

SECOND EDITION

# NUTRITIONAL ASSESSMENT

DIETARY • ANTHROPOMETRIC • BIOCHEMICAL • CLINICAL



Robert D. Lee • David C. Nieman

SECOND EDITION

# NUTRITIONAL ASSESSMENT

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*Dedicated to my mother, Mary Z. Lee, whose  
love, patience, and faith give my life  
stability and meaning, and to the memory  
of my late father, Harry C. Lee, whose  
honesty, sincerity, and determination  
continue to be guiding principles in my life.*

Robert D. Lee

*To my loving wife, Cathy Nieman, MS, RD,  
for her insights, practical advice, and moral  
support.*

David C. Nieman

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**SECOND EDITION**

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# PREFACE

Dietitians, health educators, nurses, physicians, and other health professionals often are challenged by their patients' and students' questions about the relationships between diet and health. How can I make sure that my diet gives me all of the important vitamins and minerals? How can I know if I am at risk of osteoporosis? Are Americans eating better than they did just 10 years ago? Are such programs as the National Cholesterol Education Program and the Special Supplemental Food Program for Women, Infants, and Children cost effective? Will the new food labels help me keep better track of my saturated fat intake? Which laboratory tests can best tell me if my iron status is adequate?

The second edition of *Nutritional Assessment* discusses these topics and many others, including computerized dietary analysis systems, national surveys of dietary intake and nutritional status, assessment techniques and standards for the hospitalized patient, nutritional assessment in the prevention of such diseases as coronary heart disease and diabetes, clinical assessment, and proper counseling techniques. This text builds on the strengths of its first edition and is primarily a textbook for students of dietetics and public health nutrition. It is also intended to be a valuable reference for health professionals who interact on a regular basis with patients who have diet-related medical problems.

## ORGANIZATION

We recommend that study of *Nutritional Assessment* follow the progression of the 11 chapters in the order in which they are presented. Chapter 1 gives a thorough introduction to the topic of nutritional assessment, exploring various definitions and concepts. Chapter 2 reviews the wide assortment of standards for nutrient intake, such as the 1989 Recommended Dietary Allowances, the Food Exchange System, and the Food Guide Pyramid, and gives practical guidelines for their use.

Methods for measuring diet and the strengths and weaknesses of each technique are outlined in Chapter 3. Results from the Continuing Survey of Food Intakes by Individuals, the National Health and Nutrition Examination Survey (NHANES III), and other diet and nutrition surveys are interpreted in Chapter 4, and statistics on trends in the American diet are summarized. Eight computerized dietary analysis systems are reviewed in Chapter 5, with a complete discussion of their operating features, nutrient databases, and overall strengths and weaknesses.

Chapters 6 and 7 survey anthropometric techniques for both healthy and ill people, with complete descriptions of how to measure body skinfolds and circumferences and then make appropriate decisions on classification. Nutritional assessment, as it relates to prevention of coronary

heart disease, hypertension, osteoporosis, and diabetes is reviewed in Chapter 8. Seventeen different laboratory tests are interpreted, and biochemical methods for assessing protein, iron, calcium, and other nutrient status are discussed in Chapter 9. Chapter 10 gives an overview of the clinical assessment of nutritional status. Chapter 11 reviews the major theories and techniques of both individual and group counseling methods.

## FEATURES

### Chapter Outline

Each chapter begins with an outline of the contents of the chapter. Reading this before beginning the chapter gives the student an idea of the material to be covered, and it is a useful review tool when the student is studying for exams.

### Figures and Tables

There are more than 60 tables in the text, supplemented with 114 graphs, illustrations, and photographs. The photographs depict the exact procedures involved in skinfold measurement and other anthropometric techniques. All information is up-to-date, including the most current tables on nutrient standards from several different nations, food labeling criteria, anthropometric classifications, blood panel standards, and national survey results.

### Summaries

A summary at the end of each chapter highlights all important chapter information and will be especially helpful when the student reviews for exams.

### References

A complete list of up-to-date references is included at the end of each chapter. This list provides the student and instructor with extensive sources for continued study.

## Assessment Activities

Most chapters end with two or three practical Assessment Activities to help the student better understand the concepts presented in the chapter. For example, activities are given for personal computerized dietary analysis, use of food composition tables, practice of anthropometry and one-on-one counseling, and interpretation of serum lipid and cholesterol results.

## Appendixes

To make this textbook as practical as possible, a wide variety of questionnaires, checklists, and tables are given in the appendixes. Appendixes A, B, and C contain nutrient standards from the United Kingdom, Canada, and the United States. Various recording forms and questionnaires used in measurement of the diet are presented in Appendixes D through K. Appendix L is a nutrient breakdown of more than 650 different foods. Growth charts for children and adolescents are shown in Appendix M. A list of suppliers for nutritional assessment equipment and supplies is given in Appendix N. Various anthropometric standards are tabled in Appendixes O through R. Appendix S provides reference data for serum lipid and lipoprotein levels for children, adolescents, and adults. Appendix T contains a form for self-monitoring dietary intake, and Appendix U has a checklist for counseling competencies.

## Glossary

Throughout the text, important terms are shown in boldface type. Concise definitions for these nearly 330 terms can be found in the glossary.

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# INTRODUCTION TO NUTRITIONAL ASSESSMENT

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  - Deficiency Diseases Once Common
  - Chronic Diseases Now Epidemic
- Nutritional Screening and Assessment
  - Nutritional Assessment Methods
    - Anthropometric Methods
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    - Clinical Methods
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  - Importance of Nutritional Assessment
- Opportunities in Nutritional Assessment
  - Meeting the Year 2000 Health Objectives
    - In Hospitals
    - Diabetes Mellitus
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    - Nutrition Monitoring
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## INTRODUCTION

Until about the middle of the twentieth century, infectious disease was the leading cause of death in developed countries, and nutritional deficiencies were common. Improved sanitation, vaccine development, improved health care, and increased quality and quantity of food now have virtually eliminated infectious disease as a major

killer in developed countries, and nutrient deficiency is much less common.

However, with increased life expectancy, a higher living standard, and an abundance of food has come an epidemic of chronic diseases, many of which are related to excess consumption of high-fat foods and alcoholic beverages and inadequate consumption of foods high in complex carbohydrates and fiber. This situation, along with heightened public and professional interest in the role of nutrition in health and disease, has created an increased need for health professionals proficient in nutritional assessment. The ability to identify persons at nutritional risk and to effectively enhance their health status through improved nutrition has made nutritional assessment an important tool for health professionals concerned about making health care more cost effective.

## GOOD NUTRITION ESSENTIAL FOR HEALTH

Good nutrition is critical for the well-being of any society and to each individual within that society. The variety, quality, and quantity of available food and the patterns of food consumption can profoundly affect health.

Scurvy, for example, was among the first diseases recognized as being caused by a nutritional deficiency. One of the earliest descriptions of scurvy was made in 1250 by the French writer Joinville, who observed it among the troops of Louis IX at the siege of Cairo. When Vasco da Gama sailed to the East Indies around the Cape of



Good Hope in 1497, more than 60% of his crew died of scurvy.<sup>1</sup> In 1747, James Lind, a British naval surgeon, conducted the first controlled human dietary experiment showing that consumption of citrus fruits cured scurvy.<sup>2</sup>

## Deficiency Diseases Once Common

During the nineteenth century and the first half of the twentieth century, scurvy and other **deficiency diseases** such as rickets, pellagra, beriberi, xerophthalmia, and goiter (caused by inadequate dietary vitamin D, niacin, thiamin, vitamin A, and iodine, respectively) were commonly seen in the United States and throughout the world and posed a significant threat to human health (Figure 1-1).<sup>3</sup>

Nutritional deficiencies and **infectious disease** remain serious problems in many developing countries and even among certain population groups in the United States and other developed countries.<sup>3</sup> Sanitation measures, improved health care, vaccine development, and mass immunization programs have dramatically reduced the incidence of infectious disease in developed nations. An abundant food supply, **fortification** of some foods with important trace nutrients, **enrichment** to replace certain nutrients lost in food processing, and better methods of determining the nutrient content of foods have made nutrient deficiency diseases relatively uncommon in developed nations.<sup>3</sup> Among certain groups, however, deficiencies of certain nutrients remain a problem.<sup>4</sup>

## Chronic Diseases Now Epidemic

Despite the many advances of nutritional science, nutrition-related diseases not only continue to exist but result in a heavy toll of disease and death. In recent decades, however, they have taken a form different from the nutrient-deficiency diseases common in the early 1900s. Diseases of dietary excess and imbalance now rank among the leading causes of illness and death in America and play a prominent role in



**Figure 1-1** Poverty in America during the economic depression of the 1930s led to limited food choices and diets lacking essential nutrients. Nutritional deficiency diseases often resulted. Poverty among certain groups in America continues to prevent them from obtaining adequate nutrition and health care.

the epidemic of chronic disease that Western nations are currently experiencing.<sup>5</sup> In the 1988 *Surgeon General's Report on Nutrition and Health*, 5 of the 10 leading causes of death—**coronary heart disease** (heart attack), certain **cancers**, **stroke**, **diabetes mellitus**, and **atherosclerosis**—were linked with diet.<sup>3</sup> Table 1-1 ranks the 15 leading causes of death in 1993. Of these, five are linked with diet and four (accidents, suicide, homicide, and chronic liver disease and cirrhosis) are linked with excessive alcohol consumption.

*The Surgeon General's Report on Nutrition and Health* points out that although these diseases are caused by a combination of dietary and nondietary factors and that the exact proportion attributable to diet is uncertain, “it is now clear that diet contributes in substantial ways to the development of these diseases and that modification of diet can contribute to their prevention.”<sup>3</sup> The report goes on to say that “for the two out of three adult Americans who do not smoke and do not drink excessively, one personal choice seems to influence long-term health prospects more than any other: what we eat.”<sup>3</sup> The report's

**TABLE 1-1** Estimated deaths and percent of total deaths for the 15 leading causes of death: United States, 1993

Rank	Cause of death	Number	Percent of total deaths
	All causes	2,268,000	100.0
1*	Diseases of the heart	739,860	32.6
2*	Malignant neoplasms	530,870	23.4
3*	Cerebrovascular disease	149,740	6.6
4	Chronic obstructive pulmonary disease	101,090	4.5
5†	Accidents and adverse effects	88,630	3.9
6	Pneumonia and influenza	81,730	3.6
7*	Diabetes mellitus	55,110	2.4
8	Human immunodeficiency virus infection	38,500	1.7
9†	Suicide	31,230	1.4
10†	Homicide and legal intervention	25,470	1.1
11†	Chronic liver disease and cirrhosis	24,730	1.1
12	Nephritis, nephrotic syndrome, and nephrosis	23,500	1.0
13	Septicemia	20,420	0.9
14*	Atherosclerosis	17,090	0.8
15	Certain conditions arising in the perinatal period	15,820	0.7
	All other causes	324,160	14.3

From the National Center for Health Statistics. 1994. *Monthly Vital Statistics Report* 42 (13).

\*Causes of death in which diet plays a part.

†Causes of death in which excessive alcohol consumption plays a part.

main conclusion is that "overconsumption of certain dietary components is now a major concern for Americans. While many food factors are involved, chief among them is the disproportionate consumption of foods high in fats, often at the expense of foods high in complex carbohydrates and fiber that may be more conducive to health."<sup>3</sup>

The continuing presence of nutrition-related disease makes it essential that health professionals be able to determine the nutritional status of individuals. Both the American College of Physicians and the U.S. Preventive Services Task Force regard nutritional assessment and counseling as essential components of preventive services offered by physicians and other health professionals.<sup>6</sup> This will help identify persons

who might benefit from nutritional intervention to improve their health and which interventions would be appropriate.

## NUTRITIONAL SCREENING AND ASSESSMENT

**Nutritional screening** "is the process of identifying characteristics known to be associated with nutrition problems. Its purpose is to pinpoint individuals who are malnourished or at nutritional risk."<sup>7</sup> If nutritional screening identifies a person at nutritional risk, a more thorough evaluation of the individual's nutritional status can be performed. Nutritional screening can be done by any member of the health care team such as a dietitian, dietetic

technician, dietary manager, nurse, or physician. Nutritional screening and how it fits into the nutritional care process are discussed in greater detail in Chapter 7, and examples of screening instruments are shown there.

**Nutritional assessment** is an evaluation of the nutritional status of individuals or populations through measurements of food and nutrient intake and evaluation of nutrition-related health indicators. The U.S. Department of Health and Human Services (DHHS) defines nutritional assessment as “the measurement of indicators of dietary status and nutrition-related health status to identify the possible occurrence, nature, and extent of impaired nutritional status,” which can range from deficiency to toxicity.<sup>4</sup> The American Dietetic Association defines nutritional assessment as “a comprehensive approach, completed by a registered dietitian, to defining nutritional status that uses medical, nutrition, and medication histories; physical examination; anthropometric measurements; and laboratory data.”<sup>7</sup> According to the World Health Organization (WHO), the ultimate purpose of nutritional assessment is to improve human health.<sup>8</sup>

## Nutritional Assessment Methods

Four different methods are used to collect data used in assessing a person's nutritional status: anthropometric, biochemical or laboratory, clinical, and dietary (Figure 1-2). The mnemonic “ABCD” can help you remember these different methods. Each method will be explored in depth in later chapters.

### Anthropometric Methods

**Anthropometry** is the measurement of the physical dimensions and gross composition of the body. Examples of anthropometry include measurements of height, weight, and head circumference and the use of measurements of **skinfold thickness**, **body density** (underwater weighing),

and **bioelectrical impedance** to estimate the percentage of fat and lean tissue in the body. These results often are compared with standard values obtained from measurements of large numbers of subjects. Anthropometry will be covered in Chapters 6 and 8. At the end of most chapters are suggested exercises, called Assessment Activities, that allow you to apply the concepts covered. In the Assessment Activities of Chapter 6, you will try your hand at skinfold measurements to estimate percent body fat and compare several different methods of determining body composition.

### Biochemical Methods

In nutritional assessment, biochemical or laboratory methods can include measuring a nutrient or its metabolite in blood, feces, or urine or measuring a variety of other components in blood and other tissues that have a relationship to nutritional status. The quantity of **albumin** and other **serum proteins** frequently is regarded as an indicator of the body's protein status, and **hemoglobin** levels in blood reflect iron status. Blood **cholesterol** levels, which are influenced by diet, reflect coronary heart disease risk.

Biochemical methods are covered in Chapters 7 through 9. An Assessment Activity in Chapter 8 suggests that you have your blood drawn and tested at a clinical laboratory and compare your results with recommended values. Assessment activities in Chapters 7 and 9 guide you through the application of key concepts as you evaluate biochemical and other data from patient records.

### Clinical Methods

The medical history and physical examination are clinical methods used to detect **signs** and **symptoms** of **malnutrition**. Symptoms are disease manifestations that the patient is usually aware of and often complains about. Signs are observations made by a qualified examiner during physical examination. Painful cracks in the angles of the