

CONTENTS

Preface	xi
Acknowledgments	xiii
Credits	xiv

Part



Introduction

Chapter 1	Introductory Concepts	3
	Definitions and Context	4
	Chronological Age and Age Groups	7
	Why Study These Phenomena?	8
	Types of Studies	10
	Principles of Measurement and Observation	11
	Overview of Postnatal Growth: Scammon's Curves	13
	General Regulation of Growth and Maturation	14
	Sources of Growth, Performance, and Activity Data	14
	Summary	18
	Sources and Suggested Readings	18
Chapter 2	Prenatal Growth and Functional Development	21
	Stages of Prenatal Growth	21
	Sex Differentiation	23
	Twins and Twinning	25
	Prenatal Loss	25
	Congenital Malformations	26
	Fetal Growth	26
	Fetal Motor Activity	29
	Factors That Affect Birth Weight	30
	Overview of the Prenatal Period	34
	Fetal Origins of Adult Diseases	35
	Summary	36
	Sources and Suggested Readings	36



Postnatal Growth

Chapter 3	Somatic Growth	41
	Measurements Commonly Used in Growth Studies	42
	Growth in Stature and Body Weight	49
	Growth of the Body Mass Index	64
	Growth Patterns in Other Body Dimensions	67
	Changes in Body Proportions	70
	Adjusting for Variation in Body Size—Scaling	71
	Tracking	73
	Summary	77
	Sources and Suggested Readings	77
Chapter 4	Development of Physique	83
	Concept of Somatotype	84
	Methods in the Assessment of Physique	84
	Somatotyping Children and Adolescents	88
	Examples of Somatotypes of Individuals During Growth	89
	Distributions of Somatotypes	92
	Change in Somatotype During Growth	93
	Tracking	95
	Summary	99
	Sources and Suggested Readings	99
Chapter 5	Body Composition	101
	Models of Body Composition	101
	Methods for Estimating Body Composition	104
	Applications to Children and Adolescents	108
	Concept of Chemical Maturity	110
	Composition of the Fat-Free Mass in Children and Adolescents	110
	Changes in Body Density and Total-Body Water During Growth	112
	Growth in Fat-Free Mass, Fat Mass, and Percent Fat	113
	Tracking	116
	Summary	117
	Sources and Suggested Readings	117
Chapter 6	Bone Tissue in Skeletal Growth and Body Composition	121
	Bone Cells	121
	Bone Formation	122
	Growth of a Long Bone	124
	Bone As a Component of Body Composition	127
	Tracking	134
	Summary	134
	Sources and Suggested Readings	134
Chapter 7	Skeletal Muscle Tissue	137
	Muscle As a Tissue	137
	Myogenesis	142

Muscle Fiber Types 143
 Muscle Fiber Size 146
 Contractile Properties of Muscle 147
 Metabolic Properties of Muscle 148
 Assessing Muscle Mass of the Body 150
 Development of Muscle Tissue by Bodily Region 152
 Summary 154
 Sources and Suggested Readings 154

Chapter 8 Adipose Tissue 159

The Fat Cell As a Complex Structure 159
 Stages and Mechanisms of Adipogenesis 161
 White and Brown Adipose Cells 163
 White Adipose Tissue in Prenatal Life 165
 White Adipose Tissue in Postnatal Life 165
 Subcutaneous Fat Distribution During Growth 169
 Abdominal Visceral Fat During Growth 172
 Stability of Body Fat During Growth 174
 Summary 175
 Sources and Suggested Readings 175



Functional Development

Chapter 9 Heart, Blood, and Lungs 181

Features of Fetal Circulation 181
 Cardiopulmonary Adjustments at Birth 183
 Changes in Heart Size 184
 Changes in Heart Functions 185
 Changes in Features of Blood During Growth 187
 Changes in Lungs and Respiratory Functions During Growth 189
 Summary 192
 Sources and Suggested Readings 192

Chapter 10 Motor Development 195

What Is Motor Development? 196
 Motor Pattern and Skill 196
 Classifications of Motor Activities 196
 The Newborn Infant and the Reflexes of Infancy 197
 Motor Development—Birth to 2 Years of Age 198
 Development of Independent Walking 199
 Development of Fundamental Motor Skills 202
 Early Motor Development and Growth of the Brain 207
 Status at Birth and Subsequent Motor Development 208
 Early Postnatal Growth and Motor Development 209
 Overview of Motor Development 209
 Summary 210
 Sources and Suggested Readings 210

Chapter 11 Strength and Motor Performance	215
Physical Fitness	216
Measures of Strength and Motor Performance	216
Performance in Early Childhood	217
Performance in Middle Childhood and Adolescence	218
Relationships of Strength and Motor Performance	
to Size, Physique, and Body Composition	224
Scaling of Strength and Motor Performance	227
Tracking	228
Summary	231
Sources and Suggested Readings	231
Chapter 12 Aerobic Performance	235
Measurement Issues	236
Growth-Related Adaptations in Aerobic Performance	238
Summary	248
Sources and Suggested Readings	248
Chapter 13 Anaerobic Performance	251
Anaerobic Versus Aerobic Energy Turnover	252
Determinants of Anaerobic Performance	253
Measurement Issues	254
Growth and the Determinants of Anaerobic Performance	258
Summary	264
Sources and Suggested Readings	264
Chapter 14 Thermoregulation During Growth	267
The Physics of Heat Transfer	267
Physiological Means of Thermoregulation	268
Responses to Heat Associated With Growth and Maturation	268
Acclimatization and Acclimation	270
Response to Cold Climates	271
Summary	272
Sources and Suggested Readings	273



Biological Maturation

Chapter 15 Biological Maturation: Concepts and Assessment	277
Assessing Skeletal Maturity	278
Assessing Sexual Maturity	283
Assessing Somatic Maturity	293
Assessing Dental Maturity	297
Interrelationships Among Maturity Indicators	297
Summary	302
Sources and Suggested Readings	302

Chapter 16 Timing and Sequence of Changes During Adolescence	307
Adolescent Growth Spurt	307
Sexual Maturity	310
Sequence of Sexual and Somatic Maturity	315
Growth Spurts in Other Dimensions	318
Body Dimensions and Composition Relative to Peak Height Velocity	323
Growth Spurts in Performance	327
Performance Relative to Menarche	331
Summary	333
Sources and Suggested Readings	333

Chapter 17 Maturity-Associated Variation in Growth and Performance	337
Classifying Children by Maturity Status	338
Maturity-Associated Variation in Body Size	340
Maturity-Associated Variation in Physique	341
Maturity-Associated Variation in Body Composition	342
Maturity-Associated Variation in Adipose Tissue Distribution	348
Maturity-Associated Variation in Strength and Motor Performance	350
Maturity-Associated Variation in the Adaptation to Exercise and $\dot{V}O_2$ max	358
Maturity-Associated Variation in Anaerobic Performance	361
Summary	362
Sources and Suggested Readings	362

Part **V** **Influencing Factors**

Chapter 18 Genetic Regulation of Growth, Maturation, and Performance	369
The Human Genome	370
The Human Gene	373
From Genes to Proteins to Phenotypes	375
Gene Expression	377
The Special Case of Mitochondrial DNA	377
Genetic Variation in Human Genes	377
The Multifactorial Phenotype	379
Genetics of Fetal Development	380
Genetic Influences on the Newborn	381
Genetics of Selected Growth Phenotypes	382
Genetics of Maturation	386
Genetics of Selected Performance Phenotypes	388
Examples of Growth-Related Genes	393
Summary	395
Sources and Suggested Readings	395

Chapter 19 Hormonal Regulation of Growth and Maturation . . .	399
Endocrine, Paracrine, Autocrine, and Intracrine Systems	399
Endocrine Hormones	400

Other Growth-Promoting Factors and Hormones	402
Hypothalamic and Pituitary Hormones	403
Growth Hormone and Related Growth Factors	404
Thyroid Hormones	407
Parathyroid and Calcitonin Hormones	409
Hormones From the Adrenal Medulla and Cortex	410
Gonadal Glands and Hormones	411
Insulin and Glucagon	416
Leptin	417
Regulation of Puberty	420
Menstrual Cycle	422
Overview of Hormones and Their Actions	423
Summary	425
Sources and Suggested Readings	425

Chapter 20 Energy and Nutritional Requirements 429

Nutrients	430
Breast-Feeding and the Infant	430
Energy Needs	431
Energy Requirements for Growth	432
Dietary Reference Intake (DRI) for Energy Intake	438
DRI for Protein Intake	440
DRI for Lipid Intake	444
Carbohydrate Requirements	446
Vitamin Requirements	446
Mineral Requirements	448
Summary	453
Sources and Suggested Readings	453

Chapter 21 Physical Activity and Energy Expenditure: Assessment, Trends, and Tracking 457

What Is Physical Activity?	458
What Is Energy Expenditure?	458
Methods of Assessing Patterns or Levels of Physical Activity and Energy Expenditure	459
Developmental Trends in Physical Activity and Energy Expenditure	467
Tracking of Physical Activity Levels	470
Correlates of Physical Activity Levels in Childhood and Adolescence	471
Summary	474
Sources and Suggested Readings	474

Chapter 22 Physical Activity As a Factor in Growth, Maturation, and Performance 479

Physical Activity	480
Approaches to the Study of Physical Activity	480
Activity and Stature	481
Activity, Body Weight, and Body Composition	482
Activity and Physique	484
Activity and Specific Tissues	485
Activity and Biological Maturity	489
Overview of Activity, Growth, and Maturation	490
Activity, Fitness, and Performance	490

The Concept of Trainability	493
Summary	504
Sources and Suggested Readings	505
Chapter 23 Undernutrition in Childhood and Adolescence	509
Criteria	509
Prevalence	510
Forms of Undernutrition	511
Undernutrition in Preschool Children	511
Undernutrition in School-Age Children	516
Long-Term Consequences of Undernutrition	521
Summary	522
Sources and Suggested Readings	522
Chapter 24 Obesity in Childhood and Adolescence	527
Indicators	527
Criteria and Prevalence	528
Correlates of Overweight and Obesity	532
Consequences of Obesity for Children and Adolescents	538
Long-Term Consequences of Obesity	544
Treatment	545
Summary	546
Sources and Suggested Readings	547
Chapter 25 Other Factors Affecting Growth, Maturation, Performance, and Activity	553
Social Conditions, Growth, and Maturation	553
Social Conditions, Motor Development, Performance, and Activity	560
Ethnic Variation in Growth and Maturity	565
Ethnic Variation in Motor Development, Performance, and Activity	571
Climate, Growth, and Maturity	574
Climate, Performance, and Physical Activity	575
Summary	577
Sources and Suggested Readings	577

Part VI Applications

Chapter 26 Risk Factors During Growth and Adult Health	587
Primary and Secondary Prevention	587
Risk Factors for Common Metabolic Diseases	588
Current Risk Profile of Children and Adolescents	592
Summary	604
Sources and Suggested Readings	604
Chapter 27 Chronic Clinical Conditions and Physical Disabilities	609
Selected Clinical Conditions That Affect Growth and Maturation	610
Physical Activity of Children and Adolescents With Chronic Conditions	612

Fitness and Performance of Children and Adolescents With Chronic Conditions . 615
 Summary 618
 Sources and Suggested Readings 619

Chapter 28 The Young Athlete 623

Participation in Youth Sports 624
 Selection and Exclusion in Sport 625
 Who Is the Young Athlete? 626
 Stature and Weight of Young Athletes 627
 Maturity Status and Progress of Young Athletes 628
 Age at Menarche in Athletes 629
 Physique of Young Athletes 633
 Body Composition of Young Athletes 633
 Motor Performance Characteristics of Young Athletes 634
 Physiological Characteristics of Young Athletes 635
 Does Training for Sport Influence the Growth and Maturity of Young Athletes? . 636
 Gymnastics and Ballet: Special Cases? 641
 Overview 644
 Summary 645
 Sources and Suggested Readings 646

Chapter 29 Secular Trends in Growth, Maturation, and Performance 651

Definitions 652
 Sources of Secular Trend Data 652
 Limitations and Assumptions in Secular Comparisons 652
 Secular Trends in Body Size 653
 Secular Trends in Body Proportions 660
 Secular Trends in Indicators of Maturity 660
 Secular Trends in Performance 664
 Secular Trends in Developing Countries 669
 Factors Underlying Secular Trends 670
 Summary 671
 Sources and Suggested Readings 671

Appendix A: Conversion Tables 677

Appendix B: Suggestions for Individual and Group Activities 679

Index 695

About the Authors 711