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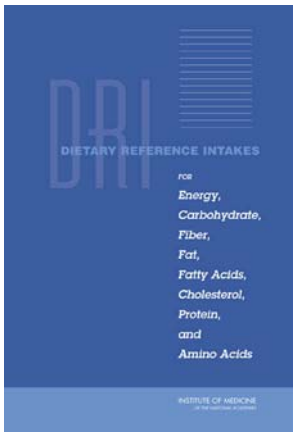
Shaping the Future for Health

DIETARY REFERENCE INTAKES FOR ENERGY, CARBOHYDRATE, FIBER, FAT, FATTY ACIDS, CHOLESTEROL, PROTEIN, AND AMINO ACIDS



Unlike vitamins and minerals, which sometimes perform unique functions to meet the body's needs, fats, carbohydrates, and proteins substitute for one another to some extent to meet the body's energy needs. In a recent report released by the Food and Nutrition Board of the National Academies, acceptable *ranges* of intake for each of these energy sources are set, based on evidence that consumption above or below these ranges may be associated with nutrient inadequacy and increased risk of developing chronic diseases, including coronary heart disease, obesity, diabetes, and/or cancer. For example, studies have shown a connection between low-fat, and therefore, high-carbohydrate diets and decreased high-density lipoprotein cholesterol in the bloodstream, a physiological indicator associated with increased risk of coronary heart disease. Conversely, diets too high in fat may result in increased caloric intake, and therefore lead to obesity and its complications.

The report, titled *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids*, is the sixth in a series providing Dietary Reference Intakes (DRIs) developed jointly by American and Canadian scientists, and focuses on carbohydrate, fiber, fat, fatty acids, cholesterol, protein, and amino acids, collectively known as the macronutrients, as well as energy and physical activity. The report recommends that to meet the body's daily nutritional needs while minimizing risk for chronic disease, adults should consume 45 to 65 percent of their total calories from carbohydrates, 20 to 35 percent from fat, and 10 to 35 percent from protein. The acceptable ranges for children are similar to those for adults, except that infants and younger children need a somewhat higher proportion of fat in their diets. These ranges may be more useful and flexible for dietary planning than single maximum values recommended in the past.

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The report also contains a new set of definitions of fiber in the diet that excludes fiber-like products, whether manufactured or extracted from whole foods, which have no proven health benefits. New products that currently meet regulatory definitions of fiber have recently been marketed, yet isolation procedures and definitions of the term vary greatly, creating the need for a uniform concept. The report defines *total fiber* as the combination of *dietary fiber*, the edible, non-digestible carbohydrate and lignin components as they exist naturally in plant foods, and *functional fiber*, which refers to isolated, extracted, or synthetic fiber that has proven health benefits. If adopted for use in food regulations, the new set of definitions of fiber should impact which fiber-like food additives get counted as fiber on the nutrition facts panel that became mandatory on food labels in 1990.

FROM RDAS TO DRIS

More than 60 years ago, the Food and Nutrition Board of the National Academies issued its first set of Recommended Dietary Allowances (RDAs) for vitamins, minerals**,** protein, and energy in response to the War Department's concern over the nutritional fitness of new recruits, malnutrition among existing troops, and the need to provide adequate nutrients to malnourished populations after they were liberated by Allied troops. Since 1941, RDAs have served as the basis of almost all federal and state food and nutrition programs and policies and have been revised nine times, with the list of RDAs growing from eight to 27 nutrients in 1989.

Where are the RDAs being used?

RDAs are used as the basis for nutrition labeling of foods, for the Food Guide Pyramid, and for other nutrition education programs. They are used to determine the types and amounts of food:

- provided in the WIC (Women, Infants, and Children) Supplemental Feeding Program and the Child Nutrition Programs such as School Lunch,
- served in hospitals and nursing homes for Medicare reimbursement,
- found in the food supply that should be fortified with specific nutrients,
- used in a host of other important federal and state programs and activities.

Since the publication of the 10th and last edition of the Recommended Dietary Allowances in the United States in 1989 and the Recommended Nutrient Intakes in Canada in 1990, new information has emerged about nutrient requirements that warrant the development of updated guidelines. Over the past eight years, the Board has implemented an expanded system for determining the RDAs and other nutrient based reference values now called Dietary Reference Intakes (DRIs). The new DRIs are based on scientifically grounded relationships between nutrient intake and indicators of good health as well as the prevention of chronic diseases in apparently healthy populations.

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In addition to providing RDAs (nutrient recommendations by age and gender for healthy people), the new DRIs include three additional reference values: the Estimated Average Requirement (EAR), the Adequate Intake (AI), and the Tolerable Upper Intake Level (UL). EARs are the average daily amounts of a nutrient estimated to meet the needs of only half the healthy individuals in given age and gender categories. These values are particularly useful for determining the prevalence of inadequate intakes among groups that lead to nutritional deficiencies, such as iron deficiency in vegetarians or vitamin B_{12} deficiency in older residents in nursing homes.

When studies linking intake of different levels of nutrients to specific health outcomes are lacking, EARs cannot be determined. Since RDAs are now specifically defined as meeting the needs of almost all individuals in a population group, they are based directly on the average requirement for that group; thus, they too cannot be determined. In these cases, the report provides AIs, which are usually based on average amounts of nutrients consumed by similar groups of apparently healthy people. These values are less certain

and in many cases may be significantly greater than RDAs. Therefore, consuming less than the AI for a specific nutrient does not necessarily increase a person's risk for developing a health problem; consuming the AI or more should provide a sufficient intake of the nutrient.

The third new category of reference values, the UL, is the highest daily intake level likely to pose no risk of adverse health effects. As chronic intake exceeds the UL, the potential for increased risk of adverse effects increases. In other words, ULs are ceilings on the maximum level of a single nutrient to consume on a chronic basis, usually from all sources (food, supplements, fortified food, etc.). While the ULs can be used as guides to *limiting* intakes of specific nutrients, they are not intended to be *recommended* levels of intake.

Dietary Reference Intakes

Recommended Dietary Allowance (RDA): the average daily dietary nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group.

Adequate Intake (AI): the recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate—used when an RDA cannot be determined.

Tolerable Upper Intake Level (UL): the highest average daily nutrient intake level that is likely to pose no risk of adverse health effects to almost all individuals in the general population. As intake increases above the UL, the potential risk of adverse effects may increase.*

Estimated Average Requirement (EAR): the average daily nutrient intake level estimated to meet the requirement of half the healthy individuals in a particular life stage and gender group.*

* In the case of energy, an Estimated Energy Requirement (EER) is provided: it is the average dietary energy intake that is predicted to maintain energy balance in a healthy adult of a defined age, gender, weight, height and level of physical activity, consistent with good health. In children and pregnant and lactating women, the EER is taken to include the needs associated with the deposition of tissues or the secretion of milk at rates consistent with good health.

Calories In, Calories Out

Recognizing that maintaining an optimal weight to decrease risk of chronic disease depends on balancing total energy consumption with energy expenditure, the report provides targets for daily caloric intake based on the amount of physical activity an individual typically gets. The report provides guidance regarding the total numbers of calories that would be consumed by an individual of given height, weight, age, and gender for each of four different levels of activity. For the first time, the report recommends that total energy expended be at least 1.6 to 1.7 times an individual's resting energy expenditure (considered an active lifestyle) in order to maintain body weight in the ideal range (BMI between 18.5 and 25), as well as decrease risk of cardiovascular disease.

For instance, a 30 year-old woman who is 5 feet 5 inches tall and weighs between 111 and 150 pounds and is classified as sedentary (defined as 1.0 to 1.4 times resting energy expenditure) would need to consume 1,800 to 2,000 calories each day to maintain this healthy weight. A man of equal size can eat 2,050 to 2,350 calories. If the same 30-year-old woman and man have an "active" lifestyle, they will be able to consume an additional 450 to 500 calories each day to maintain body weight while getting the added maximum benefit of reducing their risk of cardiovascular disease.

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Based on a comprehensive review of the scientific data, the panel found that in order to move from a very sedentary to an active lifestyle, adults and children alike need to engage in activities equivalent to a total of 60 minutes of moderately intense physical activity throughout each day. This new physical activity goal, while higher than the

Based on a comprehensive review of the scientific data, the panel found that adults and children alike stand to gain a significant health benefit by engaging in activities equivalent to a total of one hour of moderately intense physical activity each day.

minimum goal set by the 1996 Surgeon General's Report for adults may seem unrealistic; however, it includes everything an individual does beyond sleeping and breathing. Thus, gardening, dog-walking, light housekeeping and taking the stairs instead of the elevator are all activities that contribute to an active lifestyle.

For example, someone in a largely sedentary occupation can achieve this new activity goal by engaging in activities, like walking at 4-5 miles per hour, for a total of 60 minutes each day, in a higher-intensity activity such as jogging for 20 to 30 minutes four to seven days per week, or the following: taking the stairs for 10 minutes total a day, walking for 30 minutes total during work and to the car or bus, raking the lawn for 45 minutes, walking an hour while shopping, and spending an hour in the evening preparing dinner, cleaning up the kitchen, and walking the dog.

Examples Of Various Physical Activities

Mild
Billiards
Canoeing (Leisurely)
Dancing (Ballroom)
Golf (With Cart)
Horseback Riding (Walking)
Loading/Unloading Car Playing
Taking Out Trash
Walking (2 Mph)
Walking the Dog
Watering Plants

Moderate
Calisthenics (No Weight)
Cycling (Leisurely)
Gardening (No Lifting)
Golf (Without Cart)
Household Tasks, Moderate Effort
Mopping
Mowing Lawn (Power Mower)
Raking Lawn
Swimming (Slow)
Vacuuming
Walking (3-4 Mph)

Vigorous
Chopping Wood
Climbing Hills (No Load Up To 5-Kg Load)
Cycling (Moderately)
Dancing (Aerobic, Ballet, Ballroom Fast)
Jogging (10 Minute Miles)
Rope Skipping
Surfing
Swimming
Tennis

The Skinny on Fat

Fat is a major source of energy for the body and aids in vitamin absorption and tissue development. Monounsaturated and polyunsaturated fatty acids reduce blood cholesterol concentration and help lower the risk of heart disease when they replace saturated fatty acids in the diet. People must get two types of polyunsaturated fatty acids, known as alpha-linolenic acid (an omega-3 fatty acid) and linoleic acid (an omega-6 fatty acid), from the foods they eat, since the body cannot make them. A lack of either one will result in symptoms of deficiency, including scaly skin, dermatitis, and reduced growth. This is very rare in the United States and Canada. Additionally, studies have shown that populations with diets naturally high in alpha-linolenic acid and longer chain omega-3 fatty acids, common in countries where large quantities of fatty fish are consumed, have a decreased risk of cardiovascular disease. Similarly, individuals whose diets are naturally high in linoleic acid and longer chain omega-6 fatty acids, commonly obtained from vegetable oils, have higher blood levels of high-density lipoprotein cholesterol, also protective of cardiovascular disease.

Additionally, studies have shown that populations with diets naturally high in alpha-linolenic acid and longer chain omega-3 fatty acids, common in countries where large quantities of fatty fish are consumed, have a decreased risk of cardiovascular disease.

The Adequate Intake (AI) for men and women is 1.6 and 1.1 grams of alpha-linolenic acid per day, respectively, according to the report. The report sets an AI for linoleic acid based on the median intakes in the United States. The AI for linoleic acid is 17 grams per day for adult men and 12 grams per day for adult women. Milk, nuts, avocados, olives, flaxseed, soybeans and

various oils, including safflower, canola and corn oil, are sources of these beneficial fatty acids.

Saturated fatty acids, *trans* fatty acids, and dietary cholesterol have no known beneficial role in preventing chronic disease and are not required at any level in the diet.

Saturated fatty acids, *trans* fatty acids, and dietary cholesterol have no known beneficial role in preventing chronic disease and are not required at any level in the diet. Meats, bakery items, and full-fat dairy products are the primary sources of saturated fatty acids in most diets. *Trans* fatty acids, which are chemically classified as unsaturated fatty acids but behave more like saturated fatty acids in the body, are found in partially hydrogenated vegetable oils, such as margarine and shortening, with lower levels found in meats and dairy products. Both types of fat heighten the risk of heart disease in some people by boosting the level of harmful, low-density lipoprotein cholesterol in the bloodstream; this occurs even with very small quantities in the diet. Since there is no intake level of saturated fatty acids, *trans* fatty acids, or dietary cholesterol at which there is no adverse effect, no UL is set for them; instead, the recommendation is to keep their intake as low as possible while consuming a nutritionally adequate diet, as many of the foods containing these fats also provide valuable nutrients.

This report sets the first RDA for total carbohydrates for adults and children at 130 grams per day.

Recent data have demonstrated that the higher the intake of *trans* fatty acids, the higher the ratio of low-density to high-density lipoprotein cholesterol. In fact, the magnitude of this effect may be greater for *trans* fatty acids compared to saturated fats. The report's findings and recommendations on *trans* fatty acids were released in July 2002 at the request of the Food and Drug Administration during its deliberations about whether *trans* fatty acid content should be listed on food labels.

The Low-down on Carbohydrates

Carbohydrates, which include sugars and starches, provide energy to the cells of the body, particularly the brain. This report sets the first RDA for total carbohydrates for adults and children at 130 grams per day. Most people typically exceed this daily amount, with the median intake of energy yielding carbohydrates ranging**,** depending on age**,** from approximately 200 to 330 grams per day for men and 180 to 230 grams per day for women. However, individuals who adhere to extremely low-carbohydrate regimes may not be getting enough carbohydrates from the food they eat.

While certain populations that live on a high-fat, high-protein diet containing only minimal amounts of carbohydrate appear to suffer no adverse health or longevity effects, the amount of dietary carbohydrate that provides for decreased risk of chronic disease in humans is unknown.

While certain populations that live on a high-fat, high-protein diet containing only minimal amounts of carbohydrate (e.g., Alaska and Greenland natives, Inuits in Canada, and indigenous people of the Pampas) appear to suffer no adverse health or longevity effects, the amount of dietary carbohydrate that provides for decreased risk of chronic disease in humans is unknown. There may be subtle and unrecognized health problems caused by a very low-carbohydrate diet among populations that are not genetically or traditionally adapted to such a diet. Of particular concern in Western, urbanized societies are the long-term consequences of a diet sufficiently low in carbohydrates to cause chronically increased production of keto-acids. Such a diet may result in bone mineral loss, high blood cholesterol concentrations, and increased risk of kidney stones and urinary tract deposits. It also may affect the development and function of the central nervous system.

While supplements may compensate for poor eating habits to some degree, the report stresses the benefit of getting needed nutrients from the foods we eat.

While the acceptable range for carbohydrates is 45 to 65 percent of total calories, the report suggests that no more than 25 percent of total calories come from added sugars. Unlike natural sugars, such as lactose in milk and fructose in fruits, added sugars are incorporated into foods and beverages during production and processing. The suggested maximum level is based on trends that show that people whose diets are at this level of added sugars or above are more likely to have poorer intakes of important essential nutrients. While supplements may compensate for poor eating habits to some degree, the report stresses the benefit of getting needed nutrients from the foods we eat. This is because natural foods are chemically complex and likely to contain other healthy nutrients as yet unknown. See the table below for a summary of acceptable macronutrient distribution ranges.

Acceptable Macronutrient Distribution Ranges

	Range (percent of energy)		
Macronutrient	Children, 1-3 y	Children, 4-18 y	Adults
Fat	30-40	25-35	20-35
n-6 polyunsaturated fatty acids* (linoleic acid)	5-10	5-10	5-10
n-3 polyunsaturated fatty acids* (α-linolenic acid)	0.6-1.2	0.6-1.2	0.6-1.2
Carbohydrate	45-65	45-65	45-65
Protein	5-20	10-30	10-35

*Approximately 10% of the total can come from longer-chain *n*-3 or *n*-6 fatty acids.

FIBER FACTS

The report contains the first recommended intakes for fiber from the Food and Nutrition Board.

Various health benefits have been ascribed to fiber in the diet, including increased laxation and lower blood glucose and cholesterol concentrations. Certain kinds of fiber have been shown to bind with cholesterol and prevent it from being absorbed by the body, resulting in decreased risk of heart disease. Although there is some evidence to suggest that fiber also may help to prevent colon cancer and promote weight control, the data are still inconclusive at this point.

The report contains the first recommended intakes for fiber from the Food and Nutrition Board. According to the report, men and women 50 years and younger should have 38 and 25 grams respectively of *total fiber* each day. The recommended intakes for men and women over 50 years of age are 30 and 21 grams per day, respectively, due to decreased calorie consumption among this age group. Recommended levels of *total fiber* intake also are set for children and teenagers.

QUALITY TIME FOR PROTEINS

Proteins are the major structural components of all cells of the body, and amino acids are the basic building blocks of proteins. Proteins can function as enzymes, membrane carriers, and hormones. The RDA for both men and women is set at 0.8 grams per kilogram of body weight, which is much less than most people typically consume. However, the RDA for protein for pregnant women and for women during lactation—1.1

grams per kilogram of body weight, representing an increased need during pregnancy and lactation of about 25 grams per day—indicates that there may be a greater need for protein during pregnancy and lactation than previously thought.

The report sets age-based recommended intakes for the first time for all nine of the indispensable amino acids found in dietary protein.

The report sets age-based recommended intakes for the first time for all nine of the indispensable amino acids found in dietary protein. More valuable, however, may be the scoring pattern developed for this report that can be used to evaluate the quality of a protein source, such as milk, wheat, rice, or garbanzo beans, by the relative amounts of its amino acids. This provides a method to balance intakes of poorer quality proteins by vegetarians and others who consume limited quantities of high quality dietary proteins.

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For More Information…

Copies of *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids* are available for sale from The National Academies Press; call (800) 624-6242 or (202) 334-3313 (in the Washington metropolitan area), or visit the NAP home page at **www.nap.edu.** The full text of this report is available at **http://www.nap.edu**

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