

Diet Therapy and Diabetes Mellitus

Diabetes mellitus is characterized by an inability to metabolize carbohydrate due to a deficiency of insulin or a deficiency of receptor sites. The metabolism of protein and fat is also affected. Glucose is the form of carbohydrate that is carried in the blood; all carbohydrate breaks down to glucose. Without glucose, the cells have no energy source and have to use muscle protein and tissue fat as an alternate. Without insulin, glucose cannot go from the blood into the cells. This glucose accumulates in the blood, producing hyperglycemia. The sources of blood glucose are:

1. Carbohydrate (CHO): 100% of digestible CHO converted to glucose.
2. Protein: 58% converted to glucose.
3. Fat: 10% converted to glucose.
4. Glycogen (the liver's emergency supply of carbohydrate): converted to glucose when other sources are used up. Muscle tissue also contains glycogen that may be used in emergencies.

Blood glucose is controlled by two hormones from the beta cells of the pancreas: **insulin**, which lowers blood sugar, and **glucagon**, which raises it. A third hormone, **somatostatin**, regulates the secretions of these two hormones.

Glossary

- **Insulin:** Hormone produced in the beta cells of the pancreas that controls blood glucose levels. It is the only hormone that lowers blood sugar.

- **IDDM:** Insulin-dependent diabetes mellitus.
- **NIDDM:** Non-insulin-dependent diabetes mellitus.
- **Gestational diabetes:** A high blood glucose level that develops during pregnancy. Usually there is a return to normal following childbirth, but these women may develop NIDDM later in life.
- **Glycemic index:** A measurement of how fast starches and sugars metabolize in the blood stream. It indicates how quickly specific foods affect blood sugar levels based on a scale of 1 to 100. Glycemic control refers to the use of these specific foods to help control blood sugar levels.
- **Hyperglycemia:** Condition that occurs when the glucose in the blood exceeds the normal range (the normal range for blood sugar levels is 70 to 120 mg/ml).
- **Hypoglycemia:** Condition that occurs when the glucose in the blood falls below normal range (the normal range for blood sugar levels is 70 to 120 mg/ml).
- **Hypoglycemic agent:** A drug sometimes used by diabetics not receiving insulin to assist in lowering blood sugar levels. It is not a hormone.
- **Ketoacidosis:** Formation and accumulation of ketone bodies in body tissues and fluids.
- **Polydipsia:** Excessive thirst.
- **Polyphagia:** Excessive hunger.
- **Polyuria:** Excessive urination.

Treatment and diet therapy

Although the cornerstone of treatment for diabetes mellitus is diet therapy, there are some differences in the way that the therapy is applied, depending upon the type of diabetes present. The general classification of diabetes is based upon two major types: **type I**, insulin-dependent diabetes mellitus (IDDM); and **type II**, non-insulin-dependent diabetes mellitus (NIDDM). Eighty-five to ninety percent of the diabetic population is non-insulin dependent; the other 10 to 15 percent is insulin-dependent. The following discussion illustrates some of the similarities and differences between these types of diabetes.

Type I—IDDM

This is the most severe form of diabetes, occurring most often in childhood or young adulthood. It may, or may not, be an inherited trait. Recent research indicates that the islet cells of the pancreas may have been damaged, either by a disease (such as rubella) or by certain chemicals that were toxic, which led to the onset of the disease. The classic symptoms of IDDM are polydipsia, polyphagia, and polyuria, accompanied by rapid weight loss and often ketoacidosis. IDDM has a rapid onset, is very unstable, and causes metabolic imbalances that are difficult to control. For these reasons the diet is very carefully planned and coordinated with the insulin and exercise regime. Failure to time and regulate the meals with these factors will result in great fluctuations in blood glucose, ranging from acute hypoglycemia to extreme hyperglycemia.

Type II—NIDDM

NIDDM has a much stronger genetic link than does IDDM. The majority of these clients are older adults because the onset is slow, and they are usually obese. Some endogenous insulin is still produced, making it unnecessary for them to take insulin, except in unusual situations (such as surgery or other stressors). Obesity, physical inactivity, and hypertension are strong risk factors for the onset of NIDDM. The symptoms are similar to those of IDDM, except there is no weight loss and very rarely ketoacidosis. NIDDM is a milder form of diabetes and is most often controlled with weight loss and an exercise program. Occasionally an oral hypoglycemic drug will be necessary. Persons with NIDDM have a high incidence of atherosclerosis, making it advisable to counsel them on the need for reduced fat intake as well as reduced calories. As we have advanced in our knowledge of treatments for diabetes, diabetic persons are living longer. They have increased risks of developing major complications such as kidney disease, vascular disease, nerve impairment, and diseases of the retina of the eye. In fact, as much as 20% of the diabetic population becomes blind. Fluctuations of blood glucose from uncontrolled diabetes are thought to be one important factor in the onset of these conditions, making it even more imperative to manage and monitor the diet carefully.

Nutrient Balance

In the most widely used diabetic diet plans, daily carbohydrate intake provides 50%–55% of the daily caloric requirement. Protein of high biological value is emphasized for diabetic diets, especially for children and adolescents. Protein provides 15%–20% of the daily caloric intake. Emphasis is placed on using polyunsaturated fats and limiting cholesterol in the remaining 30% of calories permitted for dietary fat.

An example will serve to illustrate the concept of nutrient balance: Mr. X is placed on a 1500 calorie per day diabetic diet. The nutrient balance is 50% carbohydrate, 20% protein, and 30% fat. What is the number of grams of each nutrient used in the daily diet plan?

1. Carbohydrate

$$1500 \text{ calories} \times .50 = 750 \text{ calories}$$

$$750 \text{ calories} / (4 \text{ calories/g}) = 187 \text{ g carbohydrate, rounded to } 190 \text{ g}$$

2. Protein

$$1500 \text{ calories} \times .20 = 300 \text{ calories}$$

$$300 \text{ calories} / (4 \text{ calories/g}) = 75 \text{ g protein}$$

3. Fat

$$1500 \text{ calories} \times .30 = 450 \text{ calories}$$

$$450 \text{ calories} / (9 \text{ calories/g}) = 50 \text{ g fat}$$

Basic nutrition requirements

Basic nutrition requirements will be determined by several factors. Some of the guidelines used are physical assessment, health and diet histories, and laboratory reports. These factors, combined with the psychological aspects of the client, will help the physician or healthcare specialist determine the diet prescription.

Nutrient distribution

When the daily amounts of protein, carbohydrate, and fat have been determined, they are converted into food servings and spread throughout the day into three meals and from one to three snacks, depending on the need for insulin injection, oral drugs, activity, or a combination of these. Large amounts of food, especially carbohydrates, should be avoided at any one time. A balance of meals throughout the day provides better control. The diabetic person should have regular meal hours to avoid fluctuations in blood glucose.

Ideal Weights and Basal Energy Needs Method

For nearly four decades, health professionals have been using three fundamental assumptions based on available medical observation as a base of calculating daily caloric needs:

1. A table or chart has been developed to show the “ideal” or “desirable” weight of a man or a woman.
2. A person’s basal energy needs are generally figured at 1 kcal/kg body weight/hr.
3. Three levels of caloric expenditure have been developed for three levels of physical activity.

An example is described below for calculating the daily caloric need of an adult patient:

Patient’s desirable weight (DW) = DW kg

Caloric need for sedentary patient = DW kg \times 20–25 kcal/kg

Caloric need for patient with light activity = DW kg \times 30 kcal/kg

Caloric need for patient with strenuous activity = DW kg \times 35 kcal/kg

Special considerations are made for other groups: childhood, adolescence, elderly, with adjustment made if the person is overweight or underweight. As a result of new scientific studies, this method is not as popular as it once was.

Nursing implications

Since diabetes is a lifelong disease, the client needs to learn to take responsibility for self-care. To promote this outcome requires extensive education. The registered dietitian (RD) is designated to be the primary teacher, but the nurse has a major role in the teaching process.

Nurses are part of a teaching team; therefore, they must be able to teach as well as reinforce the information that all diabetic clients need. The topics covered should include the following:

- 1.** Explanation of the disease and why the diet will help the client control it
- 2.** Principles of managing the diet:

- a.** Basic nutrition needs

- b.** Meal planning following the individual prescription

- c.** Menu planning that allows variety in the diet

- d.** Purchase and preparation practices appropriate to the diet therapy

- e.** Adjustments for illness or unusual activity, especially strenuous exercise

- f.** Diabetic foods

- Diabetic foods are different from dietetic foods. The first group is either sugar-free or reduced in sugar content. The second refers to foods reduced in sugar, sodium, protein, or some other nutrients.

- Diabetic foods are recommended for some but not all patients. Regular foods suitable for everyone are usually recommended, with only a few exceptions.

- g.** A relative or caretaker who can assist with meal planning should be present during patient education.

- h.** The patient should be provided with as much information as possible. Some examples include:

- Food exchange lists.
- Diet plans, written or in picture form.
- Scheduled meal times and frequency.
- List of recommended cookbooks.
- Audio cassettes (if client is vision impaired).

3. How to monitor blood and urine, why it is needed, and how to keep good records.
4. How to inject insulin: dosage, type, site rotation, and why timing of meals to insulin schedule is important.
5. How to recognize symptoms of hypoglycemia or hyperglycemia and what to do about them.
6. Why an exercise program is adjunct to diet therapy.
7. Complications of uncontrolled diabetes, especially atherosclerosis, which is 25% higher in the diabetic population than in the nondiabetic population
8. Special dietary measures to prevent or delay onset of atherosclerosis: reduced fat intake, increased fiber intake.

Hypertension

When blood pressure is chronically high, the condition is called hypertension (HTN). In 90% of hypertension cases, the cause is unknown, and the condition is called **essential**, or **primary, hypertension**. The other 10% of the cases are called **secondary hypertension** because the condition is caused by another problem. Some causes of secondary hypertension include kidney disease, problems of the adrenal glands, and use of oral contraceptives. The blood pressure commonly measured is that of the artery in the upper arm. This measurement is made with an instrument called the sphygmomanometer. The top number is the systolic pressure, taken as the heart contracts. The lower number is the diastolic pressure, taken when the heart is resting. The pressure is measured in millimeters of mercury (mm Hg). Hypertension can be diagnosed when, on several occasions, the systolic pressure is 140 mm Hg or more and the diastolic pressure is 90 mm Hg or more. The blood pressure categories are the following:

- 1- Normal-** less than 120/less than 80 mm Hg
- 2- Prehypertension-** 120-139/80-88 mm Hg
- 3- Stage 1 hypertension-** 140-159/90-99 mm Hg
- 4- Stage 2 hypertension-** 160/100 mm Hg

Hypertension contributes to heart attack, stroke, heart failure, and kidney failure. It is sometimes called the **silent disease** because sufferers can be asymptomatic (without symptoms). Its frequency increases with age, and it is more prevalent among African Americans than others. Heredity and obesity are predisposing factors in hypertension. Smoking and stress also contribute to hypertension. Weight loss usually lowers the blood pressure and, consequently, clients are often placed on weight reduction diets.

Excessive use of ordinary table salt also is considered a contributory factor in hypertension. Table salt consists of over 40% sodium plus chloride. Both are essential in maintaining fluid balance and thus blood pressure. When consumed in normal quantities by healthy people, they are beneficial. When the fluid balance is upset and sodium and fluid collect in body tissue, causing edema, extra pressure is placed on the blood vessels. A sodium restricted diet, often accompanied by diuretics, can be prescribed to alleviate this condition. When the sodium content in the diet is reduced, the water and salts in the tissues flow back into the blood to be excreted by the kidneys. In this way, the edema is relieved. The amount of sodium restricted is determined by the physician on the basis of the client's condition. Previous research focused primarily on sodium as a primary factor in the development of hypertension, but as research continues, the effects of chloride also are receiving increasing scrutiny.

In addition, the particular roles of calcium and magnesium in relation to hypertension are being studied. Knowing that sodium raises blood pressure and that potassium lowers blood pressure, the **NIH** (National Institutes of Health) created the **DASH** (Dietary Approaches to Stop Hypertension) eating plan. The DASH plan has been clinically shown to reduce high blood pressure while increasing the serving of fruits and vegetables to 8 to 12 servings per day, depending upon calorie intake.

Sodium restricted diets

A sodium restricted diet is a regular diet in which the amount of sodium is limited. Such a diet is used to alleviate edema and hypertension. Most people obtain far too much sodium from their diets. It is estimated that the average adult consumes 7 grams of sodium a day. A committee of the Food and Nutrition Board recommends that the daily intake of sodium be limited to no more than 2,300 mg (2.3 grams), and the Board itself set a safe minimum at 500 mg/day for adults.

It is impossible to have a diet totally free of sodium. Meats, fish, poultry, dairy products, and eggs all contain substantial amounts of sodium naturally. Cereals, vegetables, fruits, and fats contain small amounts of sodium naturally. Water contains varying amounts of sodium. However, sodium often is added to foods during processing and cooking and at the table. The food label should indicate the addition of sodium to commercial food products. In some of these foods, the addition of sodium is obvious because one can taste it, as in prepared dinners, potato chips, and canned soups. In others, it is not. The following are examples of sodium-containing products frequently added to foods that the consumer may not notice.

- 1-** Salt (sodium chloride): used in cooking or at the table and in canning and processing.
- 2-** Monosodium glutamate (called **MSG** and sold under several brand names): a flavor enhancer used in home, restaurant, and hotel cooking and in many packaged, canned, and frozen foods.
- 3-** Baking powder: used to leaven quick breads and cakes.
- 4-** Baking soda (sodium bicarbonate): used to leaven breads and cakes; sometimes added to vegetables in cooking or used as an “alkalizer” for indigestion.
- 5-** Brine (table salt and water): used in processing foods to inhibit growth of bacteria; in cleaning or blanching vegetables and fruits; in freezing and canning certain foods; and for flavor, as in corned beef, pickles, and sauerkraut.
- 6-** Disodium phosphate: present in some quick cooking cereals and processed cheeses.
- 7-** Sodium alginate: used in many chocolate milks and ice creams for smooth texture.
- 8-** Sodium benzoate: used as a preservative in many condiments such as relishes, sauces, and salad dressings.
- 9-** Sodium hydroxide: used in food processing to soften and loosen skins of ripe olives, hominy, and certain fruits and vegetables.
- 10-** Sodium propionate: used in pasteurized cheeses and in some breads and cakes to inhibit growth of mold.
- 11-** Sodium sulfite: used to bleach certain fruits in which an artificial color is desired, such as maraschino cherries and glazed or crystallized fruit; also used as a preservative in some dried fruit, such as dried plums.

**FOODS PERMITTED ON MOST
SODIUM-RESTRICTED DIETS**

Fruit juices without additives
Fresh fruits
Fresh vegetables (except for those on the “Avoid” list)
Dried peas or beans
Fat-free milk
Puffed-type cereals
Regular, cooked cereals without added salt, sugar, or flavorings
Plain pasta
Rice
Unsalted, uncoated popcorn
Fresh fish
Fresh unsalted meats
Unsalted margarine
Oil
Vinegar
Spices containing no salt, herbs, lemon juice
Unsalted nuts
Hard candy
Jams, jellies, honey
Coffee, tea

FOODS TO LIMIT OR AVOID

Tomato juice and vegetable cocktail
Canned vegetables, if not salt-free
Sauerkraut
Frozen vegetables if prepared with salt
Dried, breaded, smoked, or canned fish or meats
Cheeses; salted butter or margarine
Salt-topped crackers or breads
Salty foods such as potato chips, salted nuts, peanut butter, pretzels
Canned fish, meats, or soups
Ham, salt pork, corned beef, lunch meats, smoked or canned fish
Prepared relishes, salad dressings, catsup, soy sauce
Bouillon, baking soda, baking powder, MSG
Commercially prepared meals
Fast foods

References

- Roth, R., A. Nutrition and Diet Therapy. 10th ed., 2011. Cengage Learning com.