparagus C	Radish R	Beets C	Kohlrabi C
Beet greens C	Rhubarb R	Broccoli C	Mushroom R
Cabbage C	Sauerkraut C	Brussels sprouts C	Mustard greens C
Celery C or R	Summer squash C	Cabbage R	Okra C
Chicory R	Swiss chard C	Carrots R or C	Onion R or C
Cucumbers R	Tomato R	Cauliflower C	Rutabaga C
Eggplant C	Tomato juice R	Collards C	Spinach C
Endive R	Turnips C	Dandelion greens C	Tomato C
Green pepper R or C	Turnip greens C	Green beans C	Winter squash C
Poke C	Watercress R	Kale C	

Lean meat options

These meat and protein rich foods are grouped together because they have similar protein and fat content. They are listed on your meals as “Lean Meat”. Other protein rich foods such as chicken and fish, eggs and cheese are calculated separately on your menus. All meat should be cooked before it is weighed. Salt and pepper or a pinch of an herb or spice may be added during cooking.

- Beef roast – arm, chuck, eye, top sirloin, top round, bottom round
- Beef loin cuts – tenderloin, filet mignon, New York strip, t-bone, rib-eye
- Eye round of beef
- Lean ground beef – 80%
- Pork roast – loin end, pork tenderloin, pork loin
- Pork loin cuts/pork chops
- Turkey dark meat – thighs, legs



Food preparation

	Protein	Fruit	Vegetables	Cream	Fat
PREPARATION	<p>Start with fresh, or thawed unprocessed meats.</p> <p>Do not add any fat to the meat before or during cooking.</p> <p>Cook methods: Bake, broil, steam, grill or pan fry (with a non-stick pan spray).</p> <p>Do not add gravy or sauces. Do not use breaded or fried meats.</p>	<p>Use fresh or frozen unsweetened fruit.</p> <p>Use unsweetened fruit juice.</p> <p>Do not use dried or dehydrated fruit.</p>	<p>Fresh</p> <p>Frozen without added ingredients.</p> <p>Canned (with or without salt).</p> <p>Cooking methods: boil, steam, grill, bake or microwave.</p> <p>Drain the vegetable after it is cooked, before weighing.</p>	<p>Check freshness date before purchasing.</p> <p>Buy one brand consistently.</p>	<p>Fats can be mixed into foods or eaten plain.</p> <p>Use a spatula at mealtime to scrape every morsel of fat off of dishes</p>
HOW TO WEIGH	<p>Weigh after it has been cooked unless the prescribed meal specifies differently.</p> <p>Remove the bone, skin and excess fat from cooked meat before weighing.</p>	<p>The weight of the lower carbohydrate fruit (10%) is used in meals. If you want to use the 15% fruit, use 2/3 (.66) of the 10% amount.</p>	<p>Weigh according to: R = raw C = cooked</p> <p>Double the weight of Group B to get the weight of Group A Vegetables.</p>	<p>Weigh cream as is.</p> <p>Whipped cream should be weighed after it is whipped.</p>	<p>Weigh fat in small containers.</p> <p>Do not use lowfat mayonnaise or margarines.</p>
BEST CHOICE	<p>Roast beef</p> <p>Lean ground beef</p> <p>Beef loin cuts</p> <p>Pork roast</p> <p>Pork chops</p> <p>Pork loin cuts</p> <p>Chicken breast</p> <p>Chicken dark meat</p> <p>Turkey breast</p> <p>Turkey dark meat</p> <p>Fish; Salmon, Tuna Cod, Perch, Haddock Sole, Catfish, Flounder</p> <p>Orange Roughy</p> <p>Shellfish: Lobster, Crab</p> <p>Eggs</p>	<p>10% Fruit (from list)</p>	<p>Group A Vegetables and Group B Vegetables (from list)</p>	<p>36% or 40% Grade A heavy whipping cream</p> <p>Check label for additives. Avoid cream with polysorbate or added sugars.</p>	<p>Grade A butter</p> <p>Coconut oil</p> <p>Mayonnaise</p> <p>Vegetable oils: Canola Flaxseed* Olive Soy Walnut</p> <p>*limit amount</p>

20g broccoli
23g chicken breast
11g green olives
31g mayonnaise
13g olive oil
(5g mixed w/ mayo)

400 Calories
Fat: 39.96g
Protein: 8.06g
Carb: 1.93g

4:1

30g broccoli
30g chicken breast
15g green olives
32g mayonnaise
10g olive oil
(5g mixed w/ mayo)

400 Calories
Fat: 38.64g
Protein: 10.52g
Carb: 2.36g

3:1



KETOGENIC

Meal
Comparison



2:1

64g broccoli
40g chicken breast
17g green olives
1g parsley
32g mayonnaise
7g olive oil
(mixed w/ mayo)

400 Calories
Fat: 36.45g
Protein: 14.49g
Carb: 3.72g



1:1

95g broccoli
75g chicken breast
35g green olives
2g parsley
22g mayonnaise
5g olive oil
(mixed w/ mayo)

400 Calories
Fat: 30.74g
Protein: 26.18g
Carb: 4.71g

SUPER FOODS

FOR LOW-CARB AND KETOGENIC DIETS

Super Food	Unique Content	Tips
Asparagus	Anti-inflammatory, anti-oxidant and anti-cancerous compounds; high in inulin (prebiotic); chromium enhances glucose metabolism.	Steam for best flavor or chop raw into salad. Frozen asparagus are available year-round. Wild asparagus can be found in the Spring.
Arugula	Prevents cholesterol adherence to arteries, has detoxifying and anti-inflammatory benefits.	Baby greens are less bitter than mature. Serve raw, sautéed or blend into smoothies.
Avocado	Magnesium & fiber (both prevent constipation), more potassium (K+) than banana (K+ is an acid buffer), omega-3 fats, anti-inflammatory; sterols – inhibits cholesterol absorption; glutathione – powerful antioxidant.	Pear shaped, Mediterranean variety Hass is higher in fat than oval type. An avocado is ripe when its skin is a brown dark-green color and there is a little “give” when you gently press your thumb into it. Place unripe avocados on the counter to ripen for a couple of days, separating them to allow them space to release CO ₂ .
Blackberries	Highest antioxidant and fiber content of all fruit.	By fresh when they are on sale and freeze in small bags.
BRASSICA VEGETABLES: Broccoli Brussels Sprouts Cabbage Cauliflower, Kale	Sulforaphane blocks a destructive enzyme that damages cartilage; toxic to cancer stem cells. Indols repair DNA in cells. Eat at least one serving daily.	Eat raw or steam, microwave or stir-fry to preserve sulforaphane. Sauerkraut contains probiotics and is especially healthful. Shred cauliflower then steam, in place of rice. Slice cabbage into thin strips then steam in place of egg noodles.
Celery	Flavonoids; anti-inflammatory, anti-oxidant, immune system enhancing and cholesterol lowering.	Eat raw, on salads, stir-fry, soup, or blend into smoothies.
Celeriac (celery root)	Antioxidants and phosphorus (acid buffer)	Use raw in salads or coleslaw or cooked; soup or faux mashed potatoes.
Garlic	Potent antiviral, antibacterial and cholesterol lowering.	Dehydrated minced garlic is economical and easy to rehydrate.
Green tea	Phytochemical epigallocatechingallate improves blood flow and lowers cholesterol.	Contains 45mg of caffeine per cup and negligible carbohydrate. Steep green tea no more than 2 minutes to prevent bitterness.
Olive oil and olives	Phytochemicals are anti-cancerous; Oleuropein is a potent free radical scavenger protecting heart tissue.	Buy extra virgin olive oil. Pure olive oil test: place bottle in refrigerator for 3 days – if oil firms and turns yellow (like butter), its pure olive oil.
Radishes	Anthocyanins have anti-inflammatory and anti-cancerous properties.	Slice thin for salads. Chop and sauté with onions and cauliflower for faux hash browns. Black radishes are more peppery in flavor.
Spinach	Flavonoids and antioxidants, vitamins A, B2, C & K, magnesium, manganese, folate, iron, calcium & potassium.	Eating raw is the best method to preserve nutritional value. Steaming or quick sautéing are second best.
SPROUTS: Aalfalfa, broccoli, cabbage, clover, fenugreek, lentils, pea, mung, radish, garlic, etc.	Rich source of enzymes that combine with vitamins & minerals in essential metabolic pathways. Lysine (branched-chain amino acid) is helpful for ketosis. High in fiber and essential fats.	Grow sprouts inexpensively at home in 5 days. Several commercial tray designs are available for sprouting seeds. Serve sprouts as main entrée, as a salad or mix into smoothie or a stir-fry.
Sunflower seeds	High in poly-phenols & Vitamin E (antioxidants), B-complex vitamins especially folic acid & niacin (enhances brain calming GABA). High in choline, a precursor for neurotransmitters.	Raw and sprouted sunflower seeds are higher in nutrients than roasted. Sunflower seeds are high in lecithin which helps to emulsify (disperse) fat and aids in digestion. Sunflower lecithin can be purchased in powder and liquid form.

PRE-AND PRO-BIOTICS

AND THE KETOGENIC DIET

Probiotics are live, healthy bacteria found in fermented foods. They survive inside our intestines by eating a type of fiber called **prebiotics**. Several thousand bacteria strains exist. Recent studies show that they are extremely important for digesting and eliminating food in our body but are also involved in preventing and recovering from illness. In addition, healthy gut bacteria can improve the ability to think and can have a positive effect on mood. It can also lower cholesterol by limiting its absorption through the gut. Eat one or more foods from each group below daily. A quality probiotic supplement taken daily is also helpful.

PROBIOTIC-RICH FOODS

Apple cider vinegar, raw*
Cultured butter
Dill pickles with live culture
Kefir – unsweetened
Kimchee
Miso soup

Micro-algae; chlorella, spirulina
Olives – Kalamata are lowest in carb
Umeboshi – (fermented plum)
Sauerkraut with live culture
Fermented vegetables with live culture
Low-carb yogurt with live culture



*Apple cider vinegar can interfere with digestion; best if taken between meals.

PREBIOTIC-RICH FOODS

Asparagus
Avocado
Cabbage
Cauliflower
Chicory root tea
Garlic
Greens
Green banana

Jerusalem artichokes
Jicama
Kale
Mushrooms
Onions, leeks, scallions
Radishes
Shoots and sprouts



FREQUENTLY ASKED QUESTIONS ABOUT THE CLASSIC AND MODIFIED KETOGENIC DIETS

QUESTIONS	ANSWERS
What is the ketogenic diet?	The ketogenic diet is a special high-fat diet that is used for difficult to treat seizures. Heavy cream, butter and vegetable oils provide the necessary fat. The diet also completely eliminates sweets such as candy, cookies, and desserts. Other carbohydrate rich foods such as bread, potatoes, rice, cereals, and pasta are not allowed on the strictest form of the diet, but are allowed on more liberal forms of the diet. All foods must be carefully prepared and weighed on a gram scale. Each meal must be eaten in its entirety for the diet to be most effective. The Classic diet consists of a ratio in grams of fat to non-fat (protein and carbohydrates) of 4:1 and 3:1. The modified ketogenic diet consists of ratios of 2:1 and 1:1.
Who can be helped by the diet?	Children with seizures from infancy through the teenage years may be helped by the diet. There is no way to predict beforehand whether it will be successful. Traditionally the diet has been used for children with myoclonic, atonic and tonic-clonic seizures. In every decade since the 1920's, studies consistently show that 50-75% of children with difficult to control seizures of all types are helped by the diet. Creative recipes have helped to make the diet more palatable in the past few years.
How effective is the diet at controlling or eliminating seizures?	Four major meta-analyses (reviews of many studies) have been published in the past 10 years and have determined that the ketogenic diet is effective in reducing seizure frequency in children with difficult-to-control epilepsy. A controlled study published in 2008 revealed that seizure frequency after 4 months was significantly lower in 54 children on the ketogenic diet than the control group of children who were on medication therapy.
How does the diet work?	No one is certain how the diet works. A metabolic change occurs in the body which affects brain chemistry. Despite many hypotheses, the mechanism by which the diet works to control seizures remains a mystery. Scientists in several laboratories around the world are working to unlock this mystery with animal studies.
How is the diet prepared?	A calorie level is determined by a dietitian for each child based on their age and activity level. To achieve a desired level of ketosis, the diet is calculated in terms of ratios such as 4:1, 3:1, and 2:1. In a 4:1 ratio, there is 4 times as much fat as there is protein and carbohydrate combined. The dietitian devises meal plans that complete the required fat, protein and carbohydrate for each meal. Each meal plan indicates the exact gram weight of each food which must be weighed on a gram scale. A typical meal includes a small amount of fruit or vegetable, a protein rich food, and a source of fat such as heavy cream and butter or vegetable oil.
Will anti-seizure medications be reduced after my child goes on the diet?	If the child is on more than one anti-seizure medication, one may be reduced as the child starts the ketogenic diet. The reduction of remaining seizure medication may be made if the child's seizures improve over time. Some children are able to have their medications completely discontinued. Medications may act stronger with the ketogenic diet therefore close medical monitoring is necessary.
How do you begin the diet?	The diet is started under close medical supervision. The diet is begun gradually and increased to the full amount over a 3 to 4 day period or longer. During this time blood sugar and ketone levels are monitored. A fasting period is not necessary to start the diet according to recent studies.
How soon does it take for the diet to reduce or eliminate seizures?	The diet can become effective immediately or can take several months. Each child is unique and has different seizure patterns and frequency. There is usually improvement within the first 10 weeks on the ketogenic diet.

FREQUENTLY ASKED QUESTIONS ABOUT THE CLASSIC AND MODIFIED KETOGENIC DIETS

QUESTIONS	ANSWERS
What would happen if my child “cheated” on his/her diet?	If a child ate or drank something that was not part of his/her diet, they could experience a seizure within a short period of time.
Is the diet healthy for my child?	The diet alone does not contain enough vitamins or minerals. A nutritional deficiency could develop without supplements. Special vitamin and mineral supplements are prescribed for each child while on the ketogenic diet. It is also important that the child drink adequate liquids while on the diet.
How long is the diet used for?	The diet is generally used for a period of up to 3 years if it is helpful in reducing or eliminating seizures. If the diet is not helpful, it will be stopped within a few months.
Are there any adverse effects of the ketogenic diet?	The most common adverse effect of the diet is constipation. There are dietary options to prevent this problem including eating high fiber vegetables that are allowed on the diet and drinking enough water. A less common adverse effect is kidney stones. This problem can be prevented by making sure that the child drinks adequate water. There are two anti-seizure medications which can cause acidosis and kidney stones which should be monitored very closely when used with the ketogenic diet (Zonegran® and Topamax®).
Will my child gain too much weight with this high fat diet?	The ketogenic diet is calculated at a specific calorie level for each child. The dietitian will keep track of your child's growth to determine if a change in calories is needed to ensure normal growth.
Will the diet cause high cholesterol?	Most children do not develop high cholesterol levels while on the diet. If a child develops high cholesterol or lipids, the diet can be modified to lower these. Lipid levels are drawn prior to starting the diet and at regular intervals throughout the course of the diet.
Can the diet be used for children with feeding tubes?	The ketogenic diet can be provided to children with feeding tubes. Special ketogenic formulas are designed for this purpose. A dietitian will determine the type and amount of formula for your child.
Are there any special tests that are needed before starting the diet?	There are blood tests that may be needed to determine if the diet is safe for your child. These include metabolic tests to rule-out fatty acid disorders or a carnitine deficiency.

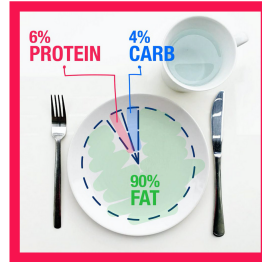
WHAT ARE

KETOGENIC THERAPIES?



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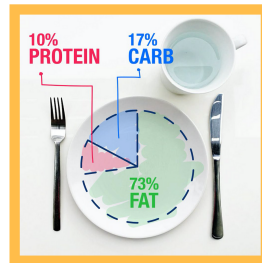
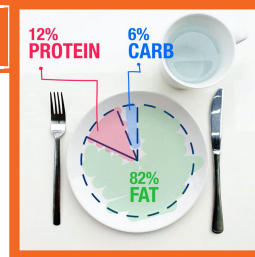
CLASSIC KETO

- An individualized and structured diet that provides specific meal plans. Foods are weighed and meals should be consumed in their entirety for best results.
- Macronutrient Ratio: 4:1 – 3:1

MODIFIED KETO

Modifying the restrictiveness of classic keto can be helpful when starting the diet, tapering down to a more sustainable, long term diet, or to meet the needs of the individual.

Macronutrient Ratio: 2:1 – 1:1



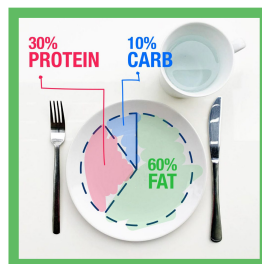
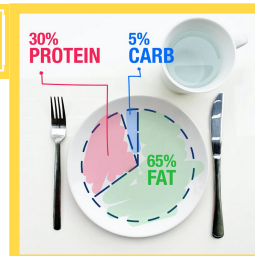
MCT

- An individualized and structured diet containing highly ketogenic Medium Chain Triglycerides (MCT), allowing for more carb and protein than classic keto.
- Macronutrient Ratio: 1:1

MODIFIED ATKINS

Limits the amount of carbohydrate, encourages fat, and does not limit protein. Carbohydrates are to be accompanied by fat when consumed.

Macronutrient Ratio: 2:1



LOW GLYCEMIC INDEX

- An individualized but less structured diet, it uses exchange lists for planning meal and emphasizes complex carbohydrates. It is not intended to promote ketosis.

Macronutrient Ratio: 1:1

LIFESTYLE AND OTHER FACTORS

Ketogenic therapy includes more than just diet. Nutritional supplements, electrolytes, hydration and digestive health are also key. This is where an experienced ketogenic specialist can be extremely helpful. Think the ketogenic diet is right for you? Talk to your doctor before adopting a ketogenic diet, or connect with one of our qualified diet professionals to determine a course of action that is right for you.

COMPARISON OF DIET THERAPIES FOR EPILEPSY

QUESTIONS	Ketogenic Therapies	MCT Oil	Low Glycemic Index Treatment	Modified Atkins
Is medical supervision required	Yes	Yes	Yes	Yes
Is diet high in fat?	Yes	Yes	Yes	Yes
Is diet low in carbohydrate?	Yes	Yes	Yes	Yes
What is the ratio of fat to carbohydrate & protein?	4:1, 3:1, 2:1, 1:1	Approximately 1:1	Approximately 1:1	Approximately 2:1
How much carbohydrate is allowed on a 1000 Calorie diet?	8gm carb on a 4:1 16gm carb on a 3:1 30gm carb on a 2:1 40-60gm carb on a 1:1	40-50gm	40-60gm	10gm adolescents or 15gm adults for 1 month 20gm afterwards
How are foods measured?	Weighed	Weighed or measured	Measured or estimated	Estimated
Are meal plans used?	Yes	Yes	Yes	Optional
Where is the diet started?	Hospital	Hospital	Home	Home
Are calories controlled?	Yes	Yes	Yes	No
Are vitamin and mineral supplements required?	Yes	Yes	Yes	Yes
Are liquids (fluids) restricted?	No	No	No	No
Is a pre-diet laboratory evaluation required?	Yes	Yes	Yes	Yes
Can there be side-effects?	Yes	Yes	Yes	Yes
What is the overall difference in design of these diets?	This is an individualized and structured diet that provides specific meal plans. Foods are weighed and meals should be consumed in their entirety for best results. The ratio of this diet can be adjusted to effect better seizure-control and also liberalized for better tolerance. This diet is also considered a low glycemic therapy and results in steady glucose levels.	An individualized and structured diet containing Medium Chain Triglycerides (MCT) which are highly ketogenic. This allows more carbohydrate and protein than the classic ketogenic diet. A 2008 study showed that both diets are equal in eliminating seizures. A source of essential fatty acids must be included with this diet.	This is individualized but less structured diet than the ketogenic diet. It uses exchange lists for planning meal and emphasizes complex carbohydrates. The balance of low glycemic carbohydrates in combination with fat result in steady glucose levels. It is not intended to promote ketosis.	This diet focuses on limiting the amount of carbohydrate while encouraging fat. Carbohydrate may be consumed at any time during the day as long as it is within limits and should be consumed with fat. Suggested meal plans are used as a guide. Protein is not limited but too much is discouraged



Does what I eat affect my epilepsy?

Sponsored by The Charlie Foundation for Ketogenic Therapies

Studies dating back to the 1920s have shown that diet can improve seizure control in people who have epilepsy. Although these studies are based on a strict diet called the ketogenic diet, recent evidence has shown that less restrictive diets may also be helpful. The Modified Atkins diet and the Low Glycemic Index Treatment are two such diets that have been studied. The common feature of these diets is that they eliminate sugar and all sweets. Nutritionists who counsel people with epilepsy have noted that even simple but consistent diet changes have resulted in improvement in seizure control. These diet changes include steps towards a natural, whole foods diet. They do not require medical supervision and may be adopted by anyone who wishes to improve his or her diet. It may take several days or even a few weeks of consistently eating a healthier diet to affect your epilepsy.

How Do I Begin?

Dietary habits can be hard to change if too many changes are made at the same time. It is also very common for people to get excited about a 'new diet' but lose that enthusiasm after two weeks. Making one change at a time is best. We recommend that you take the time to talk to a family member or friend about your intentions to improve your diet. This will help you to commit to making positive changes. He or she may even join you in this endeavor.

Step One Eliminate Simple Sugars

The first step is a very important one; eliminate foods with a high concentration of simple sugars. This type of carbohydrate has a high glycemic index which means that they are rapidly absorbed into the body. Once you have eliminated these foods completely for several weeks, you may find that you no longer have the desire to eat them. Your body will be more satisfied with whole, natural foods.

Eliminate High Glycemic Index Foods

SWEETENERS

Table Sugar
Honey
Syrups

SWEETENED BEVERAGES

Fruit Juices
Sports Drinks
Soft Drinks
Energy Drinks

SWEETS

Cake
Candy
Cookies
Crackers
Pastries
Pies
Ice Cream Treats

PROCESSED FOODS

Sweetened Cereals
Crackers
French Fries
Pretzels
Rice Cakes
Snack Chips
White Bread & Rolls
White Quick Cooking Rice
Granola and Bars

FRUIT

Dried Fruit
Fruit Roll Ups
Watermelon
Fruited Yogurt

Step Two Eat a Natural, Whole Foods Diet

This is a major step that can be broken down into smaller steps. Eating a diet that consists of whole, natural foods is a very healthy diet. Whole foods are foods that have little or no processing. Minimally processed foods have at most 3 ingredients. If you see a food label listing more than 3 ingredients, you can be sure that it is processed. Whole, natural foods have the highest concentration of nutrients and the least artificial ingredients.



Choose a Whole, Natural Foods Diet

BEVERAGES

Water

Tea

Coffee

TREATS

Nuts

Seeds

PROTEIN

Meat

Poultry

Eggs

Fish

Shellfish

Dairy

CARBOHYDRATES

Vegetables

Fruit

Whole Grains

Legumes

LIPIDS (FATS)

Olive Oil

Butter

Seed Oils

Coconut Oil

Nutrients and Brain Health

Whole Food	Nutrients	Function or Benefits
Water	Hydrogen, oxygen and minerals	These elements are essential to the life of all cells, particularly the brain which is 70% water.
Tea	Flavonoids, Polyphenols (especially green tea)	Anticarcinogenic, anti-inflammatory and immune function benefits.
Coffee	Polyphenols	Stimulant, diuretic, anticarcinogenic. Caffeine can be toxic in large doses.
Nuts & Seeds	A power-source of essential fatty acids including Omega-3 plus vitamins and minerals.	Assists in energy metabolism and cell health, especially important in brain function.
Protein Foods	Amino acids plus vitamins, minerals and fatty acids.	Essential to the formation of all cells including neurotransmitters in the brain.
Carbohydrate Foods	Glucose, vitamins and minerals, fiber, antioxidants, polyphenols, flavonoids, phytochemicals.	Carbohydrate-rich foods provide an easy energy source to cells. The nutrients that are found in whole food carbohydrates are essential enzymes in many biological pathways.
Lipids (Fats)	Fatty acids and Vitamins A, D, and E.	Essential for the health of all cells especially for myelin, the layer around our brain. Vitamin D is extra important for people who are taking anti-seizure medications. Lipids provide an excellent alternate energy source to the brain when carbohydrate is limited. Ketogenic diets include more lipids than carbohydrates. This type of therapy can be a very effective treatment for epilepsy but requires medical supervision.

WHOLE FOODS DIET

Sugar-free, gluten-free, healthy fat



PROTEIN

2–4 ounces of one, or a combination of these at each meal: eggs, fish, poultry, beef, lamb, veal, pork, sausage (without added sugar or dextrose), bacon, aged cheese. The size of a deck of cards is about 3 ounces. One egg is 1 ounce; 2 slices of bacon is 1 ounce.



FAT

2–3 tablespoons of one, or a combination of these at each meal: butter, ghee, olive oil, avocado oil, coconut oil, mayonnaise made from olive oil, Earth's Balance or Smart Balance Spreads, heavy cream. Use a variety each day. Salad dressing made with vinegar and oil for salads and over raw vegetables: 2 tablespoons oil to 2 teaspoons vinegar plus a pinch of oregano or other herb.



Four servings daily: 1/2 cup cooked or 1 cup raw of low carbohydrate vegetables. Cooking methods: steamed in water, or sautéed in butter, avocado oil or coconut oil.



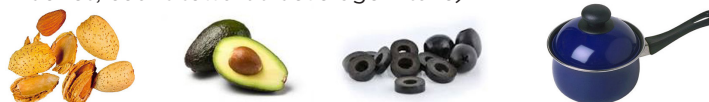
CARBOHYDRATE

Choose one serving at two meals daily (or you can combine half of 2 different servings): 1/4 cup fresh or frozen blueberries or cooked; brown rice, legumes, peas, oat bran, winter squash or quinoa, 1/2 cup fresh or frozen raspberries, blackberries, strawberries, plain full fat yogurt, carrots or turnips.



ADDITIONS

Small amounts of these foods may be included with meals. Avocado (1/4 avocado), black olives (6 olives), nuts or seeds (1 oz.), onions (1 T), garlic (1 t), and home-prepared meat or poultry broth (from bones; count towards beverage intake).



BEVERAGES

Aim to drink 6–8 cups of water daily, substituting up to 1 cup black tea or coffee and 2 cups green or herbal tea (no caffeine for children). Most of your fluid intake should be water. You may also want to try unsweetened; coconut, almond, flax, hemp or cashew milk. Look for brands that have 1gm or less of net carbohydrate (carbohydrate minus fiber) in 8 ounces (240ml). Eliminate sweetened beverages, diet soda, and decaffeinated coffee.

WHOLE FOODS DIET

Sugar-free, gluten-free, healthy fat



DIET TIPS

- Eliminate all sugar and foods that are prepared with sugar (read food labels!).
- Drink 6-8 cups of allowed beverages each day.
- No food or beverage with aspartame, saccharine, sucralose, AceK, sorbitol, mannitol, maltitol, isomalt, dextrose, corn syrup, fructose, coconut sugar or other sugars.
- Eat 3 meals daily. Avoid snacking as it can reduce your appetite for meals.
- Season meals with herbs, spices, salt and pepper as desired. Curry, turmeric, cinnamon, garlic, cumin, ginger and saffron are especially healthy. No monosodium glutamate.
- Nutrition supplements (use quality products) – check with health professional for dosages
 - Multivitamin with mineral supplement
 - Calcium with Vitamin D
 - Vitamin D 2000IU daily if taking anti-seizure medication

Sample Menu

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Eggs and sausage (sugar-free) Cauliflower & onion hash browns Blueberries topped with whipped heavy cream and shaved chilled coconut oil	Greek yogurt topped with fresh whipped heavy cream, raspberries, shaved chilled coconut oil, & cinnamon	Flaxseed, chia and buckwheat porridge** made in almond milk with cinnamon, coconut oil and butter	Crustless quiche prepared with eggs, spinach, onions and heavy cream Almond milk with cinnamon	Greek yogurt with blueberries topped with pan toasted oat bran and chopped almonds topped with chilled shaved coconut oil and cinnamon	Breakfast sausage with buttered brown rice, black beans and sliced avocado	Oat bran & flaxseed porridge** made in almond milk, with butter, macadamia nuts and cinnamon
Baby greens and quinoa salad with celery, feta cheese, sliced radishes and sunflower seeds, drizzled with olive oil & balsamic vinegar dressing	Smoothie made with *protein powder, olive oil, frozen strawberries & baby greens	Spinach and kale salad with chicken dressed with olive oil & vinegar dressing	Tuna salad with peas, celery, radishes, amaranth & avocado rolled up in butterhead lettuce leaves	Smoothie made with *protein powder, olive oil and frozen raspberries & baby greens	Melted cheese over beef patty with coleslaw Greek yogurt with raspberries	Turkey salad with celery and sliced almonds wrapped in butterhead lettuce leaf Greek yogurt with blueberries
Pan fried swai in butter and garlic Buttered broccoli & amaranth	Rosemary baked chicken Buttered asparagus with hollandaise** sauce & quinoa	Roast beef with cheesy cheddar cauliflower	Buttered spaghetti squash with ground turkey marinara drizzled with olive oil and topped with Parmesan cheese	Sautéed onions, celery, broccoli, cauliflower, red peppers and pork loin in olive oil seasoned with curry Buttered brown rice	Pizza; tomato sauce and mozzarella cheese on giant pepperoni slices – broiled Celery sticks with olive oil and vinegar dip	Baked salmon Baby greens salad with sunflower seeds, olive oil and balsamic vinegar dressing

*Look for low-carbohydrate protein powders such as whey protein isolate, or sprouted brown rice.

** Featured recipe on www.charliefoundation.org

WHOLE FOODS DIET

Sugar-free, gluten-free, healthy fat



HIGH-CARBOHYDRATE FOOD	LOW-CARBOHYDRATE ALTERNATIVE
BREAD	Butterhead lettuce; use leaves for sandwich wraps.
CHIPS	Kale chips: Cut flat leaf kale with scissors into credit card-sized pieces, discarding the hard ribs. Place on a waxed paper lined baking sheet and drizzle with 2T olive oil tossing until coated. Bake 350°F for 10 minutes then turn them over & bake for an additional 5-7 minutes. Don't over-bake.
HASH BROWNS	Cauliflower (raw) chopped into small pieces sautéed in olive oil with onions, until browned, season with salt and pepper.
MASHED POTATOES	<ul style="list-style-type: none"> Turnips – peeled, chopped then boiled, then blended with butter & cream. Cauliflower – steamed then blended with butter & cream.
MILK	Unsweetened coconut, almond, flax, hemp or cashew milk.
NOODLES	Cut cabbage into thin strips, boil 5 minutes in water. Smooth skin type, Quintal d'alsace, works best. Drain and serve.
PASTA	Spaghetti squash – halved, seeds removed then roasted cut side facing down for 45 minutes at 350°F. Scoop out strands while warm. Spiralized raw zucchini is another pasta alternative.
WHITE RICE	Cauliflower – shredded then steamed, seasoned with pepper and salt. Warm 1 cup of hemp hearts with 2 Tablespoons water. Serve with butter and a pinch of salt and herbs.
PORRIDGE	Flaxseed, chia seed, buckwheat, oatmeal and, or, hemp seed can be mixed together and cooked with water or a nut milk. Flavor with berries, coconut oil, butter, salt and cinnamon.

Nutrition supplementation with minimal carbohydrate content should be advised by your nutrition professional to complement this diet.

Supplement Brand Name	Morning dose	Mid-day dose	Evening dose	Bedtime dose
Complete Multivitamin and Minerals _____				
Brand Name of Multivitamin				
_____ mg Calcium with Vitamin D _____				
Brand Name of Vitamins				
_____ IU Vitamin D _____				
Brand Name of Vitamin D				

WHOLE FOODS DIET

Sugar-free, gluten-free, healthy fat



Meal Planner – Design up to 3 different options for each meal

Meals	Protein Ounces	Fat Tablespoon (T)	Carbohydrate	
			Low-carb cup(s)	Higher-carb 1/4 or 1/2 cup
SAMPLE MEAL	2 eggs, scrambled	1 T. olive oil to scramble eggs, & sauté mushrooms & spinach 1 T. melted coconut oil mixed with yogurt	1 C raw spinach 1/2 C sliced raw mushrooms	1/4 C raspberries with 1/4 C plain full fat yogurt
Breakfast				
Lunch				
Dinner				



HOME MADE

BETH ZUPEC-KANIA
&
DAWN MARTENZ

A COLLECTION OF HOME MADE KETOGENIC
BREADS, MUFFINS AND CRACKERS

The KetoDietCalculator™

The Ketodietcalculator was designed in 1994 by Beth Zupec-Kania (Registered Dietitian Nutritionist) and David Chase (owner, Lifetime Computing). We have strived to make it user-friendly and supportive of therapeutic goals. Daily maintenance and annual upgrades are added to stay current with technology. A licensed nutritionist must initially register for access. After he/she has created a diet calculation, access can be extended to their clients. This helps ensure the safe and effective use of ketogenic diets. The Charlie Foundation has generously funded this service as a tool to promote professional implementation of ketogenic therapies. Several food companies provide annual sponsorship. The program is used globally and continues to evolve.

HOW TO USE

The recipes in this booklet have been kitchen tested by the authors for taste and ketogenic suitability. The macronutrients for cooked or baked goods are based on the final weight of the recipe to achieve the highest accuracy versus the raw weight of the ingredients. After you have prepared and tasted a recipe, you can incorporate it into the diet. We recommend using them as a "snack" the first time to try out, then add it to a "meal" if you like it. This prevents you from ruining a meal if you don't like it. You'll find the recipe identified by its title as a "food item" in the KetoDietCalculator food list. In other words, the recipes are converted into a food item (as if you bought it at the store) so that you can include it in your meal or snack.

The recipe ingredients are provided in grams to optimize accuracy of macronutrients. A few recipes are also provided in household measure. The Charlie Foundation's Store has an excellent gram scale that measures to a tenth of a gram.

GETTING READY

1. Assemble and weigh out all ingredients before you make a recipe.
2. Weigh all ingredients; weigh dry ingredients in the same container to save time and use less dishes.
3. Use a spatula to scrape ingredient containers clean when transferring food.
4. Liquid ingredients should be measured separately.
5. Although cooking and baking times and temperatures are provided, you may need to adjust temperature to prevent burning. High-fat recipes will cook or bake faster than lower-fat recipes and cooking appliance can vary.

Mission Statment

The Charlie Foundation for Ketogenic Therapies was founded in 1994 to provide information about diet therapies for people with epilepsy, other neurological disorders and select cancers. Charlie Abrahams continues to be the inspiration for the foundation. He's been seizure-free for 20 years proving that Epilepsy can be cured through Ketogenic Therapy.



Charlie
FOUNDATION

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Almond Bread

This almond bread is light and is a good "sponge" for soaking up oil such as a vinaigrette with a salad.



Ingredients

- 150 grams (1-1/2 cup) almond flour
- 300 grams (6 large) eggs - (198 grams whites; 102 grams yolks)
- 56 grams (4 tablespoons) butter
- 14 grams (3 teaspoons) baking powder - Calumet™ or Magic™
- 0.3 grams (1/4 teaspoon) cream of tartar
- 1/2 teaspoon salt

Directions

1. Preheat oven to 350° fahrenheit.
2. Separate egg whites from yolks placing whites in mixing bowl to beat.
3. Add cream of tartar to whites and beat until soft-stiff peaks form.
4. Combine egg yolks, melted butter, almond flour, baking powder and salt. This may be done in a food processor. Dough will be lumpy; avoid over-mixing which will cause the dough to become stiff.
5. Fold half of the egg whites into the almond mixture.
6. Add remaining half of egg whites and mix well.
7. Pour dough into a buttered bread pan.
8. Bake 30 minutes or until top is uniformly golden-brown. Cut into the desired serving size.

Almond Cream Cheese Bread

This bread has the look and texture of a pound cake. It can be sliced and toasted.



Ingredients

- 224 grams Philadelphia Brand Cream Cheese™ - softened
- 113 grams butter - softened
- 200 grams raw mixed egg
- Optional - 3gm Splenda™, No Calorie Sweetener, Granular
- 8 grams baking powder- Calumet™ or Magic™
- 2 grams salt
- 360 grams almond flour or whole blanched, ground almonds

Directions

1. Preheat oven to 325° fahrenheit. Prepare a 1-1/2 quart loaf pan with spray oil.
2. Blend first 3 ingredients together.
3. Mix remaining (dry) ingredients together.
4. Fold dry ingredients into the batter.
5. Pour evenly into baking pan.
6. Bake for 50-60 minutes or until toothpick inserted in center comes out clean.
7. Cool in pan on a wire rack for 15 minutes, then invert onto a serving plate. Weigh desired serving size.

Banana Bread

This is my family's favorite keto bread. Bananas aren't a keto food on their own, but mixed with ample fat makes this ketogenic.



Ingredients

- 300 grams banana – yellow, not brown (approximately 3 medium.
- 180 grams (3 ½) eggs, raw, mixed well
- 50 grams (3 ½ tablespoons) olive oil
- 200 grams (1 ¾ cup) almond flour, blanched - ground
- 60 grams (¼ cup) pecans, raw - chopped
- 5 grams (1 teaspoon) baking powder - Calumet™ or Magic™
- 2.5 grams (1/2 teaspoon) baking soda

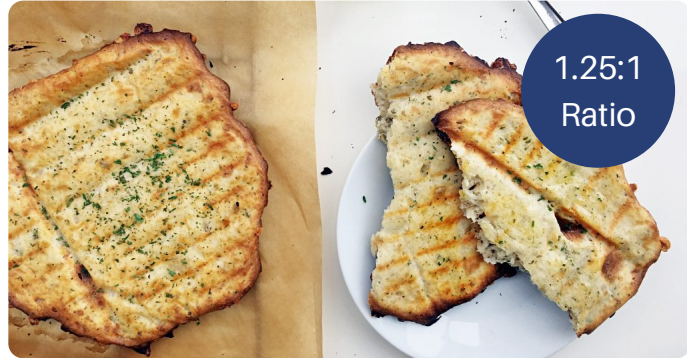
Directions

1. Preheat oven to 350° fahrenheit.
2. Grease a loaf pan with coconut oil.
3. Add all ingredients in a mixing bowl and mix on high until combined and batter is the consistency of a cake batter.
4. Pour batter into greased loaf pan. Bake for 45-50 minutes or until browned and a toothpick comes out clean.

Flatbread

Use this recipe for making sandwiches or pizza.

Recipe Makes 1: 8-9 inch flatbread - 141gm



Ingredients

- 75gm Mozzarella cheese part skim, shredded
- 50gm egg, raw mixed well
- 35gm Philadelphia Brand Cream Cheese™, room temperature
- 10gm olive oil
- 2.5gm coconut flour - Bobs Red Mill™
- Optional: salt, pepper, dried Italian herbs, garlic powder,
- 0.1g xanthan gum

Directions

1. Pre-heat the oven to 350° fahrenheit. Line a baking sheet with parchment paper.
2. Combine the egg and the room temperature cream cheese. Stir with a fork until well combined.
3. Add the remaining ingredients and stir very well.
4. Spread the mixture onto the parchment paper into an 8-inch circle. Make it the size and thickness you want, it will not spread while baking.
5. Bake for about 25-30 minutes in the center of the oven. You may flip the flatbread over during the last 10 minutes of cooking to help both sides crisp.

Flax Bread

This is a high-fiber, heavy, moist bread that is baked flat in a pan and cut into pieces (like a brownie). It tastes great warm with butter spread over it. It also makes a great base for Eggs Benedict or creamed chicken.



Ingredients

- 35 grams (2 T + 2 teaspoons) almond meal (almond flour) - Bob's Red Mill™
- 40 grams (3 tablespoons) flaxseed meal (whole ground flaxseed)
- 4 grams (1 teaspoon) baking powder-Calumet™ or Magic™
- 1.5 grams (¼ teaspoon) salt
- 2 grams (1/2 teaspoon) vinegar, white distilled (any brand)
- Optional: 4 drops liquid Stevia (such as NOW Stevia™)
- 85 grams (1½) raw mixed egg
- 31 grams (2 tablespoons) coconut oil, melted or 37gm butter, melted

Directions

1. Mix together dry ingredients.
2. Mix together wet ingredients.
3. Stir wet ingredients into dry ingredients.
4. Spread into a lightly greased 8" x 8" pan.
5. Bake at 350° fahrenheit for 8–10 minutes. Cut with a knife then lift with a spatula.

Keto Bakery Bread (mix)

We included this bread because it is quite delicious and created by Keto Hope Foundation, a non-profit organization that supports epilepsy research. The mix can be purchased from their website (ketohope.org). It can be slice and toasted.



Ingredients

- 1 package bread mix from Keto Hope Bakery™
- 200 grams (4 large) eggs
- 188 grams (13 tablespoons + 1 teaspoon) unsalted butter

Directions

1. Preheat oven to 375° fahrenheit.
2. Mix ingredients thoroughly and pour into a lined 8X4 loaf pan.
3. Bake for 35-40 minutes or until golden brown on top.

High Fiber Rolls

You will enjoy smelling the aroma of these soft rolls. The recipe has minor modifications in 3 ingredients to achieve different ratios



Ingredients

Ingredients	Ingredient gram weights			
	1:1	2:1	3:1	4:1
Egg – raw, mixed well	50	50	50	50
Sunflower or avocado oil	4	13	24	35
Apple cider vinegar	4	4	4	4
Water	25	16	5	0
Flaxseed meal	13	13	13	13
Psyllium husks	12	12	12	12
Baking powder - Calumet™ or Magic™	1	1	1	1
Baking soda	1	1	1	1
Salt	<u>pinch</u>	<u>pinch</u>	<u>pinch</u>	<u>pinch</u>

Directions

1. Pre-heat oven to 300° fahrenheit.
2. Mix the egg, oil and vinegar & water together.
3. Add the flax meal, psyllium husks, baking powder, baking soda and salt to the egg mixture. Use a small spatula to combine the ingredients very well.
4. Once the ingredients are combined, let the dough rest for 5 minutes. It will appear very wet, but as it sits, the dough will firm up to the consistency of stiff oatmeal.
5. Line a baking sheet with parchment paper. Divide the dough into 4 equal portions. You may weigh them on the scale for accuracy (total weight of ingredients in raw state divided by 4).
6. Use wet hands (to prevent sticking) and shape the dough as desired. Place them on the baking sheet and bake for 30 minutes.

Note: Prepare the recipe then after cooling, weigh the amount desired. You may make a large batch such as 10 times this amount; add a zero after each ingredient to easily increase by 10.

Muffin in a Mug

This is a quick breakfast meal that can satisfy your protein goals too. Make it in a mug or make a large batch in muffin tins and bake at 325F for 10-12 minutes



Ingredients

- 30 grams Flaxseed meal (whole ground flaxseed)
- 30 grams Egg, raw - mixed well
- 15 grams Sour Cream, cultured (not low-fat)
- 21 grams Butter
- 1 grams Baking powder – Calumet™ or Magic™
- Optional - 0.5gm Splenda™ (powder)
- 0.5 grams Cinnamon, ground
- A pinch of salt

Directions

1. Place the butter in a small coffee mug then microwave for a few seconds to melt.
2. Rotate cup to coat insides of cup with butter.
3. Place remaining ingredients in cup and mix well with a small spatula.
4. Microwave for 1 minute. Let cool then serve with a spoon or remove from cup and cut into slices.

Note: Makes approximately 83gm cooked and cooled.

Muffin – Macadamia Nut

Make a double batch of these and keep them in the freezer. They reheat beautifully in the microwave!



Ingredients

- 178 grams butter
- 100 grams almond flour
- 100 grams macadamia nuts, ground into butter
- 25 grams coconut flour
- 93 grams egg, raw mixed well
- 10 grams Truvia™
- 2 grams baking powder – Calumet™ or Magic™
- 5 grams cider vinegar
- 2 grams baking soda (not calculated in)
- vanilla extract (not calculated in, use any flavorings you would like)
- pinch of salt only if using unsalted butter

Directions

1. Pre-heat the oven to 350° fahrenheit
2. Weigh the butter in the bowl then melt the butter it in the microwave.
3. Add the coconut flour, almond meal and macadamia nuts to the melted butter and stir until all the lumps are gone.
4. Add all of the remaining ingredients and blend this together very well. The batter will be on the stiff side.
5. Divide the dough into 10 silicone muffin liners. You can use wet fingers to smooth out the tops of the muffins if you want.
6. Bake the muffins for about 18-20 minutes. A toothpick should come out clean when inserted into the center of the muffins.

Oopsie Rolls

Use this recipe as a wrap for making sandwiches or crust for pizza. This recipe makes six - 5" diameter flat rolls, each approximately 24gm after baking.



Ingredients

- 108 grams egg white - raw
- 48 grams egg yolk - raw
- 84 grams Philadelphia Brand Cream Cheese™ - room temperature
- 1 pinch of Cream of Tartar (this does not even register on a 0.0gm scale)
- 1 pinch of salt

Directions

1. Preheat oven to 300° fahrenheit.
2. Add Cream of Tartar to egg whites then beat in a mixer until stiff.
3. Using a mixer, beat the egg yolk and salt into the cream cheese. You may need to press out lumps of cream cheese with a spatula.
4. Fold the egg yolk mixture into the whites until mixture is fairly smooth.
5. Spray a cookie sheet with non-stick spray and spoon the mixture onto the sheet, making 6 mounds. Flatten each mound slightly.
6. Bake about 30 minutes or until golden brown. Let cool on the sheet for 10 minutes then remove.
7. Store in a zip-lock bag or wrap in plastic wrap. May be frozen.

Oopsie rolls made with Splenda™

Use this recipe as a wrap for making sandwiches or crust for pizza. This recipe makes six - 5" diameter flat rolls, each approximately 24gm after baking.



Ingredients

- 108 grams egg white - raw
- 48 grams egg yolk - raw
- 84 grams Philadelphia Brand Cream Cheese™ - room temperature
- Optional: 1gm Splenda™ (or 1 packet)
- 1 pinch of Cream of Tartar -Calumet™ or Magic™ (this does not even register on a 0.0gm scale)
- 1 pinch of salt

Directions

1. Preheat oven to 300° fahrenheit.
2. Add Cream of Tartar to egg whites then beat in a mixer until stiff.
3. Using a mixer, beat the egg yolk and salt into the cream cheese. You may need to press out lumps of cream cheese with a spatula.
4. Fold the egg yolk mixture into the whites until mixture is fairly smooth.
5. Spray a cookie sheet with non-stick spray and spoon the mixture onto the sheet, making 6 mounds. Flatten each mound slightly.
6. Bake about 30 minutes or until golden brown. Let cool on the sheet for 10 minutes then remove.
7. Store in a zip-lock bag or wrap in plastic wrap. May be frozen.

Unbuns

This recipe is similar to Oopsie rolls but a bit fluffier.



Ingredients

- 132 grams egg whites (whites of 4 eggs)
- 68 grams egg yolk (yolks of 4 eggs)
- 77 grams Cream Cheese, WHIPPED Original - Philadelphia™
- 0.7 grams (1/4 t.) Cream of Tartar-Calumet™ or Magic™

Directions

1. Preheat oven to 300° fahrenheit.
2. Separate the eggs very carefully; there must be no yolk in the white.
3. In one bowl, mix together the egg whites and the cream cheese.
4. In a mixing bowl, add cream of tartar and egg whites; beat on high speed until they are fluffy and form stiff peaks when the whip is removed.
5. Carefully fold the egg yolk mixture into the whites. Try not to break down the fluffiness of the whites too much.
6. Spray 2 cookie sheets with oil.
7. Use a Tablespoon to scoop the mixture into even rounds; 10 rounds of approximately 3 inches in diameter for large bread slice sized buns or 20-25 rounds for smaller sized buns.
8. Bake in the middle of the oven for 30-35 minutes until browned like a hamburger bun.
9. Remove from the pans and cool on a rack or cutting board.
10. Store in a zip-lock bag or sealed container.

Almond Crackers

A mild tasting crisp cracker that you can top with butter or spreads. After you try them you can make a big batch by multiplying all ingredients by 10.



Ingredients

- 30 grams almond flour (whole ground blanched almonds)
- 20 grams macadamia nuts, dry roasted with salt - finely ground in a food processor
- 15 grams olive oil
- 15 grams egg white - raw
- 1/8th teaspoon salt (optional)

Directions

1. Mix together all ingredients until dough becomes stiff.
2. Line a cookie sheet pan with parchment paper. Spread dough thin into an approximate 8 x 6 inch rectangle by patting dough flat with a spatula.
3. Using a spatula, cut a grid into the dough to form approximately equal cracker squares or the shape you desire.
4. Bake at 325° fahrenheit for 10-12 minutes or until golden brown.
5. Allow to cool before removing from pan. Store in a zip-lock bag or airtight container for up to 3 days or freeze.

Flax Hemp Crackers

A grainy cracker for butter or other spreads. Recipe makes approximately thirty, 8 gram crackers



Ingredients

- 120 grams flaxseed
- 120 grams water
- 120 grams hemp seeds
- 20 grams olive oil
- 5 grams (4 tsp) Forward Seasoning – Penzeys™

Directions

1. Mix water into flaxseed and allow to sit for 5 minutes.
2. Stir hemp seed, olive oil and seasoning into mixture.
3. Spread on greased baking sheet such as a rimmed 15x10 inch jelly roll pan.
4. Pat down firmly with a large spatula to flatten to the edges.
5. Optional: score into crackers of desired size with a knife.
6. Bake at 300° fahrenheit for 20-30 minutes. Test for crispness by breaking off a piece with a spatula. Allow to cool before removing from sheet.
7. Store in zip-lock bag. May be frozen.

Parmesan Crisps

This is a salty, crisp, low ratio cracker intended to be dipped into butter or spreads. Prior to cooling, you can drape cooked rounds over a bowl and they will harden into crisp bowls, perfect for filling with salad!



Ingredients

- 30gm fresh grated parmesan cheese
- Pepper (optional)

Directions

1. Preheat oven to 400° fahrenheit.
2. Line a large baking sheet with parchment paper or use an oven safe mini muffin silicone muffin pan.
3. Spoon cheese into 8 mounds 2 inches apart on prepared baking sheet.
4. Spread each mound to a 2-inch diameter.
5. Sprinkle mounds lightly with pepper (optional).
6. Bake at 400° for 6 to 8 minutes or until crisp and golden.
7. Cool completely on baking sheet or in muffin tin. Remove from baking sheet using a thin spatula. Store in airtight container.

Note: The calculations for this take into account the fat that sticks to the paper and the loss of moisture during baking.



Practice Paper of the Academy of Nutrition and Dietetics: Classic and Modified Ketogenic Diets for Treatment of Epilepsy

ABSTRACT

Ketogenic diet (KD) therapy is an established form of treatment for both pediatric and adult patients with intractable epilepsy. *Ketogenic diet* is a term that refers to any diet therapy in which dietary composition would be expected to result in a ketogenic state of human metabolism. While historically considered a last-resort therapy, classic KDs and their modified counterparts, including the modified Atkins diet and low glycemic index treatment, are gaining ground for use across the spectrum of seizure disorders. Registered dietitian nutritionists are often the first line and the most influential team members when it comes to treating those on KD therapy. This paper offers registered dietitian nutritionists insight into the history of KD therapy, an overview of the various diets, and a brief review of the literature with regard to efficacy; provides basic guidelines for practical implementation and coordination of care across multiple health care and community settings; and describes the role of registered dietitian nutritionists in achieving successful KD therapy.

J Acad Nutr Diet. 2017;117:1279-1292.

SINCE ANCIENT TIMES, PRO-longed periods of fasting have been used to treat epilepsy.¹ The first modern reports using fasting in epilepsy were by the French physicians Guelpa and Marie in 1911² and by Dr. H. Rawle Geylin, an American endocrinologist at New York Presbyterian Hospital.³ Researchers at the Harvard Medical School were the first to report improvements in seizure control after 2 to 3 days of fasting, proposing that a change in metabolism occurred in the absence of food,

specifically carbohydrate, forcing the body to utilize fat for energy.⁴

Two parties first conceptualized the modern-day ketogenic diet (KD) independently in 1921.⁴ Woodyatt⁵ of Rush Medical College in Chicago noted that the ketones acetone and β -hydroxybutyric acid were formed through starvation on a diet low in carbohydrate and high in fat. Dr R.M. Wilder of the Mayo Clinic, in Rochester, MN,^{6,7} proposed that a special diet be utilized for the treatment of seizures in efforts to achieve ketosis without inducing malnutrition that occurs with prolonged starvation. This was the origin of the classic KD.⁴

Ketogenic diet is a term that refers to any diet therapy in which dietary composition would be expected to result in a ketogenic state of human metabolism. A KD is generally defined as a high-fat, low-carbohydrate, moderate protein diet that aims to force the body to breakdown fat instead of glucose, both which provide adenosine triphosphate synthesis, essentially mimicking the metabolic state of starvation or fasting. KDs do not actually induce starvation; instead, they are precisely calculated to maintain adequate nutrient intake to prevent the malnutrition associated with starvation, therefore, ensuring healthy growth and development.⁸ Calculations for classic KDs to this day remain

similar to those first proposed by the Mayo Clinic group⁹—approximately 1 g protein/kg of body weight, 10 to 15 g carbohydrate/day, and the remaining calories from fat.

Use of KDs was common practice in the treatment of epilepsy through the 1920s and 1930s until the discovery of phenytoin in 1938.⁴ As pharmaceuticals grew in number, the KD fell out of favor due to the perceived complexity of adherence. Although there was brief interest in a version of the KD rich in medium-chain triglycerides (MCT) in the 1980s, this was short-lived due to the gastrointestinal side effects of a diet composed of 60% total calories from MCT oil.¹⁰ In 1994, the KD therapy grew in popularity after a highly publicized story, and eventual movie titled *First Do No Harm*, about a boy who quickly became seizure-free on the KD.⁴ The resurgence in use of the KD led to the development of less-restrictive versions of the classic KD intended to enhance compliance; these diets are known as the Modified Atkins Diet (MAD)^{11,12} and the low glycemic index treatment (LGIT).¹³

OVERVIEW OF EPILEPSY

Epilepsy is a chronic neurologic disorder that causes seizures, or a disruption in the electrical communication of the brain.¹⁴ While seizures are considered a

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<http://dx.doi.org/10.1016/j.jand.2017.06.006>

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symptom, epilepsy has been defined as having two or more unprovoked seizures at least 24 hours apart.¹⁵

According to the Epilepsy Foundation, 65 million people have epilepsy worldwide,¹⁴ of which one-third are considered to have uncontrolled seizures that are refractory (uncontrollable) to standard medical treatment.¹⁴ Although the etiology is often unknown, possible causes outside of mitochondrial and genetic disorders include an insult to the brain, such as traumatic brain injury, central nervous system tumors, infections, and substance abuse.¹⁴

Determining the type, duration, and intensity of the seizures is important in the diagnosis and treatment of epilepsy. Classification can be complicated, although two broad categories exist—primary generalized seizures and partial seizures. Primary generalized seizures involve the entire brain, beginning with widespread abnormal electrical activity, and can be characterized as either tonic-clonic or absence seizures. During tonic-clonic (convulsive) seizures, consciousness is lost and involuntary movement occurs,¹⁴ whereas during absence seizures, the individual may lose awareness and appear to be dazed.¹⁴ Partial seizures involve only one area of the brain, with symptoms varying depending on the area affected. Partial seizures can be classified as either

simple, where consciousness is maintained, or complex, where consciousness is lost, followed by a period of confusion. The type of seizure(s) and location of origin in the brain are often the main determinant of treatment.¹⁴ While some seizures can be controlled by anti-epileptic drugs (AEDs), others are considered refractory, and may require treatment via alternative treatment modalities, including diet therapy, surgical resection, and vagal nerve stimulation.

OVERVIEW OF KD THERAPY

Potential Mechanisms of Action

Although mechanism(s) by which the KD impacts seizure control are not completely understood, results from rodent and human studies offer multiple hypotheses, which can be classified into two categories: 1) alterations in energy metabolism, including a decrease in glucose concentration with an increase in fatty acid oxidation and ketone production; and 2) alterations in neurotransmitter production, release and uptake.^{16–18}

Alterations in Energy Metabolism. As dietary carbohydrates are reduced, blood glucose decreases and ketone levels rise. Figure 1 offers a visual depiction of differences in fuel sources between a typical Western diet and a KD. The KD reduces the supply of glucose,

decreasing glycolysis and due to adequate energy intake by way of fat consumption, prevents gluconeogenesis, resulting in increased β -oxidation, and a rise in ketone bodies, which become the main energy source for neurons.¹⁶ Decreased glycolysis alone has been found to play a role in seizure reduction, with increased seizure activity noted with reintroduction of carbohydrates and subsequent rise in glycolysis.¹⁹

As carbohydrate intake decreases and fat intake increases on a KD, blood glucose stabilizes, and ketone production from both endogenous and dietary sources rise, offering a steady fuel source for the neurons, decreasing the likelihood of disruptions in energy availability.^{8,17,19} The liver produces three types of ketone bodies, including β -hydroxybutyrate (BOHB), which is measured in the serum; acetoacetate, measured in the urine; and acetone, measured on the breath.

Alterations in Neurotransmitters. The second mechanism by which KDs may reduce seizure activity is through alterations in neurotransmitters, in manners similar to AEDs in many cases. Ketone bodies, specifically acetoacetate and BOHB,²⁰ have been found to inhibit γ -aminobutyric acid receptor-induced seizures.²¹ KDs have been found to increase production and synaptic release of γ -aminobutyric acid, thereby reducing neuronal excitation and seizure activity by decreasing the conversion of glutamate to aspartate,^{22,23} as well as potentially blocking neuronal uptake of glutamate through the presence of serum acetoacetate.²⁰ In addition, BOHB and acetoacetate may result in membrane hyperpolarization due to increases in adenosine triphosphate potassium channel activity, potentially reducing the release of neurotransmitters, and inhibition of action potentials.²² Furthermore, ketones have been found to reduce reactive oxygen species and inflammation that results from seizure activity.²⁴

Although no one mechanism has conclusively been deemed responsible for improved seizure control experienced with KD therapy, these mechanisms likely work in conjunction to control seizures in those who are affected by epilepsy.

Types of KDs

All KDs aim to reduce net carbohydrate intake and increase fat intake to

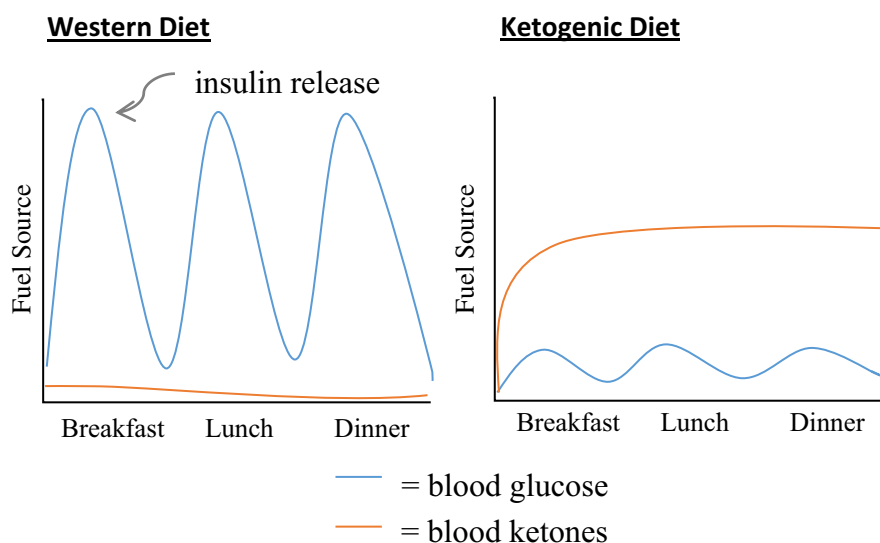


Figure 1. Variation in primary fuel source between a typical Western diet and a ketogenic diet. On a traditional Western diet, blood glucose rises after carbohydrate-rich meals (left), while on a ketogenic diet, carbohydrate intake is limited to only small quantities of those with low glycemic response, resulting in rises in serum ketone concentrations (right).

alter energy metabolism. Several variations of the KD have been found to be successful in the treatment of epilepsy; including the classic KD, MAD, MCT diet, and LGIT. Macronutrient composition of each diet in comparison to the 2015-2020 Dietary Guidelines for Americans can be found in Table 1,^{25,26} along with a sample 1,700-kcal menu for the classic KD, MAD, and LGIT in Tables 2, 3, and 4.

Classic KD and MCT Diet. The classic KD is the most restrictive, requiring all foods and beverages be carefully calculated and precisely weighed on a gram scale.^{8,27} The classic KD offers higher ketogenic potential and are prescribed as a ratio of grams of fat to combined grams of carbohydrate and protein, generally as 4:1 or 3:1, but also as low as 2:1, 1:1 ratios; while MAD, LGIT, and MCT, are typically ratios of 2:1 or 1:1. Ratios refer to grams of fat to combined grams of carbohydrate and protein (Table 1).

The MCT diet is more liberal in carbohydrates than the classic KD due to high intake of ketone-boosting MCT-rich fats, comprising up to 60% of total calories with a slightly more liberal carbohydrate content. Consumption of MCTs results in higher ketogenic potential due to ease of digestion and absorption, as they do not require bile salts for digestion; instead, MCTs are absorbed directly through the enterocyte, rapidly transported into portal circulation, and subsequently converted to ketones by the liver.⁸ Use of

the MCT diet is less common and sometimes limited by the unpleasant gastrointestinal side effects with consumption of high concentrations of MCT oil. Instead, smaller amounts of MCTs are incorporated into other versions of the KD to enhance ketosis. Due to limited use of the MCT diet, this paper will focus primarily on the classic KD, MAD, and LGIT.

MAD and LGIT. In the early 2000s, the MAD was first utilized at Johns Hopkins Hospital, and later the LGIT at Massachusetts General Hospital in efforts to ease implementation and adherence to KDs. These diets do not require gram scales; instead, portions are measured through standard household measurements. On the MAD, net daily carbohydrate intake is limited to 10 to 15 g for pediatric patients and 20 g among adolescents and adults,^{11,12} while on the LGIT, daily carbohydrates are limited to 40 to 60 g/day from foods with a glycemic index <50 to prevent rapid changes in blood glucose and insulin levels.¹³ Carbohydrates are encouraged to come from foods with high fiber contents, such as nonstarchy vegetables, nuts, and seeds. Although protein is not restricted on either version, intake above the needs of the average adult (0.8 to 1.2 g/kg actual or adjusted weight for an adult)²⁸ or above the dietary reference intake for age in pediatrics and adolescents may impact ability to maintain ketosis. Fat is encouraged on the MAD diet and the LGIT, ideally composing

60% to 70% of total calories.^{8,27} Multi-vitamin and mineral supplementation is also recommended for patients on MAD and LGIT and will be discussed in greater detail later in the paper (Figure 2).

Efficacy

Impact on Seizure Frequency. While a comprehensive review is beyond the scope of this paper, results from two recent reports^{29,30} offer insight into the benefits of KDs. Generally, efficacy is reported as a $\geq 50\%$ improvement in seizure frequency, which is consistent with measures of efficacy among pharmaceutical outcome research for epilepsy. The KD and its variations may be effective for approximately half of those who trial it for drug-resistant epilepsy. A randomized clinical trial published in 2008²⁹ revealed that 44% of children had $\geq 50\%$ improvement in seizure control. A systematic review of randomized controlled trials conducted among 427 children and adolescents indicate that when following a 4:1 classic KD, seizure freedom was observed in up to 55% of patients after 3 months of KD therapy and 85% reported seizure reduction.³⁰ Seizure freedom was achieved in 10% of children following an MAD, with 60% reporting a reduction in seizure activity. Outcomes for adults are more challenging to generalize due to limited publications; however, findings from a recent meta-analysis indicate that among 270 adults with intractable epilepsy, 52% of those following a

Table 1. Comparison of macronutrient composition and initiation requirements between various ketogenic diets and the 2015-2020 Dietary Guidelines for Americans^a

Diet	Fat	Carbohydrate	Protein	Hospital admission
	← range (%) →			
2015-2020 Dietary Guidelines for Americans	20-35	45-65	10-35	No
Ketogenic diet ratio^b				
4:1	90	2-4	6-8	Yes
3:1	85-90	2-5	8-12	Varies ^c
2:1	80-85	5-10	10-15	Varies ^c
Modified Atkins diet (1:1 ratio^b)	60-65	5-10	25-35	No
Low glycemic index treatment (1:1 ratio^b)	60-70	20-30	10-20	No
Medium-chain triglyceride diet (1:1 ratio^b)	60-70	20-30	10	Yes

^aBased on data from The Charlie Foundation for Ketogenic Therapies²⁵ and US Department of Health and Human Services.²⁶

^bRatio refers to grams of calories from fat: carbohydrate+protein.

^cAdmission requirement may vary based on institution.

Table 2. Sample menu for the classic 3:1 ketogenic diet^a

	Grams net carbohydrate	Fat (in grams)
Breakfast		
Egg Scramble (To prepare: Melt butter in frying pan; scramble all items together on medium heat.)		
71 g raw egg mixed well	0.51	6.75
17 g heavy cream	0.51	6.12
28 g butter	0.02	22.71
29 g feta cheese	1.2	6.17
21 g spinach	0.3	0.08
10 g mushrooms, chopped	0.23	0.02
10 g olive oil	0	22.71
Breakfast Subtotal:	2.76	64.56
Lunch		
Cobb Salad (To prepare: Toss all salad ingredients together in a bowl, top with olive oil and red wine vinegar.)		
72 g mixed greens	0.9	0.22
18 g avocado, sliced	0.33	2.77
68 g hard-boiled egg, chopped	0.76	7.21
14 g finely chopped bacon	0.42	6.3
15 g hard cheese shredded	0.27	4.55
31 g olive oil	0	31
15 g red wine vinegar	0	0
Lunch Subtotal:	2.68	52.05
Dinner		
Chicken and Zucchini "Pasta" (To prepare: Slice zucchini thinly into "noodles" and sauté in olive oil. Mix half the pesto into the zucchini and spread the other half on top of chicken. Basil Pesto recipe available at Ketodietcalculator.org)		
39 g baked chicken breast	0	1.4
80 g sliced or spiraled zucchini	1.69	0.26
28 g olive oil	0	28
32 g basil pesto	0.62	16.7
Dinner Subtotal:	2.76	46.36
Snacks		
Celery & Cream Cheese		
10 g stalk of celery, sliced	0.14	0
30 g full-fat cream cheese	1.1	10.3
Snacks Subtotal:	1.24	0
Daily Total:	9.44	173.27

^aApproximate daily total: 1,700 kcal; 173.27 g fat : 9.44 g net carbohydrate + 45 g protein = 3:1 diet ratio. Nutrition information obtained from: www.ketodietcalculator.org.

classic KD and 34% on the MAD experienced $\geq 50\%$ reduction in seizure frequency.³¹ The authors concluded that diet compliance (defined as either self-reported positive urinary ketosis or by diet recall) was higher among those following MAD (56%) compared to classic KD (38%).³¹ While efficacy rates vary, possibly due to fluctuations in compliance, populations that may experience higher success rates include patients with West syndrome and Lennox Gastaut syndrome.²⁸ Generally, classic KDs offer slightly higher efficacy, however, compliance is greater among modified KDs, such as MAD and LGIT, and therefore may be a better long-term therapy, particularly among those older than 2 years of age.

Limitations. Although current research regarding efficacy of the KD on seizure control among the pediatric population has been well established, results among use for seizure control in adults are limited by small sample sizes, lack of randomization, heterogeneity, high attrition rate, short study duration, and lack of description of dietary intake. Larger randomized controlled trials using various types of KDs are needed to better describe the benefits of KD therapy, particularly among adults with epilepsy. More research is needed to describe other potential benefits and side effects of KDs, including impact on seizure severity, quality of life, and long-term effects on health, as these diets become more common among the adult population. In addition, a detailed description of actual foods consumed by those on a KD (vs simple macronutrient breakdown) is needed to better understand how to achieve success and provide the most healthful therapy with the fewest complications.

KD Team Members

A well-trained, interdisciplinary team of health care practitioners is needed to initiate, manage, and best meet the complex and varying needs of patients on KD therapies. This team should include a neurologist and a nurse and registered dietitian nutritionist (RDN) both specializing in KDs, and should also include other clinical and community-based RDNs, epileptologists, nurses, nurse practitioners, pharmacists, social workers, case

Table 3. Sample menu for the modified Atkins diet^a

	Grams net carbohydrate	Fat (in servings ^b)
Breakfast		
Egg Scramble (To prepare: Melt butter in frying pan; scramble all items together on medium heat.)		
2 large eggs	1	1
2 Tbsp heavy cream	1/2	1
1 Tbsp butter	0	1
1/4 cup feta cheese	2	1/2
1/2 cup spinach	1/2	0
1/2 cup mushrooms, chopped	1	0
Breakfast Subtotal:	5	3 1/2
Lunch		
Cobb Salad (To prepare: Toss all salad ingredients together in a bowl, top with olive oil and red wine vinegar.)		
1 1/2 cups mixed greens	1/2	0
1/2 cup avocado, sliced	2	1
1 hard-boiled egg, sliced	1	1/2
1 Tbsp finely chopped bacon	0	1/2
1/4 cup blue cheese or cheddar cheese, shredded	1	1
2 Tbsp olive oil	0	2
1 Tbsp red wine vinegar	0	0
Lunch Subtotal:	4 1/2	5
Dinner		
Chicken and Zucchini "Pasta" (To prepare: Slice zucchini thinly into "noodles" and sauté in olive oil. Mix half the pesto into the zucchini and spread the other half on top of chicken.)		
1 medium baked chicken breast	0	0
1 cup sliced or spiraled zucchini	2 1/2	0
1 Tbsp olive oil	0	1
2 Tbsp pesto	1	1
Dinner Subtotal:	3 1/2	2
Snacks		
Celery & Cream Cheese		
1 stalk of celery, sliced	1	1
2 Tbsp full-fat cream cheese	2	0
Sugar-Free Gelatin, 1/2 cup	1/2	0
Snacks Subtotal:	3 1/2	1
Daily Total:	16 1/2	11 1/2

^aApproximate daily total: 1,700 kcal, 16 1/2 g net carbohydrate, 75 g protein, 150 g fat (11 1/2 servings).^b1 serving=14 g of fat.

managers/discharge planners, and families. Case managers can be an important part of the diet therapy team when it comes to planning for patient discharge and establishing connections with durable medical equipment providers for patients receiving enteral or parenteral nutrition to ensure necessary product and equipment is provided. In some settings, the nutrition and dietetics technician, registered, under the supervision of the RDN, can function in support of the RDN by working as a liaison between foodservice and the RDN concerning the delivery of food and nutrition services to patients on KD therapy.

Successful KD implementation requires good interaction among the KD team, the patient, and his or her support systems. The importance of caregivers and family support is critical for success. They provide not only social support and encouragement, but often implement the KD, and therefore must have a firm grasp on not only the diet, but also how to identify and act quickly to minimize symptoms of intolerance and prevent a potential complication.

PRACTICAL IMPLEMENTATION

In 2009, the International Ketogenic Diet Study Group published guidelines for the clinical management of children receiving the KD³²; however, these have not been updated and do not include specific recommendations for adults undergoing KD therapy. Offering more guidance is the newly revised resource by Kossoff and colleagues²⁸: *The Ketogenic and Modified Atkins Diets: Treatments for Epilepsy and Other Disorders*, 6th edition. Much of the information in the following sections is based on recommendations from this resource from the Johns Hopkins group, as well as a manual published by The Charlie Foundation for Ketogenic Therapies, and was provided during ketogenic RDN training,³³ as well as the clinical experience of the authors.

Contraindications

It is crucial to assess patients for potential contraindications for KD therapy before initiation (Figure 3). Those with a history of certain metabolic disorders that limit fat metabolism or carnitine production should not be initiated on KD therapy.³²

Table 4. Sample menu for the low glycemic index treatment^a

	Grams net carbohydrate	Fat (in servings ^b)
Breakfast		
Egg Scramble (To prepare: Melt butter in frying pan. Scramble all items together on medium heat.)		
2 large eggs	1	1
1 Tbsp heavy cream	1/2	1/2
1 Tbsp butter	0	1
1/4 cup feta cheese	2	1/2
1/2 cup spinach	1/2	0
1/2 cup mushrooms, chopped	1	0
1 medium grapefruit	18	0
Breakfast Subtotal:	23	3
Lunch		
Cobb Salad (To prepare: Toss all salad ingredients together in a bowl. Top with olive oil and red wine vinegar.)		
1 1/2 cups mixed greens	1/2	0
1/4 cup avocado, sliced	1	1/2
1 hard-boiled egg, sliced	1/2	1/2
1 Tbsp finely chopped bacon	0	1/2
1/4 cup blue cheese or cheddar cheese, shredded	1	1
1 Tbsp olive oil	0	1
1 Tbsp red wine vinegar	0	0
Lunch Subtotal:	3	3 1/2
Dinner		
Chicken and Zucchini "Pasta" (To prepare: Slice zucchini thinly into "noodles" and sauté in olive oil. Mix half the pesto into the zucchini and spread the other half on top of chicken.)		
1 medium baked chicken breast	0	0
1 cup sliced or spiraled zucchini	2 1/2	0
1 Tbsp olive oil	0	1
2 Tbsp pesto	1	1
Dinner Subtotal:	3 1/2	2
Snacks		
Celery & Cream Cheese		
3 small stalks of celery, sliced	1/2	0
2 Tbsp full-fat cream cheese	1	1
Yogurt & Strawberries		
8 oz plain/unsweetened Greek yogurt (4% milkfat)	8	1
1/2 cup strawberry halves (mix into yogurt)	5	0
Snacks Subtotal:	14 1/2	2
Daily Total:	44	10 1/2

^aApproximate daily total: 1,700 kcal, 44 g net carbohydrate, 75 g protein, 140 g fat (10 1/2 servings).^b1 serving=14 g of fat.

Although not contraindications, additional factors to consider with suggested workup plans can be found in [Figure 4](#). Choosing the right candidate and involving the patient and family in selecting the most appropriate diet is crucial when implementing KD therapy in order to optimize compliance and prevent unintended complications ([Figure 5](#)).

Initial Consultation

Initiation procedures based on diet type can be found in [Figure 6](#). Before KD implementation, a consultation between the patient and KD team is needed.³⁴ During this consultation the team will conduct a full medical and nutritional assessment for appropriateness of KD therapy, as well as to determine the most appropriate diet. Social factors impacting diet are also considered at this time. While some patients arrive with a baseline understanding of KD therapy, the initial consult offers the KD team time to offer detailed KD education and guidelines, and establish both patient and team expectations. It is crucial to assess and confirm patient and/or caregiver comprehension of initiation protocols, required testing, and anticipated follow-up schedule to prevent confusion and complications.

Baseline Data: Anthropometric and Biochemical Values. It is imperative to obtain accurate baseline weight and height/length measurements to determine appropriate protein and energy requirements. These values are the basis on which individual diet regimens are calculated. Baseline biochemical values ([Figure 6](#)) are obtained to address abnormalities and screen for contraindications or areas of concern before KD therapy, as well as to be used as a comparison after diet implementation ([Figure 3](#)).³²

Micronutrient Supplementation and Carbohydrate Composition of Medications. Supplementing with a daily multivitamin with minerals is recommended to ensure micronutrient needs are met.^{28,32-35} Those on higher ratio (3:1 and 4:1) KDs require supplementation with additional micronutrients based on age-appropriate dietary reference intakes ([Figure 2](#)).²⁸ In addition, vitamin D supplementation is

Recommended supplements:

- Multivitamin with minerals and trace minerals
- Calcium with vitamin D

Optional supplements to consider based on specific patient needs:

- Selenium
- Magnesium
- Phosphorus
- Vitamin D
- Iron
- Probiotic
- Ecosapentanoic acid/docosahexaenoic acid
- Medium chain triglyceride oil
- Laxatives
- Carnitine
- Citrates
- Table salt/light salt
- Digestive enzymes

Figure 2. Dietary supplementation for patients on ketogenic diets. Based on data from Kossoff and colleagues,³² The Charlie Foundation for Ketogenic Therapies,³³ and Neal and colleagues.³⁵

recommended for those found to be deficient. Vitamin D deficiency is a potential side effect of certain AEDs.³⁶ Correction of the deficiency has been found to have an anticonvulsant effect.³⁷ All supplements should be in tablet or powder form when possible to minimize carbohydrate consumption. Ketogenic formulas are available for enterally fed individuals and are fortified with micronutrients, but may need additional supplementation to meet the dietary reference intakes for age.

All medications must be assessed for carbohydrate content before and during KD therapy, as many can add significant carbohydrates, particularly when taken multiple times daily.³⁸ In general, medications in liquid, syrup, and elixir formulations may contain carbohydrates in the form of sugars or sugar alcohols, and therefore, may disrupt ketosis. Pharmacists should be consulted for recommendations for low-carbohydrate formulations of medications when necessary.

Initiation of KD Therapy

KD therapy can be initiated in both the inpatient and outpatient environments as long as the patient or caregiver is

- Primary carnitine deficiency
- Carnitine palmitoyltransferase I or II deficiency
- Carnitine translocase deficiency
- β -oxidation defects
 - Medium-chain acyl dehydrogenase deficiency
 - Long-chain acyl dehydrogenase deficiency
 - Short-chain acyl dehydrogenase deficiency
 - Long-chain 3-hydroxyacyl-CoA deficiency
 - Medium-chain 3-hydroxyacyl-CoA deficiency
- Pyruvate carboxylase deficiency
- Porphyria

Figure 3. Absolute contraindications to using ketogenic diet therapies. Based on data from Kossoff and colleagues.³²

prepared and well informed and there is a system in place for the patient and caregiver to access the KD team in the event of an adverse effect. All forms of KD therapy necessitate an intensive educational session. Educational formats vary by institutions, with some providing one-on-one sessions, and others employing a classroom-based environment with multiple patients.

Planned Inpatient Admissions. The rationale behind admission for diet initiation is to manage potential acute side effects and provide ample time for education over multiple days. Historically, the classic KD is initiated in the inpatient setting with a variable period of fasting; however, research indicates that fasting does not improve efficacy and may increase the risk of side effects, potentially increasing length of hospital stay.^{39,40}

Initiation of classic and MCT KD therapy occurs by gradually titrating macronutrient composition during the course of 3 to 4 days.²⁸ The two initiation methods are as follows: 1) replace one traditional meal with a ketogenic meal on day 1, increasing to full KD therapy by day 3; or 2) increase the strength of the KD ratio daily as tolerated (1:1 ratio on day 1, then 2:1 ratio on day 2, and so forth, until goal ketosis is achieved). A slow KD introduction allows the gastrointestinal tract to acclimate to changes in macronutrient composition and induces ketosis gradually, which can be easier for the patient.

Diet initiation protocols for patients requiring enteral nutrition are similar to those who eat by mouth, providing a gradual increase in diet ratio. Multiple commercial ketogenic formulas are

available, although at this time none are hypoallergenic. Blenderized formulas are an option for the caregiver with the time and ability to prepare recipes designed by a ketogenic RDN on a daily basis. Many hospitals are not equipped to offer blenderized formulas in the hospital setting, therefore, a backup recipe using commercially produced modular components may be necessary during a hospital admission.

During admission, it is important to monitor for and treat symptoms of acidosis, hypoglycemia, and excessive or persistent ketosis (Figure 2). If acidosis occurs, supplemental bicarbonate should be provided. Anti-epileptic medications that promote acidosis should be evaluated and adjusted, if able, and/or the diet ratio lowered. Thresholds for treating metabolic acidosis vary by institution (serum bicarbonate <17 to 20 mEq/L), with acidosis generally treated with 2 to 3 mEq bicarbonate per kilogram of bodyweight.³² Blood glucose should be monitored every 4 to 8 hours with the goal of >40 to 50 mg/dL (>2.2 to 2.8 mmol/L), depending on facility protocol. Glucose levels <40 to 50 mg/dL (<2.2 to 2.8 mmol/L) are treated with 15 to 30 mL juice and reassessed after 30 to 60 minutes.³³ If hypoglycemia persists, the team should consider lowering the KD ratio or increasing calories.³⁴

Blood and urine ketone monitoring during hospital admission, as well in the home environment, varies by institution. Assessment of urinary ketones (acetoacetate) may be less accurate than serum BOHB levels.^{41,42} Capillary BOHB has been found to have high sensitivity, specificity, and a positive predictive value for diabetic

Concern	Suggested Workup
Inability to maintain adequate nutrition or hydration <ul style="list-style-type: none"> Failure to thrive Dysphagia Gastrointestinal issues (chronic diarrhea, vomiting, reflux) Not able to meet fluid goals Extreme picky eating/limited food acceptance 	<ul style="list-style-type: none"> Obtain gastrointestinal consult Obtain swallow evaluation Consider need for gastrostomy tube placement Increase fat/kcal before initiation Trial of 4:1 ketogenic formula Provide recipes/foods to trial Behavioral feeding consult
Concerning medical history <ul style="list-style-type: none"> Extreme dyslipidemia Cardiomyopathy Renal disease/renal calculi Liver disease Baseline metabolic acidosis 	<ul style="list-style-type: none"> Obtain cardiology, nephrology, or hepatology consult for clearance Adjust fluid minimums Add citrate, consider bicitrate to alkalize urine, avoid/wean drugs like topiramate and zonisamide Wean insulting medications if possible, increase fluid minimums, consider beginning with lower diet ratio
Social constraints <ul style="list-style-type: none"> Access to food and kitchen Caregiver support and compliance Multiple caregivers/unstable home environment 	<ul style="list-style-type: none"> Connect family with social worker to discuss access to services, for example, but not limited to, durable medical equipment, Special Supplemental Program for Women, Infants, and Children, respite care, in home supportive services and/or formula company's assistance programs Registered dietitian nutritionist can discuss meal/food options feasible for family

Figure 4. Considerations for determining appropriateness of initiation of ketogenic diet therapy and suggested further workup before diet initiation.

ketoacidosis, and negative predictive value for identifying diabetic ketoacidosis compared to urinary ketone testing,⁴² although no studies have been published comparing BOHB to urine ketones among patients receiving ketogenic therapy. In addition, urine ketones levels may be influenced by hydration status,⁴³ as ketonuria has been found to have a small, negative association with urine osmolality, although this study was conducted in dogs. Generally, BOHB is assessed daily for level of ketosis during hospital encounters. Reference ranges for blood ketones (BOHB) can vary by laboratory, although the goal is positive ketosis.²⁸ Not all patients experience symptoms of excessive ketosis, and therefore do not need to be treated. Persistent hypoglycemia or symptomatic excessive ketosis despite multiple interventions may be indicative of an underlying metabolic condition and warrants further investigation.

Emergent Admissions. Most admissions for KD initiation are planned;

however, there are occasions where emergent KD therapy is warranted. Although limited, the available research for use of KD therapy for status epilepticus is promising in both pediatric⁴⁴ and adult⁴⁵ populations. Status epilepticus is defined as continuous or near-continuous seizure activity without returning to baseline neurologic functioning.²⁸ KD therapy for status epilepticus appears to be most efficacious among those with underlying autoimmune and/or inflammatory conditions, such as infantile spasms (West syndrome) and febrile infection-related epilepsy syndrome.⁴⁶

The goal of emergent KD therapy is to achieve ketosis as quickly as possible.³³ As all fluids, medications, and supplements are transitioned to carbohydrate-free products (if available), the patient is gradually transitioned to full calories provided by the KD during the course of 1 to 3 days, generally via enteral nutrition support,^{28,45,46} achieving ketosis within 3 to 5 days. The KD should be provided at the highest ratio possible to

achieve maximum ketogenic potential. Given the critical nature of status epilepticus and febrile infection-related epilepsy syndrome, minimum protein requirements may be temporarily sacrificed with the goal of achieving and maintaining ketosis. Levocarnitine may be initiated empirically for those receiving valproate or those found to have free carnitine deficiency, with dosing beginning at 50 mg/kg/day divided into three doses based on recommendations from The Charlie Foundation for Ketogenic Therapies manual.³³ Carnitine supplementation can improve ketosis and may need to be continued for the duration of KD therapy. A complete metabolic panel and serum BOHB are monitored daily until ketosis is established and levels stabilize.

Initiation in the Outpatient Environment. Less-restrictive versions of the KD, such as 2:1 or 1:1 classic KD, MAD, and LGIT can be initiated in the home environment, however, this requires a well-informed patient with a good support system. To

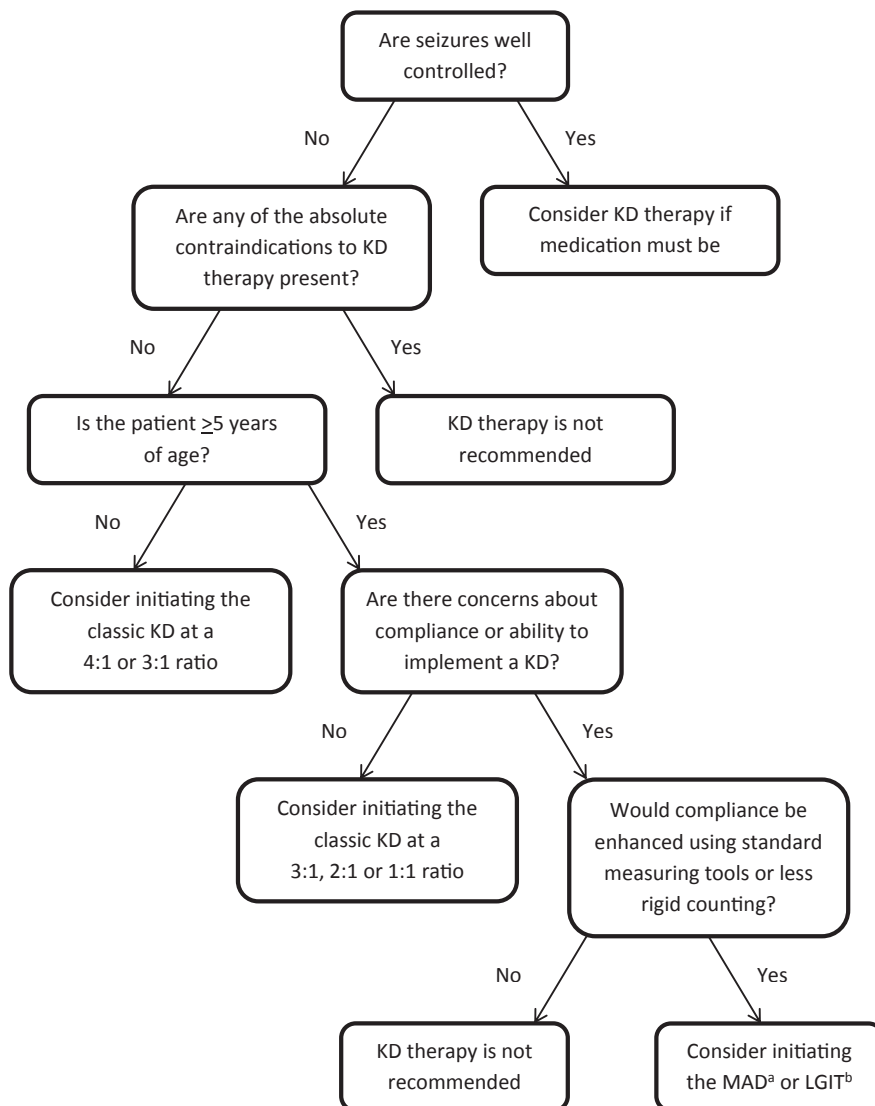


Figure 5. Ketogenic diet (KD) therapy initiation decision tree. ^aMAD=modified Atkins diet. ^bLGIT=low glycemic index treatment.

optimize success of home initiation, the patient, family, and/or caregivers must have a firm understanding of basic nutrition, an individualized diet prescription, as well as expectations and knowledge of how to manage potential complications, and have access to the KD team for any urgent issues.

Initiation of lower-ratio classic KD therapy in the outpatient home environment follows similar principals as their higher-ratio counterparts, and usually occurs during the course of several weeks. Success can be enhanced with close communication between the KD team and the patient or caregiver. For the classic KD, the diet is started at a 1:1 diet ratio with increases in the ratio weekly based on patient symptoms, tolerance to diet,

seizure control, and laboratory values. The diet can be maintained at the ratio found to offer seizure control.

Education, instruction, and initiation for the MAD and LGIT are similar and conducted in the outpatient environment. Patients are educated on how to identify sources of protein, fat, and carbohydrate, how to count grams of net carbohydrate (total grams of carbohydrate minus grams of fiber) for those following MAD, and to identify foods with a low glycemic index (<50) for those following LGIT, in an effort to prevent fluctuations in blood glucose and insulin levels. Each patient may be given an individualized diet prescription that specifies net carbohydrate, protein, and fat recommendations. Patients are encouraged to start the MAD

and LGIT therapies as tolerated over the course of a few days to weeks, depending on comfort level and tolerance.

Overall, monitoring in the home environment is less rigid than the inpatient setting. Some institutions require daily home blood glucose and blood ketone monitoring, while others simply monitor urine ketones daily, with the goal of moderate or large ketones. The gold standard for home ketone monitoring is blood ketone (BOHB) due to higher accuracy, which may be used to fine-tune the diet and achieve improved seizure control.⁴⁷ When BOHB measurements are not possible due to financial burden, urine ketones measured daily may be utilized. Correlation to seizure control has been observed between urine and blood (BOHB) ketones at low values, although poor correlation has been noted at higher values.⁴⁸ In addition, patients or caregivers are instructed to keep a log of daily dietary intake, weekly weight changes, and seizures, to help identify potential areas for improvement and minimize side effects.

Monitoring and Management. Monitoring and management strategies vary by institution, though they are generally more intense during the initial weeks and months of KD therapy. Those on a classic KD typically follow-up in an outpatient clinic with the KD team monthly for the first 3 months. Children under 1 year of age generally follow-up within 2 weeks, based on the clinical judgment of the KD team and individual institutional protocols.³² Follow-up for the MAD and LGIT generally occurs 1 to 3 months after initiation. Patients are encouraged to contact the KD team by phone or e-mail if questions arise. Follow-up timing is similar across diet types after 3 months. Assuming no complications are experienced and the diet maintains efficacy, monitoring continues to occur every 3 to 6 months for the duration of therapy, but is adjusted based on patient need to enhance compliance and tolerance.²⁸

At each monitoring visit, a complete nutrition assessment is conducted to assess nutritional adequacy, and biochemical values are obtained until stable or the diet is discontinued to assess for potential complications (Figure 6). Biochemical values are

Laboratory values	Pre-diet baseline	Daily during admission	1 and 3 mo post diet initiation	Every 3 mo until stable	Every 6 to 12 mo
Urine organic acids	X				
Plasma amino acids	X				
Complete metabolic panel	X	X	X	X	X
Complete blood count with platelets	X	X	X	X	X
Liver profile	X		X	X	X
Ionized calcium	X		X	X	X
Magnesium	X		X	X	X
Phosphate	X		X	X	X
Pre-albumin	X		X	X	X
Lipid panel (fasting)	X		X	X	X
Vitamin D-3	X			X	X
Free and total carnitine	X		X	X	X
β -hydroxybutyrate	X	X	X	X	X
Selenium	X			X	X
Zinc	X		X	X	X
Urinalysis	X		X	X	X
Urine calcium	X		X	X	X
Urine creatinine	X		X	X	X
Vitamins A, E, and B-12				X	X
Copper				X	X
Folate/ferritin				X	X

Figure 6. Standard laboratory assessment recommendations throughout various states of ketogenic diet therapy. Protocols may vary by institution, individual patient, and diet type. Based on data from The Charlie Foundation for Ketogenic Therapies.³³

monitored regularly for abnormal values. One value of particular concern for many RDNs starting patients on KD therapy is the potential impact of diet therapy on lipid profiles. While fluctuations are likely to occur initially, these values generally remain similar to baseline, or actually may improve on KD therapy, specifically increases in high-density lipoprotein and reductions in triglyceride levels.⁴⁹⁻⁵³ Serum low-density lipoprotein values occasionally rise with KD therapy,⁵⁴ though it is unclear whether it is the particle number or size that increases. Among healthy adults following low-carbohydrate diets for weight loss, low-density lipoprotein values increase due to an increase in particle size.⁵⁵ Larger, more buoyant low-density lipoprotein particles may be associated with a lower risk

for development of atherosclerosis.⁵⁶ Among the general adult population, researchers report improvements in cardiovascular risk factors and management of type 2 diabetes when following low-carbohydrate diets⁵⁷⁻⁵⁹; however, it is unknown whether this remains true among those with epilepsy. Along with laboratory values, tolerance to diet, compliance, side effects, and weight trends are assessed. In the pediatric population, growth parameters are also monitored to assure that linear growth and weight gain increase proportionally over times with diet titrations as needed to ensure appropriate growth is maintained.²⁸

Diet efficacy is assessed at each clinic visit, and is determined based on patient or family expectations of KD therapy, carefully weighing the

benefits with the challenges of following the KD when determining continuation. While seizure freedom is the ultimate goal, patients may report other factors that impact choice to continue KD therapy, even if seizure frequency is not dramatically improved. These factors may include experiencing shorter, milder seizures, improved postictal states (period of altered level of consciousness after a seizure), increased mental clarity, or improvements in cognition or level of alertness. If the decision is made to discontinue the diet based on overall challenges or lack of desired benefits, the KD should be weaned gradually.

Fine-Tuning. Before initiation, patients and families are asked to give a 3-month commitment to KD therapy.

During this period (and often beyond), fine-tuning will likely be required to enhance the efficacy of the KD. Evidence correlating ketone level and diet efficacy is limited⁴⁷; however, some patients benefit from higher levels of ketosis, or increased blood ketone (BOHB) levels, while others at milder or lower levels. Therefore, ratios may be adjusted to optimize ketone levels and potentially diet efficacy, if necessary. MCT oil may also be gradually incorporated and titrated to enhance ketosis. For those experiencing undesirable weight change or large fluctuations in blood glucose or ketones, a calorie adjustment may be beneficial.³⁴ Monitoring of free carnitine levels and initiating supplementation may increase KD efficacy (Figure 2).³⁵ For those on prolonged KD therapy, short periods of intermittent fasting may enhance ketosis and potentially increase efficacy.⁶⁰

Adjusting for Tolerability and Enhancing Success. Mild side effects and tolerance concerns can occur during the first few days and weeks after KD initiation. Intolerance often presents as fatigue, headaches, nausea, constipation, hypoglycemia, or acidosis. If these symptoms occur, an oral citrate or sodium bicarbonate can be added to buffer acidosis, and/or the diet ratio can be decreased to improve tolerability and palatability. It is important to note that many oral citrate products contain significant amounts of carbohydrate, which must be calculated in the diet. The ketogenic and medical teams should work together to resolve the acidosis, potentially adjusting medication if necessary. Once tolerance has been established, the diet may be adjusted to increase ketogenic potential if needed for enhanced efficacy.

Close communication among the epilepsy nurse, ketogenic RDN, and patient or caregiver during the few weeks after initiation may enhance success, as compliance is the most important factor in successful KD implementation. Poor understanding and compliance will likely result in reduced efficacy and KD discontinuation. Offering encouragement via close monitoring and open lines of communication, as well as providing education materials, including sample meal plans and recommendations for eating outside of home and during social occasions, offer the patient support and

encouragement during times when noncompliance is most likely, and may enhance KD success. In addition, because undesirable gastrointestinal side effects are another common reason for diet discontinuation, offering recommendations to prevent these effects, such as methods for ensuring adequate fiber and fluid intake, can enhance compliance and KD maintenance.

For those receiving enteral nutrition support, initial KD administration via continuous feedings may be better tolerated with a transition to bolus feeds once tolerance has been established. Standard ketogenic enteral formulas and modular, such as MCT oil and protein powders, may be necessary to enhance ketosis and meet protein needs. Soy or peptide-based formulas are available if food allergies or malabsorption are of concern and, as discussed previously, blenderized KD enteral regimens may be utilized if desired by the family; however, close monitoring and calculation by a ketogenic RDN is needed to maintain appropriate KD ratio and micronutrient goals.

Weaning and Discontinuation. Length of KD therapy often dictates length of time over which the KD is weaned, and guidelines for weaning may vary by patient and/or institution. KD therapy is usually implemented for a minimum of 3 to 6 months.^{32,35} Patients generally follow KD therapy for several years. Many choose to continue the KD due to continued efficacy and/or improvements in other areas of life, such as mental clarity and alertness.²⁸ If compliance is not possible, the patient no longer wishes to continue KD therapy, or KD therapy is deemed ineffective early on, early discontinuation is possible.

Diet discontinuation should occur gradually and under continued supervision of the KD team to prevent the potential for rebound seizures.^{32,35} For those on KD therapy for fewer than 3 months, carbohydrate content can be increased gradually by 1 to 5 g net carbohydrate per week, or by a 0.5 to 1.0 decrease in diet ratio per week until ketosis is lost.^{28,33} For those on long-term therapy, this process should occur over the course of weeks to months. If seizures or other side effects occur with weaning, the KD should be

resumed at the last point where it was effective. Once ketosis is lost and if seizures remain stable with discontinuation, patients are encouraged to continue to adhere to an overall healthy diet low in processed foods, specifically sugars.

ROLE OF THE RDN

Role of the Ketogenic RDN

Ketogenic RDNs require highly specialized training to ensure appropriate implementation and monitoring of KD therapy. RDNs with demonstrated and documented education and training with KD therapy are an integral part of the multidisciplinary team, and are vital in designing and maintaining a successful KD program. Ketogenic RDNs are involved in every aspect of therapy, from assessing appropriateness of KD therapy, education, providing recommendations for KD regimen, initiation, management of symptoms, to diet discontinuation. Ketogenic RDNs' primary role is to safely and effectively design a KD to optimize seizure control; this requires careful diet manipulation and planning, and can be demanding, as there are often many questions and additional communication with the patient and caregivers.

Appropriate staffing ratios. Staffing ratios vary widely. Unfortunately, no documented consensus as to the optimal ratio of patients to RDNs exists; therefore, it is difficult to provide recommendations for the number of full-time equivalents that would be necessary to maintain a successful KD program. With the rigorous demands of maintaining patients on KD therapy and potential for frequent, emergent hospital admissions, it is beneficial to have a minimum of two trained and competent ketogenic RDNs on staff, including a ketogenic RDN with pediatric experience if the program includes pediatric patients.

Models for RDN Reimbursement. Reimbursement and staffing models for RDNs specializing in KD therapy have yet to be standardized; therefore, models across other RDN specialties may serve as a reference.⁶¹ Due to the need for highly specialized training, detailed diet education, close and

frequent monitoring, and risk for complications, ketogenic RDNs may spend more time with each patient, overall seeing fewer patients than standard RDNs. Inpatient models do not offer appropriate comparison, and most outpatient models may not appropriately categorize time involved to maintain a successful KD program. One major barrier for RDN reimbursement is the cost for care. Many clinics use a fee-for-service model in which insurance companies reimburse the clinic or clinician; however, this is only possible for an overall small number of diagnoses⁶² for which KD therapy is not included. Even for reimbursable diagnoses, frequency of RDN visits is limited, regardless of patient need and clinical judgment. Reimbursement for KD therapy poses additional consideration due to the time necessary for intensive education, particularly with patients who require a hospital admission or have limited nutrition knowledge.⁶³ Ongoing and further advocacy is critical to expand RDN reimbursement for KD therapy.

Cost-Savings Analysis. The RDN is an integral part of the KD team in both the inpatient and outpatient settings and may not only improve clinical outcomes, but also increase overall cost savings.⁶⁴ While the cost benefit of RDN involvement on the KD team has not been established, use of KD therapy among children and adolescents with intractable epilepsy that experienced improved seizure control on KD therapy has resulted in an overall significant reduction in health care costs, including reduced medication costs when compared to pre-KD costs.⁶⁵⁻⁶⁹ Further research is warranted to determine the cost benefits of KD therapy overall, specifically examining the cost savings when ketogenic RDNs are part of the treatment team.

Care Coordination: From Clinic to Community

Each patient should be provided with multiple customized letters to share with other members of their medical support team. These letters help ensure that KD guidelines are followed in a variety of settings, and can vary based on the audience. Important information to include is not limited to fasting protocols, blood glucose and

- Academy of Nutrition and Dietetics Nutrition Care Manual: www.nutritioncaremanual.org
- Kossof EH, Turner Z, Doerr S, Cervenka MC, Henry BJ. *The Ketogenic and Modified Atkins Diets: Treatment for Epilepsy and Other Disorders*. 6th ed. New York: demosHEALTH; 2016.
- The Charlie Foundation for Ketogenic Therapies: www.charliefoundation.org
- Matthew's Friends: www.matthewsfriends.org
- Carson Harris Foundation: www.carsonharrisfoundation.org
- Carley Eissman Foundation: www.carleyeissmanfoundation.com
- Keto Hope Foundation: www.ketohope.org
- KetoDietCalculator: <https://ketodietcalculator.org>
- Nutricia: www.myketocal.com
- Cambrooke Therapeutics: www.ketovie.com

Figure 7. Ketogenic references for registered dietitian nutritionists (RDNs). These resources were determined to provide quality ketogenic recommendations by RDNs practicing ketogenic diet therapy.

ketone ranges, avoidance of carbohydrate-containing medications (if possible in nonemergent situations), meal and fluid schedules, and ingredients and equipment necessary for dietary management. For school-aged children or adolescents or adults residing in managed-care environments, coordination between ketogenic RDNs and the school or home environment is essential for KD success.

RDNs in the community may interact with patients following a KD and must be informed on the basics outlined in this review. The knowledge of KD therapy needed for RDNs in the community may include basic understanding of how to achieve and maintain ketosis, monitor for complications, and when and how to contact ketogenic experts for further guidance. This is particularly important in the hospital environment, as the primary KD treatment team can offer recommendations and adjustments, as well as offer basic education for those unfamiliar with KD therapy. If initiation of KD therapy is desired, it is crucial for the RDN and health care teams unfamiliar with KD therapy to reach out to organizations, such as The Charlie Foundation for Ketogenic Therapies or Matthew's Friends, and local experts for guidance to find appropriate recipes, baking mixes, equipment, menu ideas, and cooking demonstration (Figure 7). If outpatient KD therapy is desired, RDNs are responsible for receiving appropriate training and demonstrated, documented competency from these

organizations, or referring the patient to RDNs with KD training.

SUMMARY STATEMENT

RDNs play a unique and critical role in the assessment, initiation, management, and treatment of patients following KD therapy. Once an area of nutrition rarely utilized and considered unfeasible for most patients, particularly adults, use of KD therapy is rapidly expanding. It is the responsibility of all RDNs to be knowledgeable on the basics of KD therapy, their potential role in management, and how to locate experts in the field, particularly as this effective and novel treatment expands outside the realm of epilepsy, including possible management of malignant brain tumors and other various forms of cancer, autism, Parkinson's disease, Alzheimer's disease, traumatic brain injuries, mitochondrial disorders, and for weight management.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

Kelly Roehl wrote an introduction to a ketogenic cookbook and received a one-time contract fee. Sarika L. Sewak reported no potential conflicts.

FUNDING/SUPPORT

There is no funding to disclose.

Reviewers: Sharon Denny, MS, RD (Academy Knowledge Center, Chicago, IL); Jennifer Noll Folliard, MPH, RDN (Academy Policy Initiatives & Advocacy, Washington DC); Sarah Picklo Halabu, RDN, LDN, CDE (Academy Publications and Resources, Chicago, IL); Rosa Hand, MS, RDN, LD, FAND (Academy Research, International and Scientific Affairs, Chicago, IL); School Nutrition Services dietetic practice group (Carol Longley, PhD, RD, LD, Retired-Western Illinois University, Macomb, IL); Pediatric Nutrition dietetic practice group (Jessica M. Lowe, MPH, RDN, CSP, University of Southern California, Los Angeles, CA); Denise Potter, RDN, CSP, CDE (University of Michigan Health System, Ann Arbor, MI); Mary Pat Raimondi, MS, RD (Academy Policy Initiatives & Advocacy, Washington, DC); Beth Zupiec-Kania, RDN (Ketogenic Therapies LLC, Elm Grove, WI).

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We thank the reviewers for their many constructive comments and suggestions. The reviewers were not asked to endorse this practice paper.

KETOGENIC DIET FOR GLUT-1 DS

SUMMARY OF 2015 FAMILY CONFERENCE PRESENTATION

OVERVIEW

This is a summary of information provided at the Glut-1DS Family Conference in 2015. Newer information may precede the guidelines in this document.

Glucose normally fuels the brain. In the ketogenic diet, ketones rather than glucose are the main source of fuel for the brain. Ketogenic diet therapies should be supported by a knowledgeable nutritionist and supervised by a physician. Laboratory monitoring is advised to monitor health status and prevent adverse effects.

Ketogenic diet therapies include the following:

- β -OHB monitoring
- Diet
- Fluids
- Supplements
- Laboratory monitoring
- Super Foods

β -OHB MONITORING

β -OHB stands for betahydroxybutyrate which you will monitor for in the blood. Purchase or obtain a "Precision Xtra" meter at a pharmacy or online (abbott.com); the cost is approximately \$75. The meter comes with a few strips. Additional strips are approximately \$3-6 each. There is potential coverage through insurance (with letter of medical necessity). Urine ketone testing is not necessary if using the monitor.

When to check β -OHB Levels.

- During the initiation of ketogenic diet therapy check daily at the same time.
 - Levels are typically lowest after sleeping and highest after meals and activity.
- When levels are stable, check once a week.
 - Check again if the individual has an increase in seizures, is more ataxic, or is less focused.
- Goal β -OHB Levels:
 - Children 4-5mmol/L
 - Adults < 4mmol/L

KETOGENIC DIET FOR GLUT-1 DS

SUMMARY OF 2015 FAMILY CONFERENCE PRESENTATION

DIET

Ketogenic diets are high in fat, low in carbohydrate and moderate in protein. The Classic Ketogenic diet is designed in a ratio of fat to non-fat (carbohydrate and protein) of 4:1 and 3:1 and foods are weighed in grams. These ratios are advised for infants and children until puberty. Less restrictive ratios of 2:1 and 1:1 can be managed without weighing foods and are easier for older children and adults.

- Adjust the ratio of fat to carbohydrate + protein until β -OHB range is 4-5mmol/L.
 - Infants may not reach 4-5mmol/L. Glucose should also be checked in infants.
 - Children can become ketotic with lower fat to carb + protein ratios such as 3:1.
 - Work with nutritionist to adjust ratio to fit the patient's protein requirements.
 - Carnitine may be a helpful prescription supplement to achieve higher ketones.
 - Medium chain triglycerides (MCT) may help to boost ketosis.
- Adjust calories to maximize ketosis:
 - Avoid obesity by consuming sufficient but not excessive calories.
Ketogenic snacks may be used to flex calories up for active children.
 - Calories should be established to ensure there is growth, and that height and weight are proportional. Children grow at a predictive rate from birth through puberty.
 - Weight and height should be measured regularly:
 - Infants under 6 months – daily.
 - Infants older than 6 months – weekly.
 - Toddlers – every 2 weeks.
 - Older children – every month.

KETOGENIC DIET FOR GLUT-1 DS

SUMMARY OF 2015 FAMILY CONFERENCE PRESENTATION

FLUIDS

Ketogenic diets cause the kidneys to release fluid more efficiently which can cause dehydration. It is important to know how much fluid is needed to prevent dehydration. Dehydration that occurs frequently can lead to feeling sluggish, cause headache, constipation and even kidney stones.

Caffeine should not be consumed by individuals with Glut1-DS. Caffeine interferes with glucose transport into the brain.

Fluid Requirements

The chart shows an average amount of fluid needed for each age group. The specific amount needs to be individualized. People living in warm climates need more water than others. More fluid may be needed during illness with fever, vomiting or diarrhea. The best fluid is water.

Infants	Up to 1000mL (4 cups)
Young children	1000-1500mL (4-6 cups)
Older children	1500-2000mL (6-8 cups)
Adults	2000-2500mL (8-10 cups)

Electrolyte Replacement Fluid for Sick-Days or During Fasting

Name and Manufacturer	Electrolytes	Measure	Minerals	Directions
Morton Lite Salt	Potassium (K) Chloride (Cl)	1/8 + 1/4 teaspoons	525mg K 1133mg Cl	Dissolve salts into water. Use within 1 day. Does not need to be refrigerated.
Baking Soda	Bicarbonate (CO ₃) Sodium (Na)	1/2 teaspoon	1670mg CO ₃ 1050mg Na	
Water - room temperature, purified water (not distilled)		1 liter (4 c.)		

KETOGENIC DIET FOR GLUT-1 DS

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NUTRITIONAL SUPPLEMENTS

Ketogenic diets are low in many vitamins and minerals and for this reason supplementation is necessary. The supplements should have zero or minimal carbohydrate content. Two products that contain a wide array of vitamins, minerals and trace minerals are listed below. Another option is to use a combination of several different products. Ask your nutritionist to assist you with selecting the best options. Alpha-Lipoic acid is a metabolic support supplement that is recommended by Dr. Daryl Devivo for optimal energy use in the brain. Look for quality brands that are in capsule form. These will have the least carbohydrate.

Full Spectrum - Low Carb Vitamin with Mineral Supplements

Name and Manufacturer	Form	Carbohydrate Content	Features
FruitiVits - Vitaflo	Packets of powder. Dose is determined by age.	300mg per 6gm packet	29 micronutrients plus fiber
NanoVM t/f - Solace Nutrition	Powder with scoop. Dose is determined by age.	20mg per 5.4gm	25 micronutrients

Supplements Which may be Helpful for Glut-1DS

Name and Manufacturer	Form	Carbohydrate Content	Notes
Vitamin D3	Liquid or capsules	Various brands - without added carb.	Important hormone for multiple biological functions including mental health and bone health.
Omega-3 Fatty Acid	Liquid or capsules	Various brands without added carb	Important for brain function. May be obtained from food sources i.e. eggs, avocados, olive oil, seed and nut oils.
Carnitine Sigma Tao or Generic brand. Prescription required.	330mg tablet	0	Aids in using fat at the cellular level and boosts ketones.
	Sugar-free solution	0	
MCT oil Various brands	Liquid oil	0	Saturated fat source that is easily used by the brain; boosts ketosis. Has a laxative effect in large doses.
MCT oil emulsion 1. Betaquik (Vitaflo) 2. Liquigen (Nutricia)	Oil and water mixture	0	Saturated fat source that is easily used by the brain; boosts ketosis. May be better tolerated than MCT oil. Has a laxative effect in large doses.
Digestive aids 1. Pancreatic enzyme	Capsules	Check with nutritionist	Can assist with digestion of fats and lower triglycerides.
	2. Lecithin emulsifier: Sunflower or Soy	Various forms including liquid and powder	Varies
			Can assist with digestion of fats and lower triglycerides. Helps to keep fat mixed into liquids and smoothies.

KETOGENIC DIET FOR GLUT-1 DS

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LABORATORY MONITORING

Laboratory monitoring is recommended to ensure health and prevent potential deficiencies. The following laboratory studies should be drawn prior to starting the ketogenic diet and at 1, 3 and 6 months then every 6 months.

- Complete blood count
- Lipid profile
- Liver/hepatic profile
- Metabolic panel
- Electrolytes
- Calcium
- Magnesium
- Phosphorus
- Selenium
- Carnitine profile

KETOGENIC DIET FOR GLUT-1 DS

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SUPER FOODS FOR KETOGENIC DIETS

Optimize ketogenic diets with nutrient-dense foods

Super Food	Unique Content	Tips
Asparagus	Chromium enhances glucose metabolism.	Steam for best flavor or chop raw into salad. Frozen asparagus are often fresher than store-bought fresh.
Arugula	Prevents cholesterol adherence to arteries, has detoxifying and anti-inflammatory benefits.	Baby greens are less bitter than mature. Serve raw, sautéed or blend into smoothies.
Avocado	Magnesium & fiber (both prevent constipation), more potassium (K+) than banana (K+ is an acid buffer), omega-3 fats, anti-inflammatory; sterols – inhibits cholesterol absorption; glutathione – powerful antioxidant.	The pear shaped, Mediterranean variety is higher in fat than oval type. An avocado is ripe when its skin is a brown dark-green color and there is a little “give” when you gently press your thumb into it. Place unripe avocados on the counter to ripen for a couple of days, separating them to allow them space to release carbon dioxide.
Blackberries	Highest antioxidant content of all fruit. High in fiber.	Buy fresh when they are on sale and freeze in quantities.
BRASSICA VEGETABLES: Broccoli Brussels Sprouts Cabbage, Cauliflower, Kale	Sulforaphane blocks a destructive enzyme that damages cartilage; toxic to cancer stem cells. Indols repair DNA in cells.	Boiling decreases the level of sulforaphane; however, steaming, microwaving, or stir frying does not result in significant loss. Sauerkraut (cabbage) has additional nutritional benefits and is low carb.
Celery	Flavonoids; anti-inflammatory, anti-oxidant, immune system enhancing, cholesterol lowering.	Eat raw or blend into smoothies.
Celeriac (celery root)	Antioxidants and phosphorus (acid buffer)	Use raw in salads or coleslaw, or cooked in soup, or as faux mashed potatoes.
Garlic	Potent antiviral, antibacterial and cholesterol lowering.	Dehydrated minced garlic is economical and easy to rehydrate.
Green tea	Phytochemical epigallocatechingallate improves blood flow and lowers cholesterol.	Contains 45mg of caffeine per cup and negligible carbohydrate. Steep green tea in boiling water no more than 2 minutes to prevent bitterness.
Olive oil and olives	Phytochemicals are anticancerous; Oleuropein is a potent free radical scavenger protecting heart tissue.	Avoid olives cured in lye. Seed pure olive oils, not one that is cut with oil (less expensive brands).
Radishes	Anthocyanins have anti-inflammatory and anti-cancerous properties.	Slice thin for salads. Chop and sauté with onions and cauliflower for faux hash browns. Black radishes are more peppery in flavor.
Spinach	Flavonoids and antioxidants, vitamins A, B2, C & K, magnesium, manganese, folate, iron, calcium & potassium.	Eating raw is the best method to preserve nutritional value. Steaming or quick sautéing are second best.
SPROUTS: Alfalfa, Broccoli Fenugreek LENTILS Pea, Radish, Mung	Rich source of enzymes that combine with vitamins and minerals in essential metabolic pathways. Lysine (branched-chain amino acid) helpful for ketosis. Essential fats.	Grow sprouts inexpensively at home in 5-7 days. Several commercial tray designs make it simple and affordable. Serve over salad or mix into smoothie or stir-fry.
Sunflower seeds	High in poly-phenols and Vitamin E (antioxidants), B-complex vitamins especially folic acid and niacin (enhances brain calming GABA). Also high in choline which is a precursor for neurotransmitters.	Sunflower lecithin syrup is a great fat emulsifier for blended keto beverages and tube-feeding formulas. The high choline content also aids in fat digestion.