

Contents

Preface vi ■ Acknowledgments x ■ Credits xi

1 Nutrients

| | |
|--|----|
| Function of Nutrients | 2 |
| Carbohydrate | 3 |
| Fat | 9 |
| Protein | 15 |
| Water | 18 |
| Vitamins, Minerals, and Trace Elements | 19 |
| Phytonutrients | 20 |

2 Nutrients and Recommended Intakes

| | |
|--|----|
| Essential Nutrients | 26 |
| Development of Recommended Intakes | 27 |
| Current Recommended Intakes | 28 |
| Practical Guidelines for a Balanced Healthy Diet | 32 |
| Food Labels | 35 |
| Analyzing Dietary Intake | 40 |

3 Fuel Sources for Muscle and Exercise Metabolism

| | |
|--|----|
| Subcellular Skeletal Muscle Structure | 48 |
| Force Generation in Skeletal Muscle | 48 |
| Fiber Types | 49 |
| Energy for Muscle Force Generation | 51 |
| Fuel Stores in Skeletal Muscle | 62 |
| Regulation of Energy Metabolism | 63 |
| Metabolic Responses to Exercise | 68 |
| Metabolic Adaptations to Exercise Training | 74 |

4 Energy

| | |
|--|----|
| Energetic Efficiency | 81 |
| Measuring the Energy Content of Food | 81 |
| Measuring Energy Expenditure | 83 |
| Components of Energy Expenditure | 90 |
| Energy Balance | 92 |

5 Gastric Emptying, Digestion, and Absorption

| | |
|--|-----|
| Anatomy of the Gastrointestinal Tract | 100 |
| Regulation of the Gastrointestinal Tract | 104 |
| Digestion | 104 |
| Absorption | 109 |
| Function of Bacteria in the Colon | 113 |
| Regulation of Gastric Emptying | 114 |
| Gastrointestinal Problems During and After Exercise .. | 116 |

6 Carbohydrate

| | |
|--|-----|
| History | 122 |
| Role of Carbohydrate | 123 |
| Recommendations for Carbohydrate Intake | 128 |
| Carbohydrate Intake Days Before Competition | 128 |
| Carbohydrate Intake Hours Before Exercise | 133 |
| Carbohydrate Intake 30 to 60 Minutes Before Exercise | 134 |
| Carbohydrate Intake During Exercise | 136 |
| Carbohydrate Intake After Exercise | 142 |

7 Fat

| | |
|---|-----|
| Fat Metabolism During Exercise | 150 |
| Limits to Fat Oxidation | 151 |
| Fat as a Fuel During Exercise | 155 |
| Regulation of Carbohydrate and Fat Metabolism | 159 |
| Fat Supplementation and Exercise | 162 |
| Effect of Diet on Fat Metabolism and Performance .. | 163 |

8 Protein and Amino Acids

| | |
|---|-----|
| Amino Acids | 170 |
| Techniques to Study Protein and Amino Acid Metabolism | 176 |
| Protein Requirements for Exercise | 179 |
| Training and Protein Metabolism | 182 |
| Effect of Protein Intake on Protein Synthesis | 182 |
| Amino Acids as Ergogenic Aids | 184 |
| Protein Intake and Health Risks | 191 |

9**Water Requirements
and Fluid Balance****195**

| | |
|---|-----|
| Thermoregulation and Exercise in the Heat | 197 |
| Effects of Dehydration on Exercise Performance | 202 |
| Mechanisms of Heat Illness | 204 |
| Effects of Fluid Intake on Exercise Performance | 205 |
| Daily Water Balance | 211 |
| Fluid Requirements for Athletes | 213 |

10**Vitamins and Minerals****221**

| | |
|---|-----|
| Water-Soluble and Fat-Soluble Vitamins | 222 |
| Recommended Intakes of Vitamins | 225 |
| Macrominerals and Microminerals | 226 |
| Recommended Intakes of Minerals | 228 |
| Critical Micronutrient Functions | 230 |
| Assessing Micronutrient Status | 248 |
| Exercise and Micronutrient Requirements | 250 |
| Ergogenic Effect of Micronutrient Supplementation | 251 |
| Recommendations for Micronutrient Intake in Athletes | 252 |

11**Nutrition Supplements****257**

| | |
|---|-----|
| Nonregulation of Nutrition Supplements | 258 |
| Critical Evaluation of Nutrition Supplements Studies | 259 |
| Androstenedione | 260 |
| Bee Pollen | 263 |
| Beta Alanine and Carnosine | 263 |
| Beta-Hydroxy Beta Methylbutyrate | 264 |
| Boron | 265 |
| Caffeine | 265 |
| L-Carnitine | 270 |
| Choline | 273 |
| Chromium | 274 |
| Coenzyme Q10 | 275 |
| Creatine | 275 |
| Dehydroepiandrosterone | 281 |
| Fish Oil | 282 |
| Ginseng | 283 |
| Glycerol | 283 |
| Inosine | 284 |
| Lactate Salts and Polylactate | 285 |

| | |
|--|-----|
| Lecithin | 286 |
| Medium-Chain Triacylglycerol | 286 |
| Pangamic Acid | 287 |
| Phosphatidylserine | 287 |
| Phosphorus | 288 |
| Pyruvate and Dihydroxyacetone | 288 |
| Sodium Bicarbonate | 289 |
| Sodium Citrate | 290 |
| Vanadium | 290 |
| Wheat Germ Oil | 291 |
| Contamination of Nutrition Supplements | 291 |

12**Nutrition and
Training Adaptations****295**

| | |
|---|-----|
| Training Adaptations | 296 |
| Signal Transduction Pathways | 297 |
| Starting a Signaling Cascade | 298 |
| Secondary Signals | 299 |
| Nutrition Effects on Training Adaptations | 302 |
| Overtraining | 307 |

13**Body Composition****313**

| | |
|---|-----|
| Optimal Body Weight and Composition | 314 |
| Body Composition Models | 315 |
| Normal Ranges of Body Weight and Body Fat | 316 |

14**Weight Management****329**

| | |
|--|-----|
| Body Weight and Composition in Different Sports | 330 |
| Genetics | 330 |
| Energy and Macronutrient Intake | 331 |
| Regulation of Appetite | 332 |
| Effect of Exercise on Appetite | 332 |
| Physical Activity and Energy Expenditure | 333 |
| Dietary Weight-Loss Methods | 334 |
| Exercise for Weight Loss | 339 |
| Decreased Resting Metabolic Rate With Weight Loss | 341 |
| Weight Cycling | 342 |
| Gender Differences in Weight Loss | 342 |
| Practicalities of Weight Loss for Athletes | 342 |
| Defining the Strategy | 343 |

15 Eating Disorders in Athletes 347

| | |
|--|-----|
| Types of Eating Disorders | 348 |
| Prevalence of Eating Disorders in Athletes | 350 |
| Risk Factors | 351 |
| Effects of Eating Disorders on Sports Performance . | 352 |
| Effects of Eating Disorders on the Athlete's Health . | 353 |
| Treatment and Prevention of Eating Disorders | 357 |

16 Nutrition and Immune Function in Athletes 361

| | |
|---|-----|
| Functions of the Immune System and Its Cellular Components | 362 |
| General Mechanism of the Immune Response | 364 |
| Effects of Exercise on the Immune System | 371 |
| Nutritional Manipulations to Decrease Immunodepression in Athletes | 374 |
| Mechanisms of Nutritional Influences on Immune Function in Athletes | 374 |
| Conclusions and Recommendations | 392 |

| | |
|--|-----|
| Appendix A Key Concepts in Biological Chemistry Relevant to Sport Nutrition | 395 |
| Appendix B Unit Conversion Tables | 415 |
| Appendix C Recommended Daily Allowances for North America | 419 |
| Appendix D Reference Nutrient Intakes for the United Kingdom | 425 |
| Appendix E Recommended Dietary Intakes for Australia | 429 |

Glossary 430 ■ References 443 ■ Index 467 ■ About the Authors 475