

The background of the cover is a dark, textured surface covered with numerous small, elongated, and irregular crystalline or mineral-like structures. These structures are primarily in shades of deep purple, magenta, and some hints of blue and white, giving the impression of a microscopic view of minerals or a collection of dried botanical specimens. The lighting creates highlights and shadows on the facets of these structures, adding depth and complexity to the visual field.

Roland L. Weinsier  
Sarah L. Morgan

Fundamentals of  
**CLINICAL  
NUTRITION**

# Fundamentals of CLINICAL NUTRITION

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**PART**  
**ONE**

**LIFE, DIET, AND DISEASE**

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## Diet and Disease Trends

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Normal nutrition  
Vegetarian diets  
Health foods  
Vitamin supplementation

American men and women are now living longer than their parents and grandparents, and most will die of dramatically different diseases. At the turn of the century, the leading causes of death were infectious diseases—pneumonia, tuberculosis, influenza, and diarrhea-producing infections. Today, heart disease, cancer, and stroke account for two thirds of all deaths in the United States. One out of every three Americans will die of coronary disease before age 65. Many others will die of or be disabled by these illnesses and their complications, including kidney disease secondary to hypertension.

Changes in eating patterns parallel these disease trends. Instead of the high-fiber, low-calorie foods once favored, refined starches, sweets, saturated fats, and salt make up a major portion of today's typical American diet. Combined with sedentary life-styles and cigarette smoking, these habits contribute to alarming rates of hypertension, hyperlipidemia, and cancer in the general population.

Although the rise in deaths from chronic illnesses cannot be totally explained by these eating patterns, mounting scientific evidence underscores the direct relationship between diet and health. Recognizing this link, in 1977 the Senate Select Committee on Nutrition and Human Needs set the following dietary goals for the United States:

1. Increase intake of fruits, vegetables, and whole-grain cereals.
2. Decrease intake of meat while increasing use of poultry and fish.
3. Decrease consumption of high-fat foods and partially substitute polyunsaturated (vegetable) fat for saturated (animal) fat.
4. Substitute nonfat milk for whole milk.
5. Decrease intake of butterfat, eggs, and other high-cholesterol foods.
6. Decrease use of sugar and foods high in sugar.
7. Decrease use of salt and foods high in salt content.

These guidelines have been updated as the 1990 Dietary Guidelines for Americans, which include the following:

1. Eat a variety of foods.
2. Maintain a healthy weight.
3. Choose a diet low in fat, saturated fat, and cholesterol.
4. Choose a diet with plenty of vegetables, fruits, and grain products.

**Table 1-1** Recommended dietary allowances\* Food and Nutrition Board, National Academy of Sciences—National Research Council, revised 1989. Designed for the maintenance of good nutrition of practically all healthy people in the United States

| Category  | Age (years)<br>or condition | Fat-soluble vitamins |      |         |      |                     |                            |                         |                                |                        |                        |
|-----------|-----------------------------|----------------------|------|---------|------|---------------------|----------------------------|-------------------------|--------------------------------|------------------------|------------------------|
|           |                             | Weight†              |      | Height† |      | Pro-<br>tein<br>(g) | Vita-<br>min A<br>(μg RE)‡ | Vita-<br>min D<br>(μg)§ | Vita-<br>min E<br>(mg<br>α-TE) | Vita-<br>min K<br>(μg) | Vita-<br>min C<br>(mg) |
|           |                             | (kg)                 | (lb) | (cm)    | (in) |                     |                            |                         |                                |                        |                        |
| Infants   | 0.0-0.5                     | 6                    | 13   | 60      | 24   | 13                  | 375                        | 7.5                     | 3                              | 5                      | 30                     |
|           | 0.5-1.0                     | 9                    | 20   | 71      | 28   | 14                  | 375                        | 10                      | 4                              | 10                     | 35                     |
| Children  | 1-3                         | 13                   | 29   | 90      | 35   | 16                  | 400                        | 10                      | 6                              | 15                     | 40                     |
|           | 4-6                         | 20                   | 44   | 112     | 44   | 24                  | 500                        | 10                      | 7                              | 20                     | 45                     |
|           | 7-10                        | 28                   | 62   | 132     | 52   | 28                  | 700                        | 10                      | 7                              | 30                     | 45                     |
| Males     | 11-14                       | 45                   | 99   | 157     | 62   | 45                  | 1000                       | 10                      | 10                             | 45                     | 50                     |
|           | 15-18                       | 66                   | 145  | 176     | 69   | 59                  | 1000                       | 10                      | 10                             | 65                     | 60                     |
|           | 19-24                       | 72                   | 160  | 177     | 70   | 58                  | 1000                       | 10                      | 10                             | 70                     | 60                     |
|           | 25-50                       | 79                   | 174  | 176     | 70   | 63                  | 1000                       | 5                       | 10                             | 80                     | 60                     |
|           | 51+                         | 77                   | 170  | 173     | 68   | 63                  | 1000                       | 5                       | 10                             | 80                     | 60                     |
| Females   | 11-14                       | 46                   | 101  | 157     | 62   | 46                  | 800                        | 10                      | 8                              | 45                     | 50                     |
|           | 15-18                       | 55                   | 120  | 163     | 64   | 44                  | 800                        | 10                      | 8                              | 55                     | 60                     |
|           | 19-24                       | 58                   | 128  | 164     | 65   | 46                  | 800                        | 10                      | 8                              | 60                     | 60                     |
|           | 25-50                       | 63                   | 138  | 163     | 64   | 50                  | 800                        | 5                       | 8                              | 65                     | 60                     |
|           | 51+                         | 65                   | 143  | 160     | 63   | 50                  | 800                        | 5                       | 8                              | 65                     | 60                     |
| Pregnant  |                             |                      |      |         |      | 60                  | 800                        | 10                      | 10                             | 65                     | 70                     |
| Lactating | 1st 6 months                |                      |      |         |      | 65                  | 1300                       | 10                      | 12                             | 65                     | 95                     |
|           | 2nd 6 months                |                      |      |         |      | 62                  | 1200                       | 10                      | 11                             | 65                     | 90                     |

\*The allowances, expressed as average daily intakes over time, are intended to provide for individual variations among most normal persons as they live in the United States under usual environmental stresses. Diets should be based on a variety of common foods in order to provide other nutrients for which human requirements have been less well defined. See text for detailed discussion of allowances and of nutrients not tabulated.

†Weights and heights of Reference Adults are actual medians for the U.S. population of the designated age, as reported by NHANES II. The median weights and heights of those under 19 years of age were taken from Hamill PW, Drizd TA, Johnson CL, et al: Physical growth: National Center for Health Statistics percentiles, *Am J Clin Nutr* 32:607-629, 1979. The use of these figures does not imply that the height-to-weight ratios are ideal.

5. Use sugars only in moderation.
6. Use salt and sodium only in moderation.
7. If you drink alcoholic beverages, do so in moderation.

Specific recommendations include basing total calorie intake on a balance of 55% to 60% of calories as carbohydrate, 30% as fat, and 10% to 15% as protein. Cholesterol intake should be less than 300 mg per day; salt intake should be no more than 3 g per day. First published in 1941, the U.S. Recommended Dietary Allowances (RDA), detailed in Tables 1-1 and 1-2, have been updated nine times to reflect new information on safe and adequate nutrient intake. Since the RDA for each nutrient takes into account differences in needs among healthy

**Table 1-1** Recommended dietary allowances\* Food and Nutrition Board, National Academy of Sciences—National Research Council, revised 1989.  
Designed for the maintenance of good nutrition of practically all healthy people in the United States—cont'd

| Water-soluble vitamins |                  |                             |                              |              |                               | Minerals      |                  |                 |           |           |             |                |
|------------------------|------------------|-----------------------------|------------------------------|--------------|-------------------------------|---------------|------------------|-----------------|-----------|-----------|-------------|----------------|
| Thia-min (mg)          | Ribo-flavin (mg) | Niacin (mg NE) <sup>¶</sup> | Vita-min B <sub>6</sub> (mg) | Fol-ate (μg) | Vita-min B <sub>12</sub> (μg) | Cal-cium (mg) | Phos-phorus (mg) | Mag-nesium (mg) | Iron (mg) | Zinc (mg) | Iodine (μg) | Sele-nium (μg) |
| 0.3                    | 0.4              | 5                           | 0.3                          | 25           | 0.3                           | 400           | 300              | 40              | 6         | 5         | 40          | 10             |
| 0.4                    | 0.5              | 6                           | 0.6                          | 35           | 0.5                           | 600           | 500              | 60              | 10        | 5         | 50          | 15             |
| 0.7                    | 0.8              | 9                           | 1.0                          | 50           | 0.7                           | 800           | 800              | 80              | 10        | 10        | 70          | 20             |
| 0.9                    | 1.1              | 12                          | 1.1                          | 75           | 1.0                           | 800           | 800              | 120             | 10        | 10        | 90          | 20             |
| 1.0                    | 1.2              | 13                          | 1.4                          | 100          | 1.4                           | 800           | 800              | 170             | 10        | 10        | 120         | 30             |
| 1.3                    | 1.5              | 17                          | 1.7                          | 150          | 2.0                           | 1200          | 1200             | 270             | 12        | 15        | 150         | 40             |
| 1.5                    | 1.8              | 20                          | 2.0                          | 200          | 2.0                           | 1200          | 1200             | 400             | 12        | 15        | 150         | 50             |
| 1.5                    | 1.7              | 19                          | 2.0                          | 200          | 2.0                           | 1200          | 1200             | 350             | 10        | 15        | 150         | 70             |
| 1.5                    | 1.7              | 19                          | 2.0                          | 200          | 2.0                           | 800           | 800              | 350             | 10        | 15        | 150         | 70             |
| 1.2                    | 1.4              | 15                          | 2.0                          | 200          | 2.0                           | 800           | 800              | 350             | 10        | 15        | 150         | 70             |
| 1.1                    | 1.3              | 15                          | 1.4                          | 150          | 2.0                           | 1200          | 1200             | 280             | 15        | 12        | 150         | 45             |
| 1.1                    | 1.3              | 15                          | 1.5                          | 180          | 2.0                           | 1200          | 1200             | 300             | 15        | 12        | 150         | 50             |
| 1.1                    | 1.3              | 15                          | 1.6                          | 180          | 2.0                           | 1200          | 1200             | 280             | 15        | 12        | 150         | 55             |
| 1.1                    | 1.3              | 15                          | 1.6                          | 180          | 2.0                           | 800           | 800              | 280             | 15        | 12        | 150         | 55             |
| 1.0                    | 1.2              | 13                          | 1.6                          | 180          | 2.0                           | 800           | 800              | 280             | 10        | 12        | 150         | 55             |
| 1.5                    | 1.6              | 17                          | 2.2                          | 400          | 2.2                           | 1200          | 1200             | 320             | 30        | 15        | 175         | 65             |
| 1.6                    | 1.8              | 20                          | 2.1                          | 280          | 2.6                           | 1200          | 1200             | 355             | 15        | 19        | 200         | 75             |
| 1.6                    | 1.7              | 20                          | 2.1                          | 260          | 2.6                           | 1200          | 1200             | 340             | 15        | 16        | 200         | 75             |

‡ Retinol equivalents. 1 retinol equivalent = 1 μg retinol or 6 μg β-carotene.

§ As cholecalciferol. 10 μg cholecalciferol = 400 IU of vitamin D.

|| α-Tocopherol equivalents. 1 mg d-α tocopherol = 1 α-TE. See text for variation in allowances and calculation of vitamin E activity of the diet as α-tocopherol equivalents.

¶ 1 NE (niacin equivalent) is equal to 1 mg of niacin or 60 mg of dietary tryptophan.

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people, they should not be used to judge individual requirements. (For information on specific nutrients and their roles in metabolism, see Chapters 5 through 8).

## NORMAL NUTRITION

Contrary to what is often reported in the popular press, there are no magical foods. For most people, a prudent diet consists of a variety of foods—fruits, vegetables, whole grains, dairy products, lean meat, and fish.

Calorie needs vary according to weight, age, gender, and level of physical activity. In general, adult men need 2300 to 3100 kcal each day; adult women

**Table 1-2** Estimated safe and adequate daily dietary intakes of selected vitamins and minerals\*

| Category                 | Age (years) | Vitamins    |                       |             | Trace elements |               |               |                 |
|--------------------------|-------------|-------------|-----------------------|-------------|----------------|---------------|---------------|-----------------|
|                          |             | Biotin (µg) | Pantothenic acid (mg) | Copper (mg) | Manganese (mg) | Fluoride (mg) | Chromium (µg) | Molybdenum (µg) |
| Infants                  | 0-0.5       | 10          | 2                     | 0.4-0.6     | 0.3-0.6        | 0.1-0.5       | 10-40         | 15-30           |
|                          | 0.5-1       | 15          | 3                     | 0.6-0.7     | 0.6-1.0        | 0.2-1.0       | 20-60         | 20-40           |
|                          | 1-3         | 20          | 3                     | 0.7-1.0     | 1.0-1.5        | 0.5-1.5       | 20-80         | 25-50           |
| Children and adolescents | 4-6         | 25          | 3-4                   | 1.0-1.5     | 1.5-2.0        | 1.0-2.5       | 30-120        | 30-75           |
|                          | 7-10        | 30          | 4-5                   | 1.0-2.0     | 2.0-3.0        | 1.5-2.5       | 50-200        | 50-150          |
|                          | 11+         | 30-100      | 4-7                   | 1.5-2.5     | 2.0-5.0        | 1.5-2.5       | 50-200        | 75-250          |
| Adults                   |             | 30-100      | 4-7                   | 1.5-3.0     | 2.0-5.0        | 1.5-4.0       | 50-200        | 75-250          |

\*Because there is less information on which to base allowances, these figures are not given in the main table of RDA and are provided here in the form of ranges of recommended intakes.

†Since the toxic levels for many trace elements may be only several times usual intakes, the upper levels for the trace elements given in this table should not be habitually exceeded.

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require 1600 to 2400 kcal to maintain their weight and energy needs. In either case, those calories should come from foods that yield the most nutrients for the fewest calories. Consider that 1 g of carbohydrate or 1 g of protein has 4 calories, whereas 1 g of fat has 9 calories.

The bulk of an average adult's diet should consist of vegetables, fruits, and unrefined starches such as potatoes, corn, beans, whole-grain cereals, rice, and bread. These three food groups contain most of the vitamins and minerals the body needs. Four to 6 ounces each day of meat, fish, or low-fat cheese will provide adequate protein. Dairy foods should be as low in fat as possible, and fats and oils should be limited to 3 or 4 tsp per day.

## VEGETARIAN DIETS

---

With careful planning, completely meatless diets can be consistent with adequate nutrient intake, and they may offer certain health advantages. Vegetarian diets may either totally exclude meat, fish, eggs, and dairy products (vegan) or rely upon fish (pesco-vegetarian), eggs (ovo-vegetarian), or dairy products (lacto-vegetarian) as a source of protein.

Generally, legumes (dried beans, dried peas, and lentils) are combined with grains, nuts, or seeds to provide all essential amino acids. Vitamin B<sub>12</sub>, which is found only in animal products, may be supplied through tablet supplementation or through fortified soybean products if no animal products are consumed.

Plant-based diets that include one or a combination of dairy products, eggs, or fish can be nutritionally similar to diets containing meats if menus are planned to provide sufficient calories, essential amino acids, and adequate sources of calcium, riboflavin, iron, and vitamins A, D, and B<sub>12</sub>. Vegetarian diets may lower risk factors for heart disease by lowering serum cholesterol levels, they may help control body weight, and they may reduce the risk of cancer since they tend to be low in fat and high in fiber and  $\beta$  carotene-containing vegetables and fruits. While complementary plant proteins were stressed in the past, it is now felt that an adequate mix of amino acids will be consumed by eating a variety of plant products.

## HEALTH FOODS

---

The terms *organic*, *natural*, and *health foods* are loosely defined and are often used interchangeably. There is no scientific basis for claiming that organic foods are more nutritious than conventional foods. Food grown by chemical processes do not necessarily differ in taste, appearance, or nutrient content from those that are grown organically.

The Federal Trade Commission has proposed to prohibit use of the term *health food* in advertising because it may fool consumers into thinking that one specific food is the key to good health.

## VITAMIN SUPPLEMENTATION

---

Although the majority of Americans consuming a varied diet do not require vitamin supplementation, such supplements are routinely consumed by one third

**Table 1-3** Situations in which vitamin supplements are recommended

- 
1. Pregnancy
  2. Infancy
  3. High-risk life-styles
    - Low socioeconomic status
    - Anorexia/starvation
    - Some obesity regimens
    - Pregnant teenagers
    - Vegans
  4. Medical conditions which impair nutrient absorption or utilization, or if nutrient needs are increased
- 

to two thirds of the American population. In some subgroups such as the elderly, use of vitamins may be even higher.

Clear indications for vitamin supplementation (listed in Table 1-3) include pregnancy (folate and iron); infancy (iron); and certain high-risk situations such as anorexia nervosa, participation in some weight-loss programs, and a vegan dietary pattern.

Multiple vitamin supplements can be categorized into two groups. It is important to be familiar with the content of these supplements, since not all contain the same vitamins or doses. The categories are as follows:

1. Replacement or supplemental vitamins. These generally contain 50% to 150% of the RDA for the nutrients provided. Replacement vitamins are best used as supplements in patients at risk for the development of vitamin deficiency.
2. Therapeutic vitamins. These should not exceed two to ten times the RDA for the vitamins included. Fat-soluble vitamins generally are present at two times or less the RDA. Therapeutic vitamins should be used for treatment of deficiency states or in situations where absorption and utilization of vitamins are reduced or requirements are increased.

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## Disorders of Nutrition

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Obesity  
Diabetes mellitus  
Diet, hyperlipidemia, and coronary artery disease  
Hypertension  
Diet and cancer  
Nutrition and oral health  
Osteoporosis  
Nutritional anemias  
Eating disorders

### **OBESITY**

---

Excess weight has been associated with a number of health problems, ranging from hypertension to cancer. Certainly not all obese persons are unhealthy, and health problems are not evenly distributed among all obese people; nevertheless, there is convincing evidence that obesity has an adverse effect on longevity and, other things being equal, the greater the degree of obesity, the higher the death rate.

#### **Factors predisposing to obesity**

It is almost certain that obesity is multifactorial and that there are different types of obesity. Although the causes are not completely understood, the net effect is an imbalance of energy intake and expenditure. One of the oldest schemes for classifying obesity divides it into two types: endogenous, which implies internal causes, and exogenous, suggesting external or acquired causes.

Endogenous factors include genetic, endocrine, and metabolic conditions. Obese parents frequently have obese children (Fig. 2-1), suggesting a familial factor. In fact, this reflects the well-established role of heredity in predisposition to obesity but does not rule out the possible role of the family environment or even that of the in utero and immediate postnatal environment on the observed concordance of obesity in identical twins.

Endocrine abnormalities such as hypothyroidism, Cushing's syndrome (adrenal excess), polycystic ovary syndrome (Stein-Leventhal), and insulinoma can cause obesity, but altogether these account for less than about 1% of all cases. Interestingly, the markedly obese person is least likely to have an endocrine disorder. Other abnormalities to consider include hypothalamic lesions involving centers of appetite control and congenital disorders such as the Prader-Willi syndrome (Fig. 2-2).