N E L S O N

ESSENTIALS OF PEDIATRICS

N E L S O N

ESSENTIALS OF PEDIATRICS

Richard E. Behrman, M.D.

Department of Pediatrics
Case Western Reserve University
School of Medicine
Cleveland, Ohio

Robert Kliegman, M.D.

Department of Pediatrics
Case Western Reserve University
School of Medicine
Cleveland, Ohio

1990

W.B. SAUNDERS COMPANY
Harcourt Brace Jovanovich, Inc.

Philadelphia · London · Toronto · Montreal · Sydney · Tokyo

W. B. SAUNDERS COMPANY
Harcourt Brace Jovanovich, Inc.

The Curtis Center
Independence Square West
Philadelphia, PA 19106

Library of Congress Cataloging-in-Publication Data

Textbook of pediatrics.

Nelson essentials of pediatrics.

Briefer and updated version of: Nelson textbook of pediatrics. 1987.

1. Pediatrics. I. Nelson, Waldo E. (Waldo Emerson) 1898– II. Behrman, Richard E., 1931– III. Kliegman, Robert. IV. Title. V. Title: Essentials of pediatrics. [DNLM: 1. Pediatrics. WS 100 T3553]

RJ45.T43 1989 618.92 88–23827

ISBN 0–7216–2229–1

Editor: Lisette Bralow
Designer: Paul Fry
Production Manager: Bill Preston
Manuscript Editor: Carol DiBerardino
Mechanical Artist: Risa Clow
Illustration Coordinator: Lisa Lambert
Indexer: Aja Lipavski

NELSON ESSENTIALS OF PEDIATRICS ISBN 0–7216–2229–1

Last digit is the print number: 9 8 7 6 5 4 3 2

This book is dedicated to the coming generations. To Amy, Michael, Carolyn and Hillary and to Jonathan, Rachel, Alison and Matthew, and, particularly, to Sharon and Ann for their support, patience and understanding during the preparation of this book. It is hoped that future generations of medical students will find **Nelson Essentials of Pediatrics** *helpful in their own growth and development as physicians.*

CONTRIBUTORS

HERBERT T. ABELSON, M.D.

Professor and Chairman, Department of Pediatrics, University of Washington School of Medicine, Seattle, Washington. Pediatrician-in-Chief, Children's Hospital and Medical Center, Seattle, Washington.

BEN L. ALLEN, JR., M.D.

Clinical Professor of Surgery, Duke University Hospital, Durham, North Carolina. Chief of Staff, Greenville Unit, Shriners Hospitals for Crippled Children, Greenville, South Carolina.

R. STEPHEN S. AMATO, Ph.D., M.D.

Clinical Professor of Pediatrics, University of Maryland College of Medicine; Lecturer, Pediatrics, Johns Hopkins University, Baltimore, Maryland. Chairman, Dept of Pediatrics, Director, Medical Genetics, Greater Baltimore Medical Center, Baltimore, Maryland.

IRA BERGMAN, M.D.

Associate Professor of Pediatrics and Neurology, University of Pittsburgh Medical School, Pittsburgh, Pennsylvania. Children's Hospital of Pittsburgh; Magee-Womens Hospital, Pittsburgh, Pennsylvania.

JEFFREY L. BLUMER, Ph.D., M.D.

Associate Professor of Pediatrics, Assistant Professor of Pharmacology, Case Western Reserve University School of Medicine, Cleveland, Ohio. Chief, Division of Pediatric Pharmacology and Critical Care, Rainbow Babies and Childrens Hospital, Cleveland, Ohio.

WILLIAM J. BYRNE, M.D.

Clinical Associate Professor of Pediatrics, University of California, San Francisco, California. Director of Pediatric Gastroenterology and Nutrition, Children's Hospital-Oakland, Oakland, California.

STEVEN P. CHERNAUSEK, M.D.

Associate Professor of Pediatrics, University of Cincinnati School of Medicine, Cincinnati, Ohio. Associate Professor, Children's Hospital Medical Center, Cincinnati, Ohio.

HOWARD R. FOYE, JR., M.D.

Associate Professor of Pediatrics, University of Rochester School of Medicine and Dentistry, Rochester, New York. Attending Pediatrician, Strong Memorial Hospital, Rochester, New York.

MICHAEL D. FREED, M.D.

Associate Professor of Pediatrics, Harvard Medical School, Boston, Massachusetts. Senior Associate in Cardiology, Children's Hospital, Boston, Massachusetts.

MARIANNE M. HENRY, M.D.

Assistant Professor of Pediatrics, University of North Carolina, Chapel Hill, North Carolina.

ROBERT M. KLIEGMAN, M.D.

Associate Professor of Pediatrics, Case Western Reserve University, Cleveland, Ohio. Vice Chairman and Associate Director of Pediatrics, Rainbow Babies and Children's Hospital, Cleveland, Ohio.

STEVE KOHL, M.D.

Professor, Department of Pediatrics, University of Texas Medical School, Houston, Texas. Attending Pediatrician, Hermann Hospital; Infectious Disease Consultant, University of Texas M.D. Anderson Hospital and Tumor Institute, Houston, Texas.

DEBORAH WELT KREDICH

Associate Professor of Pediatrics, Duke University School of Medicine, Durham, North Carolina.

RICHARD E. KREIPE, M.D.

Associate Professor of Pediatrics, Director of Adolescent Services, University of Rochester, Rochester, New York. Associate Attending Pediatrician, Strong Memorial Hospital, Rochester, New York.

MARGARET W. LEIGH, M.D.

Assistant Professor of Pediatrics, University of North Carolina, Chapel Hill, North Carolina.

JOHN E. LEWY, M.D.

Professor and Chairman, Department of Pediatrics, Tulane University School of Medicine, New Orleans, Louisiana.

JEROME LIEBMAN, M.D.

Professor of Pediatrics, Case Western Reserve University Medical School, Cleveland, Ohio. Pediatrician, Rainbow Babies and Children's Hospital, Cleveland, Ohio.

ELIZABETH R. McANARNEY, M.D.

Professor of Pediatrics, Chief, Division of General Pediatrics and Adolescent Medicine, University of Rochester, Rochester, New York. Attending Pediatrician, Strong Memorial Hospital, Rochester, New York.

BUFORD L. NICHOLS, M.D.

Professor, Department of Pediatrics and Physiology, Baylor College of Medicine, Houston, Texas. Center Director, USDA/ARS, Children's Nutrition Research Center, Houston, Texas.

JOHN F. NICHOLSON, M.D.

Associate Professor of Pediatrics and Pathology, College of Physicians and Surgeons, Columbia University, New York, New York. Associate Attending Pediatrician, Babies Hospital; Director, Clinical Chemistry Service, The Presbyterian Hospital, New York, New York.

MICHAEL J. PAINTER, M.D.

Associate Professor of Pediatrics and Neurology, University of Pittsburgh Medical School, Pittsburgh, Pennsylvania. Chief, Division of Child Neurology, Children's Hospital of Pittsburgh; Magee-Womens Hospital, Active Staff, Pittsburgh, Pennsylvania.

LARRY K. PICKERING, M.D.

Professor of Pediatrics, Director, Pediatric Infectious Diseases, University of Texas Medical School at Houston, Houston, Texas.

THEODORE SHER, M.D.

Assistant Clinical Professor of Medicine and Pediatrics, Case Western Reserve University School of Medicine, Cleveland, Ohio. University Hospitals; Mount Sinai Hospital; Hillcrest Hospital, Cleveland, Ohio.

SUSAN B. SHURIN, M.D.

Associate Professor of Pediatrics, Case Western Reserve University School of Medicine, Cleveland, Ohio. Associate Pediatrician, Rainbow Babies and Children's Hospital, University Hospitals of Cleveland, Cleveland, Ohio.

MARK A. SPERLING, M.D.

Professor of Pediatrics and Associate Professor of Medicine, University of Cincinnati, College of Medicine, Children's Hospital Medical Center, Cincinnati, Ohio. Director, Division of Endocrinology, Children's Hospital Medical Center, Cincinnati, Ohio.

STEPHEN B. SULKES, M.D.

Assistant Professor of Pediatrics, University of Rochester School of Medicine and Dentistry, Rochester, New York. Attending Physician, Strong Memorial Hospital, Rochester, New York.

ROBERT E. WOOD, Ph.D., M.D.

Professor of Pediatrics, University of North Carolina, Chapel Hill, North Carolina.

PREFACE

The scope of pediatrics has expanded substantially throughout the years when the 13 editions of *Nelson Textbook of Pediatrics* have been published. During this time, progress in biomedical science and in technology and clinical care has advanced our understanding of the normal biology of children and of the pathophysiology and therapy of many diseases of childhood. More recently, molecular biology and recombinant DNA methods have accelerated our basic understanding of genetic disorders and have better enabled us to diagnose and treat diseases that were previously difficult to identify or manage. Consequently, we have expanded the *Nelson Textbook of Pediatrics* in order for it to continue to serve as the major reference text for those who care for children. But this expansion has made it difficult for most medical students to read the entire text during their core pediatric clerkship. In publishing our new text, *Nelson Essentials of Pediatrics*, we have focused on essential pediatric problems and have tried to present some overview material to meet the special educational needs of the medical student and the starting house officer.

Nelson Essentials of Pediatrics is primarily intended to introduce important pediatric problems and diseases, representing both the common illnesses of childhood and the less common disorders of special educational importance that exemplify pathophysiologic mechanisms and disease processes. *Nelson Essentials of Pediatrics* is not a "primer" nor is it a synopsis of or a companion to the *Nelson Textbook of Pediatrics*, although initially our associates dubbed it "Baby Nelson," "Half Nelson," and "Junior Nelson."

We believe, however, that *Nelson Essentials of Pediatrics* describes this text most accurately. The term essentials does not mean "superficial" or "outlined." Rather, in a readable text with a simplified format and an array of tables and figures, it provides readers with sufficient information to improve their understanding of representative pediatric problems and clinical decisions, enabling them to gain a basic understanding of the particular disease process and to develop a clinical approach to a child's problem. In addition, the relatively short text can be digested during the usual length of a core pediatric clerkship.

We have organized each chapter in a way that reflects the clinical approach to patients. The student or house officer first should learn to generate a broad differential diagnosis based on the data obtained by taking a history and performing a physical examination; second, to perform an initial analysis of this data, which is facilitated by thinking about the data in terms of the course of the illness (acute or chronic), the organ system involved, and the evidence suggesting that particular pathophysiologic process may be present (e.g., infection or neoplasm); and third, to use this clinical information and its analysis to determine the kind of laboratory data that will further modify and narrow the list of diagnostic possibilities and lead to more specific diagnostic testing.

Besides organizing the chapters to reflect this logical process, we have emphasized both the physiologic and pathophysiologic aspects of pediatric disease, since the understanding of these processes is critical for clinical decision making. Each new contact the student has with a sick child should reinforce the pathophysiologic basis of disease that was introduced in the first two years of medical school.

Presenting the essentials of pediatric medicine does not always permit detailed discussion of the range of variations of each pediatric illness or disease or coverage of all of the less common disorders. We would anticipate that interested and committed students dedicated to a lifelong career of caring for infants, children, and adolescents will acquire a classic reference textbook that covers all pediatric issues and diseases in greater detail and discusses each topic in more depth than space permits in *Nelson Essentials of Pediatrics*.

The editors wish to express their gratitude and appreciation to the hard working and dedicated authors of the individual chapters. We appreciate the time and creative effort needed to write an original chapter in a new book. In addition, we thank the many medical students and house officers who read the early drafts of each chapter and provided constructive criticism that has improved the final text.

We also wish to extend our special thanks to Ms. S. Hazan for her expert organization and editing of the book and to Ms. C. Svet for her professional preparation of the edited manuscript.

Richard E. Behrman
Robert M. Kliegman

CONTENTS

1 Developmental and Behavioral Pediatrics

HOWARD FOYE

STEPHEN SULKES

GROWTH AND DEVELOPMENT

A knowledge of the normal growth and development of children is essential for preventing disease and for detecting disease by recognizing overt deviations from normal patterns. While the processes of growth and development are not completely separable, it is convenient to refer to "growth" as the increase in the size of the body as a whole or the increase in its separate parts, and to reserve "development" for changes in function, including those influenced by the emotional and social environments. The development of the human organism is a very large, complex topic, but in order to identify and treat underlying disorders, it is important for all who care for children to be familiar with normal patterns of growth and development so that they can recognize abnormal variations.

Every individual's path of growth and development through the life cycle is unique, with a range of complex, interrelated changes occurring from the molecular to the behavioral level. Further, the patterns of development may be very different for individual children within the broad limits that characterize normal development. One goal of pediatrics is to help each child achieve his or her individual potential for growth and development, thus becoming a mature adult. An important means of accomplishing this goal involves periodically monitoring each child for the normal progression of growth and development and screening for abnormalities (Fig. 1–1).

Normal Growth Patterns

Deviations in growth patterns are nonspecific but very important indicators of serious medical disorders. They often provide the first clue that something is wrong, occasionally even when the parents do not suspect a problem. An accurate measurement of height and weight should be obtained at every health supervision visit. In addition, head circumference should be measured at each visit in the first year of life. Serial measurements are much more useful than single measurements because deviations from a particular child's growth pattern can be detected even if the value remains within arbitrarily defined normal limits (e.g., between the 3rd and the 97th percentile).

Normal growth patterns have spurts and plateaus, so one can expect some shifting on percentile graphs, but large shifts warrant attention. Large discrepancies among height, weight, and head circumference percentiles also deserve attention. For example, when caloric intake is inadequate the weight percentile falls first, then the height, and last the head circumference. A head circumference that is disproportionately large may occur when there is familial megalencephaly, hydrocephalus, or merely "catch-up" growth in a neurologically normal premature infant. Serial measurement of head circumference along with the history (knowing the size of the parents' heads is essential) and the current physical examination would help distinguish among these possibilities.

Whenever possible, growth should be assessed by plotting accurate measurements on growth charts (Figs. 1–2 to 1–14), and comparing them with previous measurements. The most common reasons for deviant measurements are technical (faulty equipment and human errors in measurement or plotting), so the first step in investigating a deviant measurement should be to repeat it. It is also helpful to know some rough rules of thumb, as presented in Table 1–1.

RECOMMENDATIONS FOR PREVENTIVE PEDIATRIC HEALTH CARE

Committee on Practice and Ambulatory Medicine

Each child and family is unique; therefore these **Recommendations for Preventive Pediatric Health Care** are designed for the care of children who are receiving competent parenting, have no manifestations of any important health problems, and are growing and developing in satisfactory fashion. **Additional visits may become necessary** if circumstances suggest variations from normal. These guidelines represent a consensus by the Committee on Practice and Ambulatory Medicine in consultation with the membership of the American Academy of Pediatrics through the Chapter Presidents. The Committee emphasizes the great importance of **continuity of care** in comprehensive health supervision and the need to avoid **fragmentation of care.**

A **prenatal visit** by the parents for anticipatory guidance and pertinent medical history is strongly recommended.

Health supervision should begin with medical care of the newborn in the hospital.

	INFANCY						EARLY CHILDHOOD					LATE CHILDHOOD					ADOLESCENCE[1]			
AGE[2]	By 1 mo.	2 mos.	4 mos.	6 mos.	9 mos.	12 mos.	15 mos.	18 mos.	24 mos.	3 yrs.	4 yrs.	5 yrs.	6 yrs.	8 yrs.	10 yrs.	12 yrs.	14 yrs.	16 yrs.	18 yrs.	20+ yrs.
HISTORY																				
Initial/Interval	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
MEASUREMENTS																				
Height and Weight	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Head Circumference	●	●	●	●	●	●														
Blood Pressure										●	●	●	●	●	●	●	●	●	●	●
SENSORY SCREENING																				
Vision	S	S	S	S	S	S	S	S	S	S	○	○	○	○	S	○	○	S	○	○
Hearing	S	S	S	S	S	S	S	S	S	S	○	○	S[3]	S[3]	S[3]	○	S	S	○	S
DEVEL./BEHAV.[4] ASSESSMENT	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
PHYSICAL EXAMINATION[5]	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
PROCEDURES[6]																				
Hered./Metabolic[7] Screening	●																			
Immunization[8]		●	●	●			●	●	●			●					●			
Tuberculin Test[9]	←———	———	———	———	———	●→	←———	———	●→	———	———	———	———	———	———	———	←———	———	●→	———
Hematocrit or Hemoglobin[10]	←———	———	———	———	●→	———	←———	———	●→	———	———	←———	———	●→	———	———	←———	———	●→	———
Urinalysis[11]	←———	———	———	●→	———	———	←———	———	●→	———	———	←———	———	●→	———	———	←———	———	●→	———
ANTICIPATORY GUIDANCE[12]	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
INITIAL DENTAL REFERRAL[13]										●										

1. Adolescent related issues (e.g., psychosocial, emotional, substance usage, and reproductive health) may necessitate more frequent health supervision.
2. If a child comes under care for the first time at any point on the schedule, or if any items are not accomplished at the suggested age, the schedule should be brought up to date at the earliest possible time.
3. At these points, history may suffice: if problem suggested, a standard testing method should be employed.
4. By history and appropriate physical examination: if suspicious, by specific objective developmental testing.
5. At each visit, a complete physical examination is essential, with infant totally unclothed, older child undressed and suitably draped.
6. These may be modified, depending upon entry point into schedule and individual need.
7. Metabolic screening (e.g., thyroid, PKU, galactosemia) should be done according to state law.
8. Schedule(s) per Report of Committee on Infectious Disease, *1986 Red Book.*
9. For low risk groups, the Committee on Infectious Diseases recommends the following options: ①no routine testing or ②testing at three times—infancy, preschool, and adolescence. For high risk groups, annual TB skin testing is recommended.
10. Present medical evidence suggests the need for reevaluation of the frequency and timing of hemoglobin or hematocrit tests. One determination is therefore suggested during each time period. Performance of additional tests is left to the individual practice experience.
11. Present medical evidence suggests the need for reevaluation of the frequency and timing of urinalyses. One determination is therefore suggested during each time period. Performance of additional tests is left to the individual practice experience.
12. Appropriate discussion and counselling should be an integral part of each visit for care.
13. Subsequent examinations as prescribed by dentist.

N.B.: **Special chemical, immunologic, and endocrine testing** are usually carried out upon specific indications. Testing other than newborn (e.g., inborn errors of metabolism, sickle disease, lead) are discretionary with the physician.

Key: ● =to be performed: S=subjective, by history: ○=objective, by a standard testing method.

September 1987

Figure 1–1. Recommendations for preventive pediatric health care. *Pediatrics* 81(3), Mar 1988.

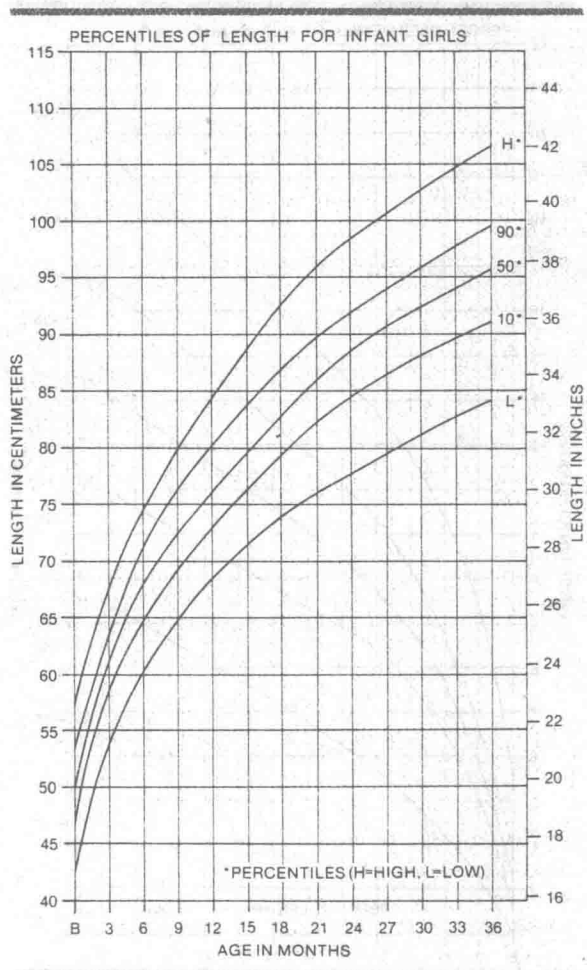


Figure 1–2. Length by age percentiles for girls, ages birth to 36 mo, including highest and lowest values at each age. (From Pomerance HH: Growth Standards in Children. New York, Harper and Row, 1979, p 30.)

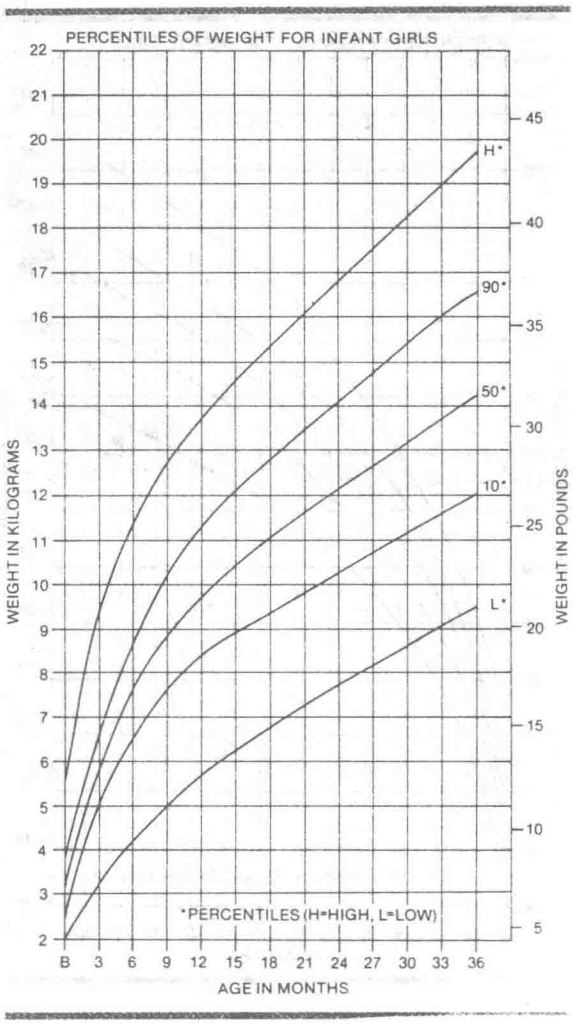


Figure 1–3. Weight by age percentiles for girls, ages birth to 36 mo, including highest and lowest values at each age. (From Pomerance HH: Growth Standards in Children. New York, Harper and Row, 1979, p 26.)

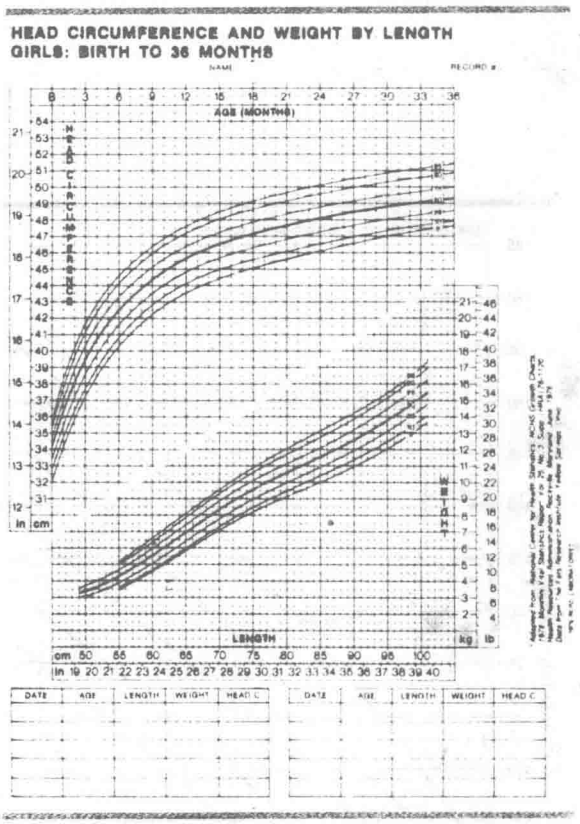


Figure 1–4. *Above,* head circumference by age percentiles for girls, ages birth to 36 mo. *Below,* weight by length percentiles for girls, ages birth to 36 mo. (From Behrman RE, Vaughn VC: Nelson Textbook of Pediatrics. 13th ed. Philadelphia, WB Saunders Co., 1987, p 25. Adapted from NCHS Growth Charts by Ross Laboratories.)

Variability in body proportions occurs from fetal to adult life (Fig. 1–15). In addition, there are individual variations in body forms of normal children (physiques or somatotypes). **Ectomorph** somatotype is characterized by relative linearity, light bone structure, and small mass relative to body length. The **endomorph** has a relatively stocky build, with large amounts of soft tissue, and matures earlier than the ectomorph. The **mesomorph** physique lies in between that of the ectomorph and the endomorph and is often relatively muscular. Other differences in body proportions depend on variations in the growth rates of parts of the body or organ systems. Certain growth disturbances result in characteristic changes in the proportional sizes of trunk, extremities, and head.

There are distinctive patterns of proportionate growth rates for several body systems that correlate closely with function. Growth of the nervous system is most rapid in the first 2 yr, whereas the growth rate for lymphoid tissue peaks at about 12 yr. Osseous maturation (bone age) is determined from roentgenograms on the basis of (1) the number and size of epiphyseal centers; (2) the size, shape, density, and sharpness of outline of the ends of bones, and (3) the distance separating the epiphyseal center from the zone of provisional calcification. Functional correlations also exist between growing systems. Thus, bone age corresponds more closely to sexual maturity, which is dependent on the growth and development of the endocrine system, than to chronologic age. The heart is relatively large at birth, and a pubertal growth spurt in its size parallels the general growth spurt. Pulse rate and blood pressure vary with age and growth, as do a great many metabolic and nutritional changes.

Behrman RE, Vaughan VC III (eds): Nelson Textbook of Pediatrics. 13th ed. Philadelphia, WB Saunders, 1987, Sec. 2.1–2.11.

Knoblock H, Pasamanick B (eds): Gesell and Amatruda's Developmental Diagnosis. 3rd ed. New York, Harper and Row, 1974.

Lowrey GH: Growth and Development of Children. 8th ed. Chicago, Year Book Medical Publishers, 1986.

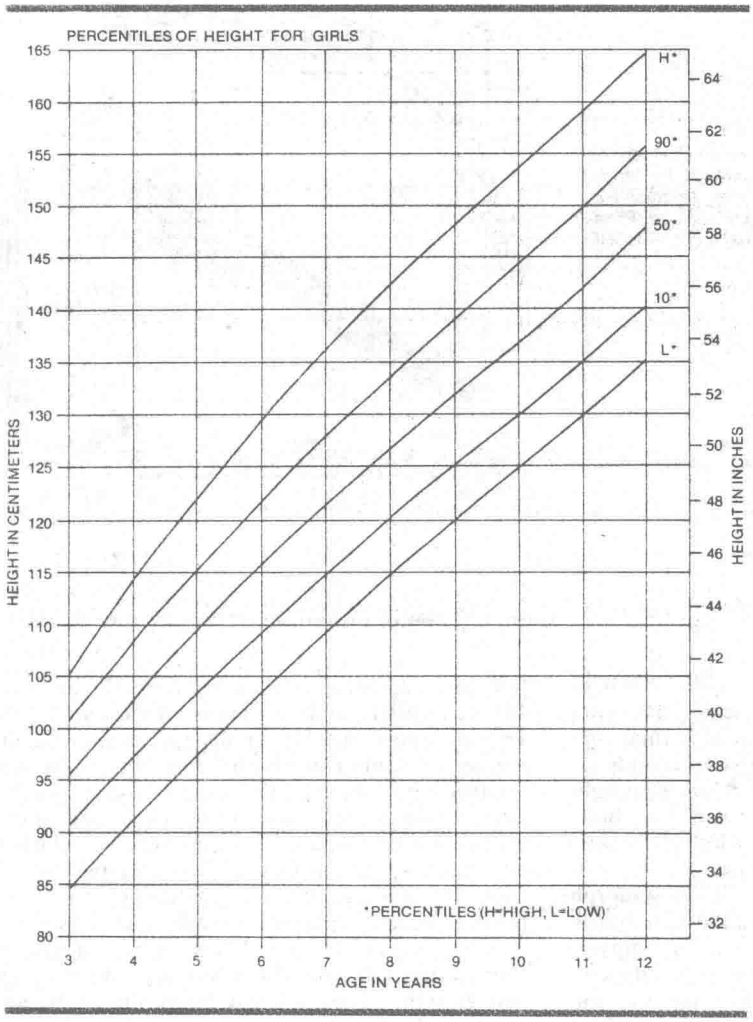
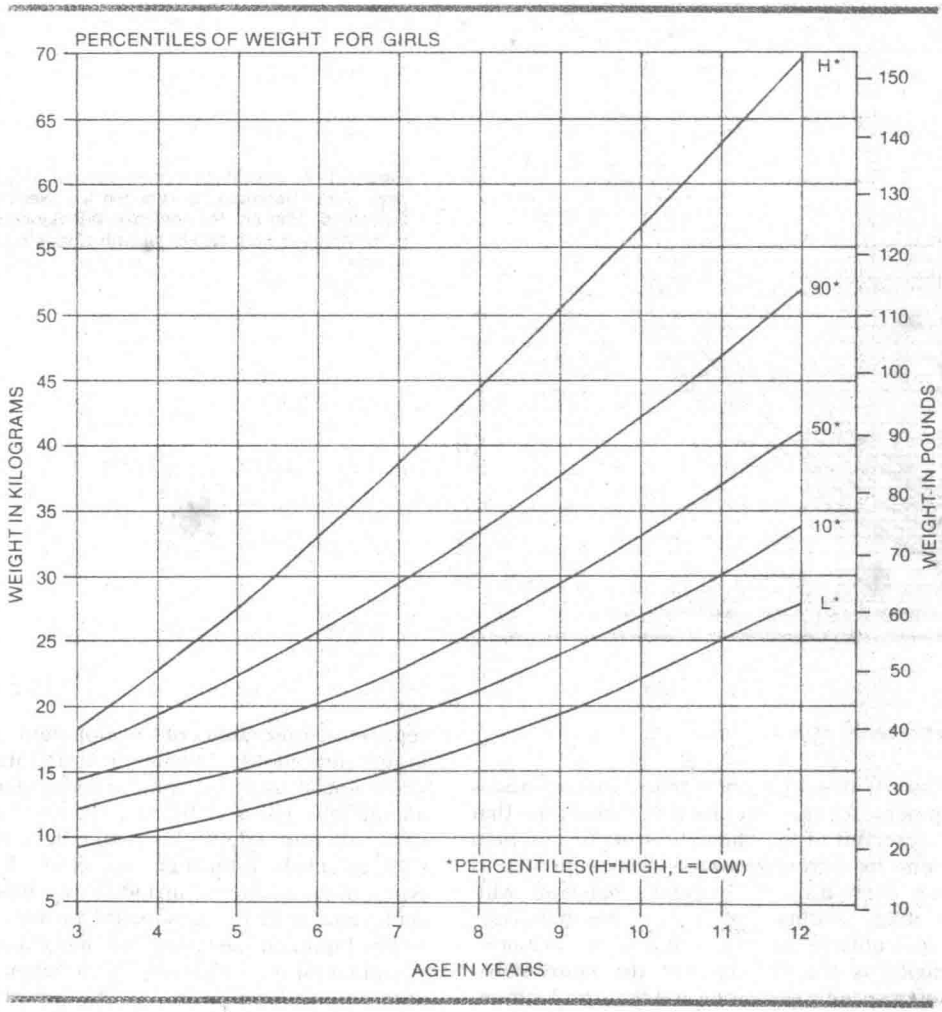


Figure 1–5. Stature by age percentiles for girls, ages 3–12 yr, including lowest and highest values at each age. (From Pomerance HH: Growth Standards in Children. New York, Harper and Row, 1979, p 32.)



re 1–6. Weight by age percentiles for girls, ages 3–12 yr. (From Pomerance HH: Growth Standards in Children. New York, er and Row, 1979. p 28.)