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- AND MUCH MORE

GAYLA J. KIRSCHMANN and JOHN D. KIRSCHMANN

NUTRITION ALMANAC

FOURTH EDITION

Gayla J. Kirschmann

Nutrition Search, Inc. • John D. Kirschmann, Director

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Preface

Nature is a true miracle and there are few people who can grasp and report effectively on its wonder. I believe that my father is one such person. The way that natural nutrition happens in life is what laid the groundwork for the objective and simple approach that he used to put together the very first *Nutrition Almanac* more than 20 years ago. Over these many years, he has continued to help those who wish to help themselves research their own state of well-being. This new and updated edition of the *Almanac* has truly been a labor of love, and even though plowing through years and years of new information was at best a laborious chore, we knew that reporting these findings was essential.

Across time, across countries, and across many different cultures, the *Almanac* has prevailed as one of the leading alternative health publications of this century. As the field of nutrition blossoms even further, we hope to report the most up-to-date information to you in a manner that is in the true spirit of the creation we call the *Nutrition Almanac.*

Gayla J. Kirschmann

Suggestions for Using This Book

The system presented in this book can be employed in two ways. It can help the reader work out a total plan for personal nutrition, or it can quickly answer simple questions regarding food, nutrition, and health.

Nutrition and Health; Exercise; and Sources of Calories: Carbohydrates, Fats, and Protein. The first and third sections of this book are for those who wish to understand what the body does with the food that we eat. The inner workings of the body and how all nutrients integrate and create overall health and well being are the focus of these important sections. Exercise is vital to the performance of *all* nutrients and bodily functions. Many forms of exercise are described in Section II, along with their benefits, specific ailments they help to remedy, caloric expenditures, and other interesting information.

Nutrients. This section discusses over 40 vitamins and minerals in terms of description, absorption and storage, dosage and toxicity, deficiency effects and symptoms, beneficial effect on ailments, human tests, and animal tests. A list of ailments for which the nutrients may be beneficial follows the discussion of each vitamin or mineral. In order to obtain a more thorough understanding of the function of nutrients in relation to total health, the reader should cross-reference to related sections of the book.

Ailments and Other Stressful Conditions. It is a proven fact that many common ailments and weight problems result from an imbalanced intake of nutrients. In this section, ailments are discussed and explained in layperson's language. The discussion of each ailment is accompanied by a list of nutrients and a description of herbs, aromatherapy, and homeopathy that have been shown to be beneficial in the treatment of the ailment. When quantities for a particular nutrient are given, it must be remembered that these quantities are *not prescriptive* but merely represent research findings. This section can be best utilized when cross-referenced with the Nutrients, Herbs, and Foods sections.

Herbs. This section introduces the world of herbs with a brief commentary and a short summary of a number of common types. Cross-referencing to the Ailments section may be helpful for those who are ill. For those who want to prevent disease, there is information and some instructions on how to use the herbs. The glossary at the end of this section explains any unfamiliar terms used.

Foods, Beverages, and Natural Supplementary Foods. The discussions of foods and supplemental foods give valuable information about specific foods or classes of foods and supplements. The list of Rich

Sources of Nutrients shows at a glance what foods are good sources of the vitamins and minerals.

Table of Food Composition. The Table of Food Composition gives the complete nutrient analysis of over 1,600 foods. This simple guide makes it possible for the reader to compare food values and analyze and prepare meals balanced in nutrients and calories. The Nutrient Allowance Chart gives a complete breakdown of the nutrient needs for each person in view of body size, metabolism, and calorie requirements.

In summary, this *Almanac* is not the type of book that one would read from front cover to back cover as one would with most other books, but is a very useful reference tool when each of the various sections are used for a particular reason. Like the individual B-complex vitamins or each amino acid, each section is important in its own right, but when used simultaneously, *all* sections have a much more beneficial effect.

NOTE: The information contained in this publication is not intended to be prescriptive. Any attempt to diagnose and treat an illness should come under the direction of a physician who is familiar with nutritional therapy. It is possible that some individuals may suffer allergic reactions from the use of various dietary supplement preparations or the media in which they are contained; if such reactions occur, consult your physician. Nutrition Search, Inc., and the publisher assume no responsibility.

Contents

SECTION I

Nutrition and Health

Nutrition is the relationship of foods to the health of the human body. Good nutrition is essential for normal organ development and functioning, for normal reproduction, for growth, for maintenance, for optimum activity level and working efficiency, for resistance to infection and disease, and for the ability to repair bodily damage or injury. Proper nutrition means that all the essential nutrients—carbohydrates, fats, protein, vitamins, minerals, and water—are supplied and utilized in adequate balance to maintain optimal health and well-being. Nutritional deficiencies may result in disease whenever inadequate amounts of these essential nutrients are provided to the tissues that must function normally over long periods of time.

No single substance will maintain vibrant health. Although specific vitamins and minerals are known to be more important in the functions of certain parts of the body, even these nutrients are totally dependent upon the presence of others for their best effects. Therefore, every effort should be made to attain and maintain an adequate, balanced, daily intake of all those nutrients that are necessary throughout life.

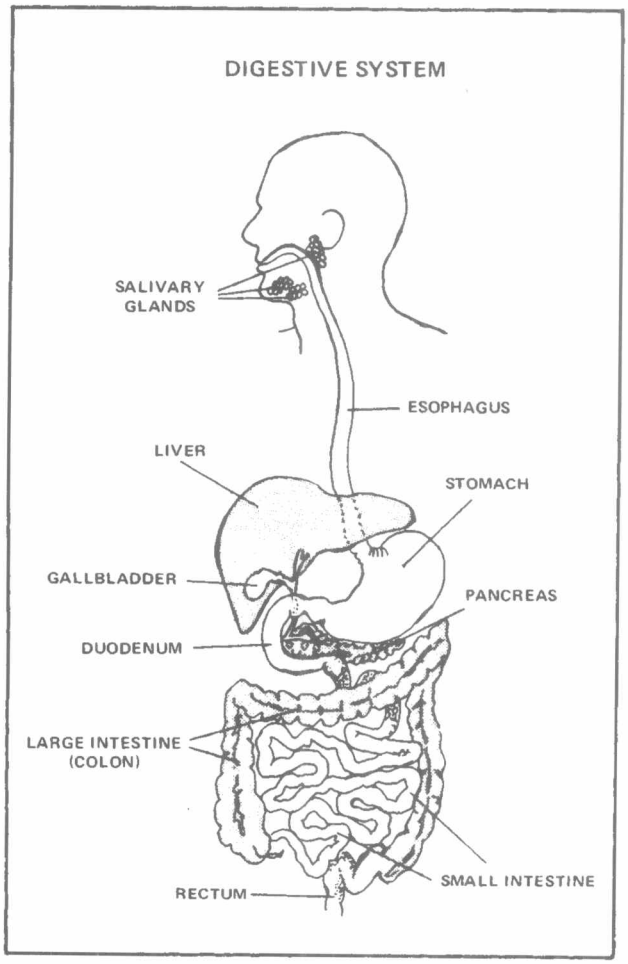
DIGESTION, ABSORPTION, AND METABOLISM

Foods eaten by humans are chemically complex. They must be broken down by the body into simpler chemical forms called nutrients, which are then taken in through the intestinal walls and transported by the blood to the cells. There they provide energy and the correct building materials to maintain human life. The processes involved are called digestion, absorption, and metabolism.

DIGESTION

Digestion is a series of physical and chemical changes by which food that is taken into the body is broken down in preparation for absorption from the intestinal tract into the bloodstream. These changes take place in the gastrointestinal (GI) tract, which includes the mouth, esophagus, stomach, small and large intestines.

The active materials in the digestive juices which cause the chemical breakdown of foods are called enzymes, combinations of amino acids that are capable of inducing chemical changes in other substances. They are highly specialized—for example, an enzyme that breaks down fats cannot break down proteins or carbohydrates, and vice versa. Enzymatic action originates in five areas of the body: the salivary glands, stomach, pancreas, liver, and wall of the small intestine. Carbohydrates, fats, and proteins, the three types of energy-yielding nutrients, are dependent upon enzymes for their breakdown into basic components that can be absorbed for use by the body.



Digestion actually begins when chewing breaks large pieces of food into smaller pieces. The salivary glands in the mouth produce saliva, which contains water, salts, and enzymes that moisten food for swallowing and prepare food for digestion. Saliva also protects the tooth surfaces and linings of the mouth, esophagus, and stomach from attack by molecules that might harm them. Enzymes released in the mouth do not affect the fats, proteins, vitamins, minerals, and fibers that are present in foods; however, an enzyme called salivary amylase begins the breakdown of carbohydrates.

Once a mouthful of food has been swallowed, it is called a bolus. This masticated mass passes back to the pharynx under voluntary control but from then on and through the entire body, the process of moving food substances downward is called peristalsis. This automatic action involves a slow, wavelike motion that happens along the entire gastrointestinal tract. When the food passes into the stomach's entrance, a bank of muscle called the cardiac sphincter contracts and closes so that the bolus cannot slip back.

Active chemical digestion begins in the middle portion of the stomach where food is mixed with gastric juices containing hydrochloric acid (HCL), water, and more enzymes that break up protein and other substances. It is here that the stomach acid kills bacteria that enters the body with food while the cells of the stomach wall protect themselves from the same acids by secreting a mucus (a white polysaccharide) that coats the stomach's lining. Also, salivary amylase will not function in this acidic environment and it is at this time that the digestion of starches gradually diminishes. The amino acids in the amylase are then absorbed into other body proteins.

The major digestive accomplishment of the stomach is the initiation of the breakdown of proteins. This is achieved by the enzyme pepsin and the stomach acid itself, which both act as catalysts. Lesser actions are the digestion of some fat, and to a small extent sucrose, by stomach acid as well as the secretion of a protein substance necessary for the absorption of vitamin B_{12} (called intrinsic factor).

After 1 to 4 hours, depending upon the combination of foods eaten, peristalsis pushes the bolus, which is now in the liquid form of chyme, out of the stomach by means of the pyloric sphincter and into the small intestine. By this time the digestion of all three of the energy-yielding nutrients has begun, as they leave the stomach in the following order: carbohydrates, proteins, and fats, which take the longest amount of time to break down.

When chyme enters the small intestine, the pancreas secretes its digestive juices. Bile, produced by the liver and stored in the gallbladder, is secreted if fats are present. This digestive aid is an emulsifier, not an enzyme, that separates the fat into small droplets so pancreatic enzymes can break it down for absorption. The pancreatic juice that enters through the common bile duct contains enzymes that con-

tinue the breakdown of proteins and carbohydrates; it also contains the substance sodium bicarbonate, which neutralizes the acidic chyme.

After the absorption of the available nutrients, the remaining undigested products enter the large intestine by means of the ileocecal valve, another sphincter. No digestive enzymes are secreted here, but the presence of certain bacteria lend to the production of vitamin K, which is also absorbed in the large intestine. Other bacteria in the large intestine guard against certain diseases.

The leftover residue that enters the large intestine includes some fibers which are not absorbed but continue through the colon, providing a semisolid mass that helps stimulate the muscles of the gastrointestinal tract to perform peristalsis efficiently. Absorption by fiber keeps the stool soft and also incorporates bile acids, sterols (including cholesterol), and fat. The strong muscles of the rectum hold back this semisolid waste until it is time to defecate. The muscles then relax and the last sphincter, the anus, allows the waste to pass.

Some of the Digestive Juices and Their Functions

(The ending *ase* indicates an enzyme; the root of the word tells what it digests.)

Amylase Breaks down amylose, a form of starch.
Carbohydrase Breaks down carbohydrates.
Protease Breaks down protein.
Lipase Breaks down lipids (fats).
Gastric glands Exocrine glands (released out) in the stomach wall that secrete gastric juice into the stomach.
Gastric juice Rennin (curdles milk protein, which readies it for pepsin action), pepsin (for protein), and lipase (for emulsified fats) are secreted by the gastric glands out of the stomach wall.
Pepsin A protein-digesting enzyme that secretes out of the stomach wall.
Mucus A relative of carbohydrate that is secreted outward by the cells in the stomach wall (mucous membrane).
Intestinal juice Secretions of the intestinal glands; contains the enzyme for the digestion of carbohydrate and protein and a minor enzyme for fat digestion.
Pancreatic juice Contains enzymes for the digestion of carbohydrate, fat, and protein (secreted out into the small intestine). The production of insulin (an endocrine function secreting into the blood) and other hormones is also a function of the pancreas.
Bicarbonate Occurs widely in all cell fluids. Secreted by the pancreas and passed into the intestine through the common bile duct.
Bile An exocrine secretion of the liver which is stored in the gallbladder.

ABSORPTION

Absorption is the process by which nutrients are taken up by the intestines and passed into the bloodstream to facilitate cell metabolism. Within 3 to 4 hours after a meal has been eaten, the body must find a way to absorb millions of nutrient molecules including amino acids (proteins), monosaccharides, monoglycerides, glycerol (carbohydrates), fatty acids and glycerol (fats), vitamins, and minerals.

Absorption takes place primarily in the small intestine, where its surface area is comparable to a quarter of a football field and its length is 20 feet. The surface is wrinkled into hundreds of folds which are covered with small fingerlike projections called villi. A single villus magnified turns out to be composed of several hundred cells, each covered with microscopic hairs called microvilli. These villi are in constant motion. Any nutrient molecules small enough to be absorbed are trapped in the microvilli and are drawn into the cells underneath and absorbed. Some partially digested nutrients from the stomach are also caught in the microvilli, digested further by enzymes there, and then absorbed into the cells.

The cells of the three portions of the small intestine (duodenum, jejunum, and ileum) are specialized to absorb different nutrients. Nutrients that are readily available (broken down or water-soluble), are absorbed near the top of the tract while those that take longer to be digested are absorbed

further down. The duodenum is specialized to absorb calcium, vitamin A, and the B vitamins thiamin and riboflavin. Fats are mostly absorbed by the jejunum and vitamin B_{12} is absorbed by the ileum. The process of chelation combines minerals and amino acids for increased absorption.

Once a molecule has entered a cell in a villus, it may enter either the vascular or the lymphatic systems of transport. The water-soluble nutrients (including the smaller products of fat digestion) go into the vascular system from the cells under the villi by way of capillaries. Blood, pumped in a figure-eight pattern throughout the body, directly picks up the nutrients by way of a portal vein that goes straight to the liver. Blood leaving the liver transports some of these nutrients to the heart by way of the hepatic vein while others are stored or used within the liver. The heart then pumps the nutrients in the blood to wherever the body needs them. The liver is thus strategically placed into this system of circulation so that it will have the first chance to screen all products absorbed from the intestinal tract and guard against any agents that may try to invade the body.

Unlike those entering the vascular system, the larger fats and fat-soluble vitamins that are transported by the lymphatic system do not go to the liver first; they go to the heart. For these nutrients, direct access into the blood is impossible because they are not only too big but also insoluble in water, which is the main component of blood. Their eventual entrance into the bloodstream is by a one-way route through the liquid spaces between the cells; the nutrients move from one section to another as muscles contract and push them into a large duct (thoracic) behind the heart. This duct ends in a vein (subclavian) that can accept the nutrients and that moves them into the bloodstream and the heart for distribution. The body's cells remove the parts they can use. The final stop is the liver, where whatever is left is reassembled to again enter the bloodstream (see Fats in Section III).

In the liver, many different enzymes help change the nutrient molecules into new substances for specific purposes. Unlike digestion, which prepares nutrients for absorption and transport, the reactions in the liver produce the end products needed by individual cells to give us healthy bodies.

Delivery of Nutrients into the Blood

Vascular system

Water-soluble nutrients. Vitamin C, B-complex vitamins, non-B nutrients.

Carbohydrates. Monosaccharides.

Lipids. Glycerol, short-chained fatty acids, medium-chained fatty acids.

Proteins. Amino acids.

Lymphatic system

Fat-soluble nutrients (in lipids). Monoglycerides, triglycerides, cholesterol, phospholipids.

Fat-soluble vitamins. Vitamin A, vitamin D, vitamin E, vitamin K.

The Six Basic Nutrients and Where They Are Affected in the Process of Digestion and Absorption

Fiber, dietary. Fiber that remains after food is digested.

Mouth. Crushes and rips fiber to mix with salvia and ready it for swallowing.

Stomach. Increases bulk of food.

Small intestine. Binds minerals such as bile salts used by the body to prepare fat for absorption.

Large intestine. Most fiber passes untouched through the digestive tract and goes to the large intestine, where bacterial enzymes digest hemicellulose into glucose, which is absorbed. However, energy contribution is very small. Dietary fibers exercise intestinal muscles so they retain their health and tone. Cholesterol and some minerals are bound and excreted with fiber.

Carbohydrate. Starch and sugar.

Mouth. Salivary gland excretes the enzyme salivary amylase, beginning the digestion of starch to polysaccharides and maltose.

Stomach. Acid and enzymes start to digest salivary enzymes, stopping the digestion of starch. Maltose and sucrose are partially broken down by the stomach acid.

Small intestine. Carbohydrase is released by the pancreas, which breaks polysaccharides into maltose. Enzymes on the surface cells break down the polysaccharides into disaccharides and then to monosaccharides, which are then absorbed by the cells.

Fat. Triglycerides (fats and oils), phospholipids (lecithins), and sterol (cholesterol, vitamin D, and the sex hormones).

Mouth. Lingual lipase is secreted, and fats melt as they reach body temperature.

Stomach. Triglycerides are split into diglycerides. Breakdown is minimal for all fats except milk fats. Acids are mixed with fats and water. Gastric lipase finds and hydrolyzes a small amount of fat.

Small intestine. Bile from the liver flows through the common bile duct to emulsify the fat. Pancreatic lipase breaks down the emulsified fat into monoglycerides, glycerol, and fatty acids for absorption.

Large intestine. Some fat and cholesterol remain in the feces.

Protein. Amino acids linked into chains.

Mouth. Protein foods are chewed and made ready to swallow.

Stomach. Acid undoes protein strands and enzymes are activated. Proteins become smaller polypeptides.

Small intestine. Polypeptides are split by pancreatic and small intestine (protease) enzymes. More enzymes on the surface of the intestinal cells hydrolyze the peptide, then absorb the amino acids.

Vitamins

Stomach. Intrinsic factor (a necessary compound for absorption) attaches to vitamin B_{12}.

Small intestine. Fat-soluble vitamins are emulsified by bile and are absorbed with other fats as well as the water-soluble vitamins.

Large intestine. Vitamin K, produced by bacteria, is absorbed.

Minerals and Water

Mouth. Water is secreted with saliva to integrate and bind food.

Stomach. Acid (HCL) reduces iron for absorption. Water is released to form chyme from the food eaten.

Small intestine. Approximately 2 gallons of water a day are added from the food eaten.

Small intestine. Approximately 2 gallons of water a day are added from the pancreas, liver, and small intestine. Minerals are absorbed. Calcium is provided with vitamin D to be properly absorbed.

Large intestine. The remainder of the minerals and more water are absorbed.

METABOLISM

At this point, the handling of food within the body has reached its final stage. The process of metabolism involves all the chemical changes that nutrients undergo from the time they are absorbed until they become a part of the body or are excreted from the body. Metabolism is the conversion of the digested nutrients into components for energy or for building material for living tissue.

The basic units of metabolism are

Glucose—from carbohydrate

Glycerol—from fat

Fatty acids—from fat

Amino acids—from protein

Metabolism happens in two general phases that occur simultaneously, anabolism and catabolism. Anabolism (uses energy) involves all the chemical reactions that the nutrients undergo in the construction or building up of body chemicals and tissues such as blood, enzymes, and hormones. Catabolism (usually releases energy) involves the reactions in which various compounds are used to do the body's work, to produce heat, or to be stored for later use.

Energy from carbohydrates, fats, and protein for the body's cells, comes from their conversion to glucose, which combines with oxygen in a series of chemical reactions that form carbon dioxide, water, and cellular energy. The energy is used for body functions, and the carbon dioxide and water are waste products that are carried out of the body by the bloodstream.

Carbohydrate is the ideal source of glucose because it is composed mostly of that substance. The starches and sugars are readily convertible to glucose. Complex carbohydrates are more slowly processed, making them valuable for maintaining constant energy levels (see Carbohydrates in Section III).

When the body metabolizes fats, the glycerol component donates only 5% of its structure to glucose. Fat lends itself more readily to storage than energy. Since the brain and the nervous system both thrive on glucose for their nutrition, fat becomes an inefficient source. And when there is too much fat for the liver to handle, the remainder is stored throughout the body in the kind of fat that we often try to lose by dieting. Fats play a vital role in the functioning of a healthy body and sufficient amounts are essential; however, too much can put one at risk for many degenerative diseases (see Fats in Section III).

When the body needs to grow or needs to be regenerated, it turns to the metabolism of protein to provide the material. Protein is a fairly good source of glucose when carbohydrate is not available, but providing for the body's energy needs should be secondary to its major building function. Sufficient carbohydrates need to be taken along with protein to achieve a maximum operating level (see Protein in Section III).

The process of metabolism requires that extensive systems of enzymes be maintained to facilitate the thousands of different chemical reactions that must be performed, and also to regulate the rate at which these reactions proceed. The presence of protein, vitamins, and minerals is essential for these enzymes to perform their functions at their very best.

FACTORS INHIBITING DIGESTION/ ABSORPTION

The gastrointestinal tract is sensitive and responsive to conditions within the environment. The movements of the stomach are interfered with by nervousness and anxiety. Eating while agitated, fatigued, or worried may give rise to gastrointestinal disturbances. In a person under stress, digestive secretions are reduced and the blood is routed to the muscles more than to the digestive tract. This action impairs efficient absorption of nutrients. To digest and absorb food best, one should be relaxed and tranquil at mealtimes. Hurried meals under tense conditions are not beneficial to normal digestion. Weather variations and physical disorders may also inhibit normal digestion.

SECTION II

Exercise

"By taking yourself from a sedentary state, you can, in effect, reduce your biological age by 10 or 20 years" is a statement made by Roy Shephar, M.D., Ph.D., at the Department of Preventative Medicine and Biostatistics at the University of Toronto. Researchers who conducted an extensive study on fitness and mortality concluded that "moderate levels of physical fitness that are attainable by most adults appear to be protective against early mortality." Also, extensive evidence confirms that even slight improvements from regular activity can produce health benefits and prevent disease.

Exercise imparts vigor and activity to all organs and secures and maintains the healthful integrity of all their functions. Exercise improves the tone and quality of muscle tissue and stimulates the processes of digestion, absorption, metabolism, and elimination. It also strengthens blood vessels, the lungs, and the heart, resulting in improved transfer of oxygen to the cells and increased circulation of the vascular and lymph systems.

Exercise develops grace, poise, ease, and symmetry of the body, helps in correcting defective development or injuries, and stimulates the mind. Exercise creates strength and endurance for the body to meet normal physical and mental challenges as well as to maintain its stamina and resilience in case of an emergency.

Physical inactivity is linked to the major degenerative diseases—heart diseases, cancer, stroke, and hypertension—which are primary killers of adults in developed countries. Regular physical activity can protect against backaches, cancer, diabetes, and digestive disorders (ulcers, constipation, diarrhea, and others). Growth failure in children, headaches, heart and blood vessel disease (heart attacks and strokes) can be avoided. Infections such as colds and flu are also prevented by exercising, along with kidney disease, menstruation irregularities, obesity, and osteoporosis (adult bone loss).

Carbohydrate glucose, stored in the liver and muscles as glycogen, is necessary for physical activity. The more glycogen that can be stored, the longer a workout can be maintained. Muscles that are already conditioned rely less on glycogen and more on fat for fuel, so the muscles of a trained individual burn more body fat than those of people who do not exercise. Working muscles require oxygen to produce energy. Muscles convert glycogen to glucose very quickly during high-intensity exercise when oxygen is low, as when a person is exercising at a target heart rate. Glucose can burn without oxygen, which makes carbohydrate foods essential to healthful exercise.

The body reacts to physical activity by adjusting its energy use. Hormones such as epinephrine and

norepinephrine are released into the bloodstream, signaling the liver and fat cells to release their stored energy nutrients, mostly glucose and fatty acids with a few amino acids, to do their work. How much of which fuels are used depends upon what is available, the intensity and duration of the exercise, and the degree of conditioning of the body.

A beginning exercise program should be light and should gradually increase in difficulty as endurance increases. Maintaining a moderate-intensity (reaching not more than 80% of one's maximum heart rate) program of regular activity over the long term will strengthen the interior endogenous (made by the body) forms of antioxidants like catalase, GSH, and SOD. Exercising three times a week for 30 minutes at this rate will minimize the number of excess cancer-causing free radicals produced by exercising excessively (which creates too much oxygen in the system at one time). Information given recently has stipulated that exercise is life-lengthening only if performed rigorously, as in fast walking at 4 to 5 miles per hour for 45 minutes 5 days a week. Even though for some this may be true, the benefits of moderate- and low-intensity workouts are still overwhelming for overall health and well being (see Antioxidants in Section IV for recommendations).

Exercise, if properly performed, will not overload the system. One must train at an intensity that elevates the heart rate a certain amount beyond its resting level, which is called the target heart rate zone. Exercising below the target zone will not condition the cardiovascular system, while exercising above it is dangerous and unnecessary. Two ways to determine the efficiency of a workout are breathing and heart rate. You should still be able to speak slightly while exercising, and the heart rate should be within the target heart rate zone—that is, 60–85% of the maximum number of beats your heart can produce. Check the pulse 1 minute into the warmup, midway through the workout, and after the cool-down. Consult a physician before beginning any physical fitness program. Also, do not attempt any physical exertion for at least an hour after eating, as it interferes with digestion.

Each zone can be calculated from your age and resting heart rate. Older people have a lower rate. Heart rate monitors are available, but if they are not a choice, here is how to find yours: rest a few minutes for a resting pulse or take it upon awakening (this rate will decrease as conditioning occurs and increases if you are overtraining or if ill).

Place your hand over your heart or your finger over an artery in any pulse location that gives you a clear rhythm. Using a timepiece with a second hand, start counting at a convenient second, and continue counting for 10 more. If a heartbeat occurs exactly on the tenth second, count it as one-half beat. Multiply by 6 to obtain the beats per minute to ensure a true count. Use this number for the number (1) when following the directions below. Note that the thumb has the same beat as the heart; using the fingers will be less confusing. Too strong a hold will interfere with the pulse rhythm.

1. Find your resting heart rate.
2. Estimate your maximum heart rate by subtracting your age from 220 (205 if your are using swimming as your form of aerobic exercise). *Never exercise at this rate.*
3. Subtract your resting rate (1) from your maximum rate (2).
4. Multiply by 0.50 and round off.
5. Add the resulting number (4) to your resting heart rate (1).

The final number defines the bottom end of your target heart rate zone. Your heart should beat at least that fast when you work aerobically.

The exercise intensity zones are as follows:

Low-intensity aerobic zone: 50–60% of maximal heart rate

Moderate-intensity aerobic zone: 70–80% of maximal heart rate

Aerobic zone: 80–90% of maximal heart rate

Red line zone: 90–100% of maximal heart rate

The body needs to be readied for the physical activity that it is going to perform, and after the activity it needs an easy transition into nonaction. A warmup allows for a gradual readiness and also

begins the hormonal changes that release the needed fuels from the body's storage depots. An adequate warmup is achieved when one has slowly broken into a sweat, usually between 3 to 5 and 7 to 10 minutes, depending upon the activity. Cooldown activity eases the transition from exercising to normal functioning. Between 5 to 7 and 10 minutes of light activity relaxes tight muscles and increases the circulation of blood through them. The circulation in turn brings heat from the inside of the body to radiate out from the surface.

Besides the forms of physical activity listed below, recreational exercises such as golfing, riding, and skating are all healthy choices. There are endless sports that can improve the functioning of the body, no matter how minimal. The important thing to remember is to exercise *regularly* and to maintain a nutritionally balanced diet of a variety of good, healthy, whole foods. An ideal exercise program may include many different forms of the following activities.

AEROBICS (oxygen-requiring cardiovascular endurance training)

If the exercise elevates the heartbeat and requires additional oxygen intake, the exercise is categorized as aerobic, or oxygen-requiring. Aerobic training is running, brisk walking, dance aerobics, swimming, or any physical exertion that enhances the ability of the heart, lungs, and blood to deliver oxygen to, and remove waste from, the body's cells. Aerobics requires the heart and lungs to work extra hard to deliver oxygen to the muscle cells for certain amounts of time. As the cardiovascular system gradually adapts itself to the demands of aerobic exercise, the body delivers oxygen more efficiently, benefiting both the body and the mind.

The benefits from aerobics are: an increase in total blood volume, a larger and stronger heart, a slower pulse rate, more efficient breathing, improved circulation, lower cholesterol, lower blood pressure, and weight loss resulting from the burning of calories and body fat. White blood cells, including T-helper cells (made in the thymus gland) and macrophages (from arterial walls), are stimulated and put into circulation when aerobic exercise is performed (see AIDS in Section V). Cardiovascular endurance, or aerobic exercise, is a highly respected form of physical achievement because it reflects the health of the heart and the circulatory system, on which all other body systems depend.

Aerobic dance is done to music and, unlike other forms of aerobics, gives a full body workout. Through the years, aerobics experts have learned that one can get an efficient workout with a low-impact (one foot remains on the floor at all times), high-intensity (how hard the cardiovascular system works) routine. One of the advantages of this type of exercise is the reduced stress on the musculoskeletal system. There is less chance of getting hurt if one stands properly, wears proper athletic shoes, and exercises on the appropriate surface. Landing on the heel and rolling to the toe is recommended. The low-impact, high-intensity routine is also excellent for sedentary (inactive) people and for those just beginning a program.

Chest and arm work in low-impact aerobic dance may not increase the rate of respiration even though heart rates may rise. Although this is still beneficial, a pumping heart that one can feel and hard breathing for 20 continuous minutes indicate a good workout. A workout will last 35 minutes, including 7- to 10-minute warmup and cooldown periods. Three 10-minute workouts per day that reach the target heart rate may be equally beneficial.

Boredom from repetition of the same aerobics can cause injury and become a problem. These variations may help: step, which is stepping up and down on a platform 4 to 10 inches high where the angle behind the knee is at least 90 degrees; weights, which is using light types (1 to 5 pounds) for the wrist or hand to strengthen the arms and the cardiovascular system (can be part of a low-impact dance routine); and toning, which is doing floor exercises such as abdominal curls, leglifts, and pushups. Doing these different forms of aerobics to music should give a sufficient variety of styles so as not to repeat any one activity 2 days in a row.

Music for aerobics should be between 128 and 135 beats per minute for low-impact forms and no higher than 160 beats for high-impact forms. For footwear, an aerobic shoe should have a squarish front so the toes can move freely. High tops may provide better ankle support.