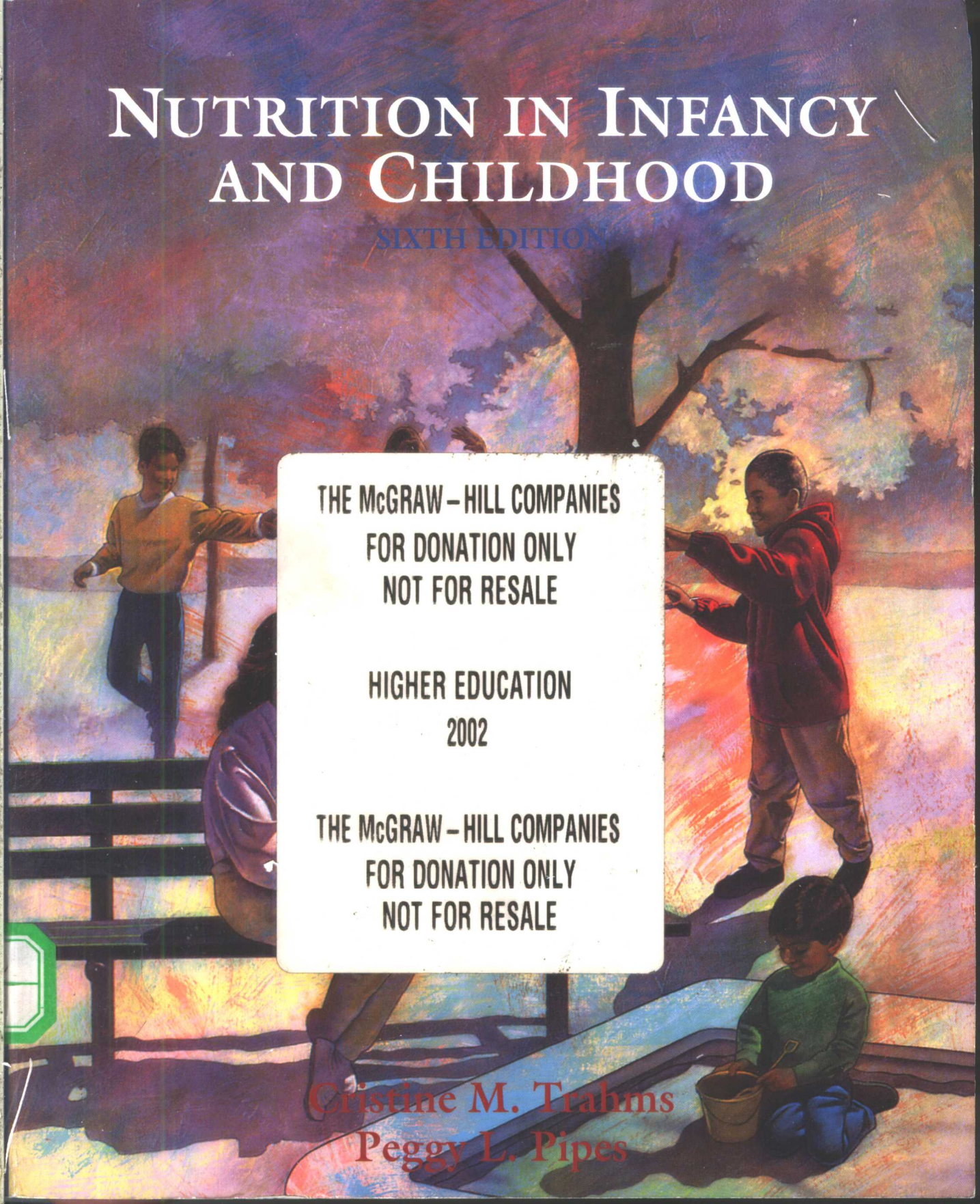
NUTRITION IN INFANCY AND CHILDHOOD

SIXTH EDITION



Cristine M. Trahms
Peggy L. Pipes

NUTRITION IN INFANCY AND CHILDHOOD

EDITED BY

CRISTINE M. TRAHMS, *M.S., R.D., C.D., F.A.D.A.*

Lecturer, Division of Pediatric Genetics,
Department of Pediatrics, School of Medicine; and Head, Nutrition,
Center on Human Development and Disabilities
University of Washington, Seattle

PEGGY L. PIPES, *R.D., M.P.H.*

Emeritus, Parent and Child Nursing, School of Nursing
University of Washington, Seattle

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Contributors

Betty Lucas, M.P.H.

Lecturer, Parent and Child Nursing, School of Nursing;
Nutritionist, Center on Human Development and Disabilities,
University of Washington, Seattle, Washington

Mary J. O'Leary, Ph.D., R.D.

Nutrition Consultant, Private Practice,
Albuquerque, New Mexico

Sally M. O'Neil, Ph.D.

Behavioral Psychologist, Private Practice,
Seattle, Washington

Robin Pritkin Glass, M.S., O.T.R.

Occupational Therapist,
Children's Hospital and Medical Center, Seattle, Washington

Jane Mitchell Rees, M.S., R.D.

Lecturer, Division of Adolescent Medicine,
Department of Pediatrics, School of Medicine;
Director, Nutrition and Education Services, Adolescent Health Program,
University of Washington, Seattle, Washington

Joan Zerzan, M.S., R.D.

Neonatal Nutritionist,
University of Washington Medical Center, Seattle, Washington

In memory of
Miriam Lowenberg, Ph.D.
A friend and supportive colleague,
whose professional contributions
to the nourishment of children endure.

Preface

From its first edition the goal of *Nutrition in Infancy and Childhood* has been to offer nutrition information related to both growth and development and also normal and abnormal conditions in infancy and childhood. The primary intended audience consists of students and providers of clinical services in the nutrition-related medical environment. However, we recognize that the general public has an increased interest in nutrition. Accordingly, we have tried to develop materials in such a way that the book is not only geared to professionals but also to the interested general reader. In doing so, we have not compromised the scientific content of the material.

Most parents are aware that nutrition plays a major role not only in the growth and development of their child but also in the prevention of disease. However, despite, or perhaps because of, the many nutrition-related articles that can be found in the popular press, many parents have questions about how best to feed their children. Some parents have questions about which foods provide needed nutrients or appropriate diet modifications for their children. Others have questions about how to create an environment in which children will consume the needed foods. Answers to these questions are provided in these chapters. The sixth edition of *Nutrition in Infancy and Childhood* is updated and expanded to best meet the twin goals of providing useful information to both professionals and the general reader.

CONTENT FEATURES

The organization of this sixth edition strives to maintain a chronological approach and to combine a consistent progression from the general or usual to the specific or unusual circumstances of nourishment, growth and development. The first chapters of *Nutrition in Infancy and Childhood* present background materials and tools that will be used in later chapters: growth and development, nutrient needs of infants and children, and the clinical approach to assessing and collecting food intake information. The next chapters focus on nourishment of well infants and the special needs of preterm and low-birthweight infants. The following chapters deal with behavior; how food patterns are developed, shaped, and changed. The chapter originally prepared by Miriam Lowenberg, Ph.D., one of the major pioneers in nutrition and feeding of children, remains in its original format. This chapter can now be considered a classic nutrition work. The next chapter focuses on more current issues related to the development of food patterns for young children. The discussion then moves to parent and child interactions as they influence food patterns and

the use of behavior modification techniques to achieve the acceptance of foods and teach feeding skills to young children. Discussions of the application of nutrition in special circumstances follow. These include the child who is vegetarian and the prevention of chronic diseases by dietary intervention.

The chronological grouping of chapters continues with emphasis on children of various ages: preschool, school-age, and adolescent children. After a discussion of adolescent growth and nutritional needs, special circumstances in adolescence that require emphasis on nourishment are presented. These include discussions of pregnancy management for adolescent females, nutritional concerns in athletic competition, and situations of disordered eating: anorexia nervosa, bulimia nervosa, and obesity. The final chapter deals with children who have special health care and nutritional needs.

To aid the student in application, review questions are a part of every chapter. Developmental and behavioral parameters are integrated into the chapter discussions. Case studies are added to each chapter to enhance application of the principles presented. The suggested learning activities and case studies provide strategies for clinical approaches that utilize the information presented in the chapters.

The implementation of nutrition plans for children, especially those with special needs, and when medical or psychosocial factors play a role in the etiology of the nutrition concern, requires an interdisciplinary assessment and management model. Therefore the interdisciplinary approach has been emphasized. In fact, an interdisciplinary group of professionals including an occupational therapist and a nurse with expertise in behavioral management techniques, as well as nutritionists known for their skills in nutrition intervention for specific age groups and conditions, contributed to the book. A variety of general readers, students, and health care professionals—especially those interested in nutrition/dietetics, maternal and child nursing, occupational therapy, and physical therapy—will find the book useful.

ACKNOWLEDGMENTS

In the preparation of any manuscript, many individuals make significant contributions. Parents of clients and clients themselves at the Center on Human Development and Disabilities, University of Washington, willingly discussed their nutrition concerns. They provided detailed information on what their children ate and factors that influenced their acceptance of foods and food plans. Parents of clients, and clients themselves, asked many thoughtful questions and helped shape the approach to nutrition services we present in this book. The nutrition trainees and students asked many probing and important questions and shaped our viewpoint on nutrition assessment and services. The contributors developed their chapters to meet an additional deadline in their already busy schedules. The encouragement from our friends and supporters in the federal Maternal and Child Health Bureau is much appreciated.

We found Jean Babrick, our editor at McGraw-Hill, to be especially helpful in providing guidance and patience as the sixth edition became a reality.

We are also grateful to the reviewers who gave of their time and expertise to help us develop a useful text. We are especially grateful to Judy Powell, MS, RD, CDE, Pediatric Nutrition Specialist; Gail Kieckhefer, Ph.D., Parent and Child Nursing, University of Washington; and Mary Story, Ph.D., Division of Epidemiology, University of Minnesota.

We appreciate the technical skills of Greg Owen whose expertise in graphics is shown in the growth charts, and Ann LeVasseur and Dorothea Trahms-Allen, whose photographs enhance the text. Finally, we thank our family members and friends who supported us as we struggled to bring the sixth edition to fruition.

Cristine M. Trahms
Peggy L. Pipes

Contents

CHAPTER

1 Growth, Development, and Nutrition

Cristine M. Trahms
Peggy L. Pipes

Objectives

After studying this chapter, the student should:

- ✔ *Understand the effect of nutrition on physical growth and development.*
- ✔ *Understand characteristics of cell growth and the concept of critical stages of growth and development.*
- ✔ *Recognize appropriate equipment necessary to secure accurate measurements of height, weight, and skinfolds.*
- ✔ *Recognize if anthropometric parameters are secured in a manner that provides accurate data.*
- ✔ *Be able to interpret growth data on individual children in relation to guidelines.*

A healthy child grows at a genetically predetermined rate that can be compromised or accelerated by undernutrition, imbalanced nutrient intake, or overnutrition. Progress in physical growth is one criterion used to assess the nutritional status of populations and of individual children. It is therefore important that persons concerned with nutrition and feeding of infants and children be familiar with the process and parameters of growth, as well as the charts used to assess it.

Although every aspect and component of growth is thought to be influenced by nutrition, this discussion focuses on those parameters dealt with by persons concerned with children's food intake: increases in linear growth and weight, changes in body composition, how to secure accurate measurements of growth, and how to

INTERRELATED SOCIOECONOMIC FACTORS ADVERSELY AFFECTING GROWTH OF YOUNG CHILDREN

- Infectious diseases
- Parasites
- Poor sanitation
- Poverty
- Chronic illness
- Food of poor quality
- Limited availability of food
- Food withheld from the child
- Lack of knowledge of appropriate food for infants and young children
- Poor social interaction and emotional support from parents and caregivers

interpret physical growth patterns of normal children. Patterns of catch-up growth after an episode of wasting (when there is a greater deficit in weight than length) and stunting (when deficits of both height and weight are present) are discussed.

NUTRITION AND PHYSICAL GROWTH

The relationship between nutrition and physical growth of infants and young children is complex. There are many broad social, economic, biologic, and psychological factors that affect the growth of the infant and young child. Many efforts have been dedicated to understanding these relationships and mechanisms. As shown in the box above, the nutrition component of depressed physical growth may be related to limited availability of foods or the poor quality of food consumed. These factors may lead to an insufficiency of energy and/or protein or an insufficient intake of one or more other nutrients. Chronic illness, parasites, or poor sanitation are also significant factors. Nutrition to support typical growth requires a minimum intake of energy, protein, and nutrients appropriate for age and body size. For the rapidly growing infant, nutrient needs closely parallel growth.

Children who are undernourished are shorter and weigh less than their well-nourished peers. The rate of gain in weight is affected more than is the rate of gain in height, but if the nutritional deficit is severe enough and continues long enough, linear growth will be deficient or may cease and pubertal maturation and **epiphyseal closure** may be delayed. Linear growth is delayed when energy intake is adequate but protein intake is deficient. Weight gain is depressed when energy intake is deficient, and linear growth will eventually be deficient (table 1-1).

Physical growth is a sign of positive interaction between nutrition, genetics, and time. Nutrition functions within the boundaries of an individual's genetic background and current environment to maximize growth potential. Growth is one measure of nutritional effectiveness in early life and is controlled by complex interrelated external and internal factors. General categories of factors affecting growth are (1) genes, (2) hormones, and (3) environmental influences that include (a) nutrition, (b) secular trends among groups of people, (c) immigration, (d) socioeconomic status, and (e) health and emotions.

SECULAR AND GENETIC INFLUENCES ON GROWTH

Growth patterns of children of racial groups whose members have been believed to be genetically small increase under conditions of improved

TABLE 1-1 Guidelines for Assessment of Growth

	Length/Height	Weight	Head Circumference
Typical growth	In channel*	In channel	In channel
Energy deprivation	In channel	Depressed	In channel
Protein-energy malnutrition	Depressed	Depressed	In channel
Severe malnutrition	Depressed	Depressed	Depressed
Various disease states	Depressed	Depressed	Often depressed
Recovery or catch-up growth	Accelerated	Accelerated	Accelerated

* *In channel* is defined as the usual growth pattern of the child between the 10th and 90th percentiles.

nutrition. Especially striking was the change in the growth pattern of Japanese children born in the post–World War II period compared with those institutionalized during the prewar period. In 1962, boys at 14 years of age were found to be 7.6 cm taller and girls at 11 years of age 6.6 cm taller than prewar children of the same ages. The change in growth patterns was credited to an increase in the intake of animal protein.[1] A 1960 survey of children in Japanese orphanages whose food budgets were limited found heights to be significantly less than those of the national averages for children of the same age and sex. Adolescents, as a group, were shorter than their age-group average than were younger children.[2] During the subsequent 10 years the provision of 180 gm of milk and one egg per day, as well as increases in food budgets resulted in improvements in the quality and quantity of protein, as well as in the total amount of nutrients consumed. Increases in average stature were greater than expected.[2]

The long-term effects of malnutrition on physical growth during infancy and early childhood have been studied in children. Asian children tend to be smaller than black children or white children. However, growth status of refugee East Asian children increased between 1978 and 1989 and is now similar to or approaching that of other ethnic groups in the United States. The researchers at the Centers for Disease Control suggest that these studies may indicate that children of different ethnic origins have similar growth potentials.[3]

Differences have been noted in rates of growth of population groups in the United States. These differences are largely attributable to socioeconomic status. American black infants are smaller than American white infants at birth. American black infants grow more rapidly during the first 2 years, and from that age through adolescence are taller than American white boys and girls of the same age groups. The Hispanic Health and Nutrition Examination Survey, 1982 to 1984, found only minor differences in height of Mexican-American children before adolescence compared with white children in the second National Health and Nutrition Examination Survey. However, differences increased during adolescence. Mexican-American teenagers were shorter than white teenagers.[4] Mexican-American children over 6 years of age had a relatively high prevalence of overweight and relatively low prevalence of thinness compared with the U.S. population of children as a whole. The mean body mass index (BMI) of American Indian schoolchildren was higher than that of children in the overall U.S. population. This suggests the prevalence of overweight is likely to be higher for these children than for other children in the United States.[5]

CHARACTERISTICS OF GROWTH

Growth may be defined as an increase in the physical size of the body as a whole or as an increase in any of its parts associated with an